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Exit Tickets' Effect on Engagement and Concept Attainment in High School Science

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Signature Sheet

This thesis, written under the direction of the candidate's thesis advisor and approved by the Chair of the Master's program, has been presented to and accepted by the Faculty of Education in partial fulfillment of the requirements for the degree of Master of Science. The content and research methodologies presented in this work represent the work of the candidate alone.

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Abstract

Many high school students struggle to stay engaged in their science class. As a result, student learning often suffers. The purpose of this study was to implement one additional strategy (Exit Tickets) to the teacher's pedagogy in order to help better engage students and promote student learning. The teacher then evaluated the efficacy of the strategy by: comparing both participant behavioral engagement and assessment results prior to and during/after the implementation of the Exit Tickets. The data was disaggregated to compare students who were typically behaviorally disengaged to those who were consistently behaviorally engaged so as to better determine the effect of the strategy. This was a dual-method teacher-action research project, which assessed qualitative data collected during the lessons by the teacher as well as survey feedback from the participants about their views of the success of the strategy, and quantitative data from the results of both Exit Tickets (once implemented) and formal assessments pre- and post- the implementation of the additional engagement strategy. The study was conducted with 50 sophomore science students at a large, public, mostly affluent, largely European-American high school in Northern California. The results showed an average increase in behavioral engagement among participants with a 16.1% increase in engagement using the a teacher report, 14.8% increase in behavioral engagement using a daily monitoring index, and a 7.6% increase in quiz scores.

Introduction

Many, if not most, of the students in my science classes demonstrate behaviors that are usually described as necessary for academic excellence: they are present and on time for class each day, prepared and ready to learn, actively participate in class, complete their homework on time, study for, and earn good grades on assessments, ask thoughtful questions and demonstrate interest and diligent work ethic on tasks. Most students show me in various modalities that they are learning and achieving the program goals for my science course. I try to provide many different opportunities for my students to demonstrate their learning. This is especially important for students who have different learning styles. Aside from formal assessments for instance, students can show me that they have ascertained the material by participating and providing insights during class or one-on-one discussions, using their knowledge to create models, apply their understandings to novel scenarios presented in post-laboratory exploratory questions.

However, there is also a population of students in my classes who do not consistently demonstrate behaviors that indicate learning or engagement in the curriculum: they are late or often do not attend class, they tend not to voluntarily participate, they chronically do not turn in homework (or turn in only partially competed work), seem to put forth subpar efforts in laboratory and other kinesthetic activities. In addition, this cohort of students typically does not fare as well as their peers on assorted assessments.

As a novice teacher, I recognized the need for me to expand my pedagogical repertoire so that I can ensure that both groups of students are accessing the curriculum and achieving the program goals for the course. However, upon the outset of this investigation, I was unclear as to

what were the most effective teaching strategies to promote engagement and learning for all students. Furthermore, I wondered how one should go about implementing different strategies to best facilitate equitable student learning. What could I learn about the population of my students who chronically drifted off, or remained unengaged in my science class? Were there similarities I could draw between these students? How could such information best help me address their needs? Why were some students not engaged with my lessons while many others seemed to genuinely enjoy them? Were there ways to evaluate their interest or engagement in my lessons so that I could better reflect upon and improve my teaching? These were many of the questions that drove me toward engaging in this study.

Statement of the Problem

Students who do not engage in science class at the high school level often miss critical information and subsequently do not perform as well on assessments and other grading criteria than their engaged peers. Furthermore, many times one or more disengaged students in a class can detract from the direction of the rest of the class and retard progress of a learning activity. A thoroughly behaviorally engaged student actively participates in class, regardless of the activity. (Conner & Pope, 2013; Ryan & Deci, 2000). That is, they ask and answer questions, they work well with their groups during collaborative activities, and work diligently at solo tasks. Students who are emotionally engaged in the class have a vested interested where they want to do well and enjoy being in the classroom environment. A student who is cognitively engaged will ask thoughtful questions, think critically about the tasks and the content, and be interested in the material.

There are students who also exhibit a number of disengaged behaviors. For instance, some students who are not behaviorally engaged in class may come late to class, often do not follow class rules or directions, and attempt to get the class off-track by blurting out off-topic comments, talking with a neighbor, or playing on their mobile devices. Students may also be emotionally unengaged, where they may be anxious or sad or even angry about being in school. Finally, students may be cognitively disengaged where they are not interested in the curriculum, or lack a desire to acquire the knowledge, and choose not to participate in the class by zoning-out during lectures, or not attempting to complete any work in or outside of class (Ryan & Deci, 2000). Not only do students who exhibit one or more of these disengaged behaviors negatively affect their own learning, but they also additionally jeopardize the learning of their peers. Neither of these outcomes is ideal, and thus chronic disengagement creates a quagmire for a teacher to navigate when the objective is learning for all the students in the classroom.

Statement of Purpose

The purpose of this study is to introduce a selected strategy for enhancing behavioral engagement in science classes and empirically test if the strategy is successful in engaging all students. The application of the selected engagement strategy will be class-wide and not targeted toward specific students so as to determine if the strategy is widely efficacious and practical. This teacher-action research study was conducted to measure the extent of student engagement using one additional engagement strategy: “Exit Tickets”. Exit Tickets are short, formative assessments at the end of a lesson. The material addressed on them is covered within the day’s lesson, and endeavors to encourage engagement throughout the class (Lemov, 2010).

Quantitative and qualitative data about the efficacy of the technique in promoting behavioral engagement and concept attainment will be collected within a unit of study in each of the teacher's five integrated science classes and compared with the level of behavioral engagement prior to the addition of the strategies.

As a byproduct of researching this single engagement strategy and developing a procedure for measuring behavioral engagement, this study endeavors to provide a template which additional engagement strategies can be implemented and assessed for efficacy in both behavioral engagement and concept attainment.

Research Questions

Does the inclusion of "Exit Tickets" as a pedagogical strategy increase behavioral engagement and concept attainment for all students in a single teacher's high school science classes? How can a teacher best engage all students in a high school integrated science class so as to improve their understanding of content and performance on assessments? To what extent can the addition of one new strategy in a teacher's pedagogy make a difference on multiple dimensions of student engagement? What are the reasons for consistent lack of engagement in science classrooms? Will the implementation of just one new engagement strategy have an effect on both behavioral engagement *and* student learning of the content?

Definitions

Behavioral Engagement. This study defines engagement as: a multidimensional construct of student behaviors within the physical boundaries of the classroom. Engagement is comprised of emotional, behavioral, and cognitive dimensions, and within each facet of overall

engagement, there is a continuum of student conduct. High behavioral engagement can be demonstrated by not only adhering to the rules and classroom conduct, but also by showing persistent effort in completion of tasks. Low behavioral engagement may manifest as skipping class or being tardy for class, disruptive behavior in class, and not trying hard to pay attention or complete tasks. Emotional engagement ranges from showing involvement and commitment and feeling connected to a particular class or teacher to feeling alienated, anxious, sad, or anger toward a teacher, a class, or school in general. Finally, cognitive engagement ranges from being eager and thoroughly intrinsically motivated to learn material to being bored and unaffected by the curriculum. This may be demonstrated by actively participating and asking and answering questions on a consistent basis for the former end of the range, to refusing to participate or offering unenthused answers and little motivation to work on and learn from assignments. This definition comes from the participation aspect of Finn's 1989 seminal research on engagement, as addressed Zyngier's 2008 work, as well as the work by Connell and Wellborn (1991) and Fredricks, Blumenfeld, & Paris (2004). This study focuses on measuring the behavioral engagement component.

Integrated Science. Integrated Science, the course in which the study was conducted, is a two-year science program that is required for graduation (that is, taking and passing both years of Integrated Science is mandatory, not elective). The course of study combines a traditional biology course with earth science, with introductions into physics and chemistry concepts. Some units within the two-year program fall almost entirely within one domain or another (e.g. plate tectonics is earth science, and vertebrate evolution is biology), whereas other units provide a blended curriculum (e.g. the Island unit includes a macroscopic view of evolution and how

evolution connects with population dynamics, climate, and even plate tectonics) (Tamalpais, 2014).

Do-Nows. One of the pedagogical strategies already utilized by the teacher. Used as an "intro" activity at the beginning of each class, a "Do Now" is typically a question or task is displayed for the students to answer. Its objective is three-fold: behaviorally, it attempts to begin class with everyone engaged and on-task; emotionally, it is a routine procedure that the students expect at the beginning of every class; and cognitively, it asks the students to think about the material presented in an earlier class, to anticipate information to come, or to practice a skill they have been taught. Students complete the Do Now individually within the first five minutes of class, and their answers often drive the first few minutes of class discussion (Lemov, 2010).

Exit Tickets (ETs). A quick, formative, individual assessment provide to the students at the end of each class. The format of the Ticket was short, consisted of either multiple choice or fill-in-the-blank questions and created expectations about productivity during the class. The tickets were graded for points toward student overall science grade. Students used a free smartphone application (appropriately called "Exit Ticket") to complete their ETs for the three weeks when the tickets were utilized. This study aimed to examine the efficacy of ETs to promote behavioral engagement and concept attainment (Lemov, 2010, Tanner, 2013).

Quiz. A short, formal, formative assessment worth more points than the ETs, but of less value than a unit exam. Each of the two quizzes administered during the course of the study—once at the end of the control week, and once at the end of the third, and final, week of the ET implementation—tested understanding of material covered only within the week of study in which the quiz was administered. This was to mitigate the fact that the control period was shorter and therefore covered less material than the ET period.

Think-Pair-Share (TPS). This is an engagement strategy already utilized by the teacher-researcher and familiar to her students. After posing a question, students individually think about the answer for a moment (they may also be asked to record their thoughts on the page). When prompted, they turn and share their thoughts with a partner for another minute. This collaboration allows them to edit and refine their answers. Finally, after working on a response, students are asked to share their answers by hands or by cold-calling (randomly chosen) students (Tanner, 2013).

Theoretical Rationale

There are two essential theoretical rationales that this study utilizes. The first, theoretical rationale for this study is based on the work of Albert Bandura. Bandura's (1977), theoretical concept of motivational processes especially with regard to incentives and reinforcement is the primary theoretical reference. Under Bandura's notion, models, like an enthusiastic teacher, or a student who is doing well by being academically engaged, provide positive reinforcement and helps foster a belief in the observer that if they behave like the model, they too, will succeed. As Bandura (1977) puts it:

> A person can acquire, retain, and possess the capabilities for skillful execution of modeled behavior, but the learning may rarely be activated into overt performance if it is negatively sanctioned or otherwise unfavorably received. When positive incentives are provided, observational learning, which previously remained unexpressed, is promptly translated into action. (p. 8)

In addition to modeling behavior, motivation plays a large role in Bandura's (1977) theory in that there must be an incentive for the learning to take place and for a change in

performance to occur. He notes that: “self-reinforcing behavior is intermittently reinforced by both subjectively created contingencies and various external sources” (p. 35).

The second essential theoretical rationale for this study is engagement theory, which describes engagement as being multimodal with cognitive, behavioral, and emotional constructs (Fredricks, Blumenfeld, & Paris, 2004). It describes engagement in school as important for deeper understanding and learning in school and correlates engagement with better outcomes on assessments (Conner & Pope, 2013; Crumpton & Gregory, 2011; Green, Liem, Martin, Colmar, Marsh, & McInerney, 2012). Engagement theory is also related to motivation as students may be intrinsically or extrinsically motivated which can affect the level to which they engage with the material (Bandura, 1977).

Assumptions

This study assumes that there is a relationship between student engagement and their understanding of material as well as their performance on assessments. Conversely, it is assumed that a lack of engagement is correlated with less understanding of the material and poorer performance on assessments. This study assumes that all students, regardless of preliminary engagement levels, can be motivated to engage in science, learn the content and find success is in a high school integrated science classroom. The study assumed that the level of behavioral engagement recorded with the use of the three daily snapshots (during the Do Now, and during two Think-Pair-Share opportunities) was reflective of student behavioral engagement throughout the lesson.

Background and Need

Engagement has been shown by many studies to have a critical impact on school success, but unfortunately, research has shown that classroom engagement wanes with the duration of the year (Marks, 2000). Furthermore, high school students report some of the highest levels of disengagement (Martin, 2009). When students are less engaged, they are more likely to do poorly at school and some of these students end up dropping out of school. "High dropout rates are a silent epidemic afflicting our nation's high schools" (Bridgeland, DiIulio, Morison, Enterprises, & Hart, 2006, p. 1). While the dropout rate has been decreasing with a record low in 2013, with, "just 7% of the nation's 18-to-24 year olds had dropped out of high school," compared to a dropout rate of 12% in 2000 (Fry, 2014, para. 1). The decline in dropouts is clearly a good sign, however, when looking at the raw data from the U.S. Census Bureau, one finds that there still were over 2.2 million high school dropouts in 2013 (Fry, 2014).

While the steady decline in dropout rate over the past decade is appreciated, there is still cause for concern for the high number of students leaving high school without a diploma. The ramifications of not graduating from high school can be devastating: high school dropouts earn on average "$9,200 less per year than high school graduates, and about $1 million less over a lifetime than college graduates…they are twice as likely as high school graduates to slip into poverty from one year to the next" (Bridgeland et al., 2006, p. 2). The impact of students dropping out of high school also impacts our economy in the United States by producing fewer competitive workers, resulting in a loss of earnings and revenue. Finally, a "dropout is more than eight times as likely to be in jail or prison as a person with at least a high school diploma" (Bridgeland et al., 2006, p. 2).

Student engagement in school has been identified by various studies including those by Green, Liem, Martin, Colmar, Marsh, and McInerney (2012) to be the precursor to learning. Furthermore, studies have shown that implementing different teaching strategies, like those outlined by Tanner (2013), have increased student engagement.

Obtaining an education is an asset to an individual, and this researcher has unfortunately observed several students in her classes that appear to be consistently unmotivated and unengaged with the curriculum. This has not only affects their peers' learning, but has also negatively affected their own pursuit of an education. Studies, like those conducted by Conner and Pope (2013), and the meta-analysis of affective teacher-student relationships conducted by Roorda Koomen, Spilt, and Oort (2011), have indicated that the student-teacher relationship is critical to increasing motivation, and it this researcher's objective to determine to what extent the cultivation of such a relationship as well as the inclusion of an additional engagement strategy(s) in her pedagogy had on all the students in her integrated science classes. Bandura (1977) agrees in a more general sense:

> Affective social cues most likely acquire arousal value as a result of correlated experiences between people. That is, individuals who are in high spirits tend to treat others in amiable ways, which arouse in them similar pleasurable affects; conversely, when individuals are dejected, ailing, distressed, or angry, others are likely to suffer in one way or another. (p. 13-14)

Summary

High school students in an integrated science class demonstrate various levels of engagement. However, while some students are consistently thoroughly engaged evidenced by

actively participating in their classes, and demonstrating interest in the curriculum, there are other students that remain unconnected to the curriculum and the classroom experience. The purpose of this study was to determine if implementing “Exit Tickets” into a teacher’s daily lesson impacted student behavioral engagement and concept attainment in a high school science class.

Review of the Literature

Introduction

This section is an examination of the research literature on student engagement and teaching strategies to increase engagement. Information was gathered from academic library searches using online resources. Research information is organized in the following categories: Historical Context of Engagement Theory, which addresses the history and development of engagement theory; Significance of Engagement, which provides literature on the importance of engagement in the classroom in promoting learning; Engagement Strategies in the Secondary Classroom, which elaborates on lists of the most effective methods to engage students in the classroom, culled from a variety of resources; and, Measuring Engagement, which provides the basis for the methods utilized for data collection in this study.

Historical Context of Engagement Theory

Engagement and motivation in students has been a focus in educational and behavioral research for over sixty years. Ryan and Deci (2000) provide a good overview of the history of intrinsic and extrinsic motivation. They acknowledge B.F. Skinner's 1950s work, which was grounded in the notion that all behaviors were motivated by rewards or avoidance of punishments. They describe how people's motivations vary from one another, not only in the extent of their motivation but also with regard to their orientation of their motivation. They cite their earlier work on Self-Determination Theory wherein they "distinguish between different types of motivation based on the different reasons or goals that give rise to an action" (p. 55).

That is, some people are intrinsically motivated to do something because they find whatever they are learning useful, interesting, or enjoyable. Others are extrinsically motivated to do something because it will result in some separate outcome. In the school setting, this manifests most often in grades.

Zyngier (2008) reviews the recent history on engagement research in his comprehensive review of the literature. He cites Goodlad's 1984 work, *A Place Called School*, for first questioning whether larger schools are capable of providing their students with curriculum that can engage all of them to an equal extent. Zyngier (2008) cites research showing that students who come from homes that closely mirror the dominant school culture are more likely to be engaged while at school than those students who do not come from the prevailing school culture. However, he also contradicts this statement with reference to Vinson's (as cited in Zyngier, 2008) work which supports the idea that ascribing a lack of ability or engagement level due to a student's address is detrimental and unproductive as it can "lead directly to destructive assumptions about the possibilities of/for student engagement so that teachers' ways of thinking translate directly into their actions" (Zyngier, 2008, p. 1768). Also germane to the scope of this study is the research cited in Zyngier's (2008) review, which indicates that, despite his acknowledgement of the vast research to the contrary, engagement is *not always* a predictor of academic success. Zyngier (2008) continues this line of thought by citing Bangert-Drowns and Pyke's (as cited in Zyngier, 2008) work showing that there is a share of students that can excel academically without being engaged in school. Zyngier's (2008) review also addresses "critical-transformative engagement" (p. 1771) pedagogy, discussed later in this chapter under 'Engagement Strategies'.

Fredricks, Blumenfeld, and Paris (2004) provide a review of the concept of and research

in school engagement over the past three decades. They describe the three well-recognized components of engagement (behavioral engagement, emotional engagement, and cognitive engagement), and various methods studies have used to measure these facets of engagement. They then describe the outcomes of engagement, and the adverse effects of disengagement, and conclude with future directions for the study and pertinence of engagement in education.

The research literature on engagement typically describes the concept of engagement as a multidimensional construct that is comprised of three different but connected facets. The first aspect is behavioral engagement, which can be defined in three ways. Fredricks, et al (2004) explains:

> The first definition entails positive conduct, such as following the rules and adhering to classroom norms, as well as the absence of disruptive behaviors such as skipping school and getting in trouble…The second definition concerns involvement in learning and academic tasks and includes behaviors such as effort, persistence, concentrations, attention, asking questions, and contributing to class discussion…A third definition involves participation in school-related activities such as athletics or school governance.
>
> (p. 62)

The second large construct of engagement is emotional engagement, also referred to as affective engagement, which involves a student's emotional orientation toward school. That is, the student's interest or boredom in the work, and their emotions regarding school, whether or not they are happy, sad, eager, or anxious about school (Connell & Wellborn, 1991).

The final component of engagement as it is currently described in the literature is

cognitive engagement. Cognitive engagement refers to the extent of interest in learning and coping in the face of struggling or failure to initially ascertain the material (Connell & Wellborn, 1991). Another interpretation of cognitive engagement is the extent of a "student's psychological investment in an effort directed toward learning, understanding, and mastering the knowledge, skills or crafts that the academic work is intended to promote" (Newmann, Wehlage, & Lamborn, 1992, p. 12).

Significance of Engagement

Crumpton and Gregory (2011) performed a two-year longitudinal study of 44 low-achieving high school students examining how the perception of academic relativity contributes to the focus students' intrinsic motivation and their engagement in science. The study found that there was a correlation ($r = 0.53$) between students who were more intrinsically motivated and their engagement in school. However, the researchers noted that the GPAs of the study participants were not significantly correlated with either engagement in the curriculum, nor their intrinsic motivation to succeed at school. In essence, the research showed that low-achieving students were likely to be more engaged in the classroom, and thus intrinsically motivated, when they found the material relevant to their lives.

Lau and Roeser (2008) utilized a person-centered approach to study the cognitive abilities and motivation and engagement in science among 318 diverse 10^{th} and 11^{th} grade high school students. The study was conducted by the completion of two assessments (the first regarding their motivational and demographic characteristics, and the second regarding fluid, crystallized, and spatial abilities) in two different sessions in their science classes. The results of these assessments were examined in association with their science grades and a final science exam.

Using various statistical analyses, researchers characterized participants into a range of character types that the researchers propose can be utilized by teachers and other practitioners to differentiate instruction to best meet the needs of their individual students.

Shumow, Schmidt, and Zaleski (2013) presented three studies conducted simultaneously in three separate science classrooms at a large public high school in a diverse Midwestern setting. Information was gathered via two waves of teacher and student surveys (once in the fall and again in the spring over the course of one school year). The researchers looked into the perception of how successful laboratory experiments were at teaching content. Researchers found that while "students reported less challenge and concentration during lab activities than during non-lab activities," students did however report, "higher enjoyment and interest in lab activities, but also reported less perceived relevance when doing labs" (Shumow, Schmidt, and Zaleski, 2013, p. 238). The researchers suggested that a good pedagogical amendment would be to create more relevance of laboratory activities by integrating them with ongoing curriculum. They also suggested that more time must be appropriated before and after laboratory activities to provide opportunities for students to connect and reflect upon the meaning (and thus relevancy) of the activities.

Green, Martin, and Marsh (2007) studied students' multidimensional motivation and engagement across math, English, and science in six Australian high schools. The researchers addressed the conflicting research between domain specific motivation (i.e. students who are motivated in one subject but not another), and the view that "constructs that are more situation- or subject-relevant (e.g. valuing, self-concept, and expectancy for success...)...will evince relatively greater domain specificity" (Green, Martin, and Marsh, 2007, p. 270). Surveys from

the 1801 students were asked to rate their motivation and engagement in mathematics and at least one of English or science. The results showed parallel correlations across subjects.

Conner and Pope (2013) conducted a qualitative study of over 6,000 adolescent students at fifteen high-achieving middle and high schools using student response to a Likert-like survey on their engagement in the school curriculum. They found that even at the high-achieving schools, where students overwhelmingly earn high marks, there was a chronic problem with a lack of engagement in the curriculum. The researchers concluded that. “authentic, meaningful engagement in [high-performing high schools] may be more rare than we might expect” (Connor and Pope, 2013, p. 1427). Furthermore, this absence of cognitive and affective engagement results in higher rates of maladaptive behavior like “internalizing, externalizing, and physical symptoms of stress” (Connor and Pope, 2013, p. 1426). The researchers cite a deal of research that indicates the correlation between higher engagement in school and a healthier, more successful life for students in and outside of school (including avoidance of drug and alcohol abuse, reduced rates of depression, and overall higher rates of well-being and life satisfaction). To further understand student engagement, Conner and Pope (2013) investigated factors that promote engagement including novel independent variables, which have received little attention in the past. The scholars looked at the students’ affective, behavioral, and cognitive dimensions as individual components to their overall motivation in school. The researchers also correlated these dimensions with student-reported grade point averages, academic worry, academic integrity, mental health, physical health, teacher support, and school context. They found that behavioral engagement (defined by the researchers as “working hard and exerting mental effort”) exceeded the rate of cognitive engagement (defined as “valuing and caring about the work”). They also concluded that 21% of the students surveyed were “reluctantly engaged” showing very

little of any type of engagement, especially affective engagement (defined as experiencing interest and enjoyment (Conner & Pope, 2013, p. 1429). Nevertheless, there were a considerable percentage of the sampled students (31%) that were labeled as "fully engaged," that is, these students charted high levels of all three types of engagement.

Critical to the focus of this paper, Conner and Pope (2013) found that while fully engaged students reported high levels of teacher support, this was not the case with reluctantly engaged students. One of the implications of this research, as suggested by the researchers, is for teachers to be more explicit with the purpose and value of their assignments to facilitate the derivation of meaning by the students. Furthermore, they suggest more professional development to assist teachers in making the curriculum more enjoyable, thereby activating the affective domain and thus bolstering students' affective engagement. Finally, their research suggests that teachers should try to foster more teacher-student relationships, which can additionally help the student become more engaged in the classroom.

With regard to the importance of teacher-student relationships (TSRs), Roorda, Koomen, Spilt, and Oort (2011) conducted a meta-analysis of 99 studies conducted between 1990 to 2011 mostly in the United States (77 studies) and examined the connections between the quality of the teacher-student relationship and the student's school engagement and their achievement. Roorda and her team specifically looked at the connections between teacher-student relationships and engagement, as well as teacher-student relationships and achievement. The researchers found that despite hegemonic belief that younger students are more influenced by their TSRs than older students, they cite several studies that show support for the opposite to be true. In fact, their results showed a higher correlation (e.g. 0.40 for secondary school versus 0.27 for primary

school) for both positive TSRs on engagement and negative TSRs and engagement (that is, the more negative a TSR, the more likely a student will not be engaged in the curriculum). They also found that the influence of TSR on boys was stronger than that for girls. Furthermore, they found that at-risk students were very influenced by their TSRs. While they did not find any primary studies looking into the effect of teacher gender or teaching experience on the strength or efficacy of the TSRs formed, their results from the meta-analysis showed that male teachers had a significantly higher effect size with regard to engagement only (not achievement). Furthermore, the results of the study showed that teacher ethnicity "significantly influenced the association between positive relationships and achievement only," and teachers who had more years of experience also had a higher effect on teaching experience and achievement (there was no significant advantage to teaching experience and the TSR effect on engagement) (Roorda et al, 2011). Finally, the research supported other research in this domain in that it showed positive correlations between TSRs and both achievement and engagement, and negative correlations between negative TSRs and negative achievement.

Green, Liem, Martin, Colmar, Marsh, and McInerney (2012) conducted a two-year longitudinal study with 1866 high school students and examined the students' academic motivation and self-concept in relation to their class participation, absenteeism, homework completion, and test performance. They found that both academic motivation and self-concept positively predicted attitudes toward school. Furthermore, their findings supported that while there was a positive correlation between attitudes toward school and presence and participation in class, and completion of homework. Finally, the researchers found that both class participation and homework completion correlated with higher test scores, absenteeism negatively predicted test performance.

Quite clearly, engagement and motivation are critical to succeeding in the classroom. Conversely, a lack of engagement can be detrimental to not only a student's success in school, but also their willingness to continue to attend and graduate from high school. Peter D. Hart Research Associates for the Bill & Melinda Gates Foundation worked in association with Bridgeland, Dilulio, and Morison (2006) to report on the silent epidemic of dropouts in America. Their report, which utilized four focus groups of ethnically diverse 16-24 year old dropouts, along with 467 interviews with ethnically and racially diverse high school dropouts in 25 various locations. Their results showed a variety of reasons for students dropping out, for instance 32% reported needing to get a job to make money; 26% became a parent and could not continue to attend school; 35% reported failing in school was a major factor. However, an astounding 47% of the dropouts surveyed also said they left high school because they did not find their classes interesting; as a result, these students were bored and disengaged from the curriculum. The researchers additionally reported that "69 percent [of dropouts] were not motivated or inspired to work hard…two-thirds would have worked harder if more was demanded of them (higher academic standards and more studying and homework), and 70 percent were confident they could have graduated if they had tried" (Bridgeland et al., 2006, p.iii). Bridgeland et al. (2006) and his colleagues made several suggestions to help keep students in school supported by their findings:

- Improve teaching and curricula to make school more relevant and engaging and enhance the connection between school and work
- Improve instruction, and access to supports, for struggling students
- Build a school climate that fosters academics
- Ensure that students have strong relationships with at least one adult in the school

- Improve communication between parents and schools. (p. v)

Engagement Strategies

Zyngier (2008) acknowledges the benefits of a student-centered pedagogy in encouraging engagement "through the individual's interests and experiences" but encourages teachers to go a step further and develop critical-transformative engagement which "perceives student engagement as rethinking these experiences and interests increasingly in communal and social terms for the creation of a more just and democratic community and not just the advancement of the individual" (Zyngier, 2008, p. 1772). Zyngier promotes the concept that when students can see themselves as represented in the curriculum there is more buy-in and students are likely to be more critically engaged in school. Zyngier's (2008) research proposes that a more engaging pedagogy would ensure the following elements:

- *Connecting*—to an engaging with the students' cultural knowledge
- *Owning*—all students should be able to see themselves as represented in the work
- *Responding*—to students' lived experiences and actively and consciously critiquing that experience
- *Empowering*—students with a belief that what they do will make a difference to their lives and the opportunity to voice and discover their own authentic and authoritative life. (p. 1773)

Though Tanner (2013) is a Biology university professor, her feature article from *Life Sciences Education* outlines objectives that any level teacher of any subject aspires to achieve: mainly, cultivating a student-centered learning environment by promoting student engagement

and ensuring classroom equity. In doing so, she acknowledges that teachers must, consider "each student's prior experience and attitude and motivation toward the material being learned, confidence in his or her ability to learn, and relative participation in the learning environment are all thought to be key variables in promoting learning of new ideas, biological or not" (Tanner, 2013). Tanner organized the teaching strategies presented in her article into five goals instructors have for their classrooms. These goals and the subsequent strategies are as outlined by Tanner (2013):

> Giving students opportunities to think and talk about [the subject]
>
> 1. Wait time
> 2. Allow students to write
> 3. Think-pair-share
> 4. Do not try to do too much
>
> Encouraging, demanding, and actively managing the participation of *all* students
>
> 5. Hand raising
> 6. Multiple hands, multiple voices
> 7. Random calling using popsicle sticks/index cards
> 8. Assign reporters for small groups
> 9. Whip (around)
> 10. Monitor student participation
>
> Building an inclusive and fair biology classroom community for *all* students
>
> 11. Learn or have access to students' names

12. Integrate culturally diverse and relevant examples

13. Work in stations or small groups

14. Use varied active-learning strategies

15. Be explicit about promoting access and equity for *all* students

Monitoring (your own and students') behavior to cultivate divergent [subject-specific] thinking

16. Ask open-ended questions

17. Do not judge responses

18. Use praise with caution

19. Establish classroom community and norms

Teaching *all* of the students in your biology classroom

20. Teach them from the moment they arrive

21. Collect assessment evidence from every student, every class (p. 324)

While Zyngier (2008) presents conflicting research on the critical nature of engagement in the classroom (see Historical Context section of this chapter), he does cite research showing that engagement can be beneficial to student learning (though not imperative). Zyngier (2008) cites several Newmann studies, which help elucidate the complex nature of engagement. In particular, Newmann's 1992 (as cited in Zyngier, 2008) study is addressed wherein two factors were shown to positively affect student engagement: "(i) school membership (clarity of purpose, fairness, personal support, success and caring), and (ii) authentic work (extrinsic rewards, intrinsic interests, sense of ownership, connection to *real world* and fun (Newmann, 1992, p.

18))" (Zyngier, 2008, p. 1770). Ultimately, Zyngier (2008) synthesizes his own research and his review of the literature and presents strategies for engaging pedagogy:

- *Connecting*—to and engaging with the students' cultural knowledge
- *Owning*—all students should be able to see themselves as represented in the work
- *Responding*—to students' lived experiences and actively and consciously critiquing that experience
- *Empowering*—students with a belief that what they do will make a difference to their lives and the opportunity to voice and discover their own authentic and authoritative life (p. 1773)

Mitchell and Carbone (2011) detailed the engagement different types of tasks which led to engagement and learning. They developed the typology utilized in their study from teacher researchers from the Project for Enhancing Effective Learning (PEEL) (which Dr. Ian Mitchell co-founded and leads and which is described later in this section). Mitchell and Carbone advocated that teachers may be able to improve students' motivation, achievement, and thinking by seeing how they react to different activities and learning different ways to present and manage said activities. PEEL's definition of quality learning, which helps guide its teacher-researcher members understanding of the efficacy of their pedagogies, is, "behaving metacognitively, having a positive volition to learn, operating at high levels of cognition, and regularly involving social aspects of learning" (Mitchell & Carbone, 2011, p. 259). However, they also acknowledge a widely used conceptualization of engagement as containing behavioral, cognitive, and affective engagement.

The researchers used the PEEL database, which at the time of their research contained

1282 articles by 598 different authors (mostly high school teachers) who detailed the tasks completed by the students in their lesson and how they impacted student learning and engagement. Eight dimensions of tasks that influenced learning were identified and repeated below:

- Routine – Novel
- Artificial – Authentic
- Closed – Open
- Degree of Ownership
- Degree of Linkage
- Degree of Reflection on Learning
- Individual – Collaborative
- Simple – Complex (p. 261)

The researchers then identified which dimensions (if any) were being used in the different lessons from the PEEL database and subsequently what level of engagement was attributed to the dimension. Mitchell and Carbone (2011) disaggregated for the type of engagement (behavioral, affective, cognitive, and meta-cognitive). The results from "Routine – Novel" dimension of the study showed that the more novel a task is (which the researchers were clear to explain pertained to the novelty of the actual task, not whether the content was new) helped to engage students who were often felt otherwise alienated from typical classroom routines. Furthermore, the researchers surmised that providing novel tasks helped frame the material in a new way, which can help develop deeper understandings.

The findings from the "Artificial – Authentic" dimension showed that, as a great deal of

research supports (Blumenfeld & Meece, 1988; French, 1998; Marks, 2000) indicated that the more authentic, that is, the more practical (from the student perspective) a task is, the more likely student engagement will be. The researchers, also found, however, that the pedagogical style of creating relevancy with the task was the most rare (frequency) out of all eight dimensions within their sample. The researchers also commented that while creating authentic tasks can lead to engagement, they are often also time consuming and therefore sometimes difficult to execute within a lesson's timeframe. Mitchell and Carbone suggested a solution in which teachers could explicitly link tasks with real-life activities, but provide abbreviated versions of these tasks.

The results from the "Closed – Open" dimension (sometimes referred to as "directed" and "exploratory" or "prescription" and "choice" or "freedom") indicated that the more choice in task that is provided to a student, the more engaged the student will be. With regard to the "Degree of Ownership" dimension, which describes the amount of student input into any aspect of the formulation of a task, the more ownership students had, the more engaged they were, especially within the affective and behavioral engagement domains. Within the "Degree of Linkage" dimension of tasks (the extent of mental connections between the task and other school work or aspects of their lives), the findings showed little correlation between engagement and linkage. While they argued that more linkage may help build understanding of the material, it is not a direct pathway toward engagement or interest. The researchers found that the higher the "Degree of Reflection on Learning" the higher the engagement (84% of the studies with this dimension of task indicated high levels of engagement). However, they also cautioned that while reflection is a very useful tool, it cannot feasibly be implemented with every task. Furthermore, the researchers were able to distill three areas where better reflection could have been utilized. Mitchell and Carbone's (2011) insight bears repeating here:

> One was getting students being more responsible and less dependent on the teacher with aspects of what is often called self regulation: thinking about the task purpose engaging in better planning, keeping better track of what they are doing and why and checking their answers for reasonableness…The second area was reflection on their thinking and learning: What their ideas are, what they need to know, what they are learning and have learnt from the task…The third area was reflection on themselves as learners – learning how to learn better. (p. 267)

The results of the "Individual – Collaborative" dimension showed that when collaborative activities utilized tasks involving the dependence of various students' skills, respecting and responding to students' ideas, and involving decision-making, the level of engagement was high. Merely putting students into groups was not enough to foster engagement; there had to be actual collaboration to yield higher levels of engagement, especially with the cognitive and affective domains. Finally, the "Simple – Complex" dimension, which the researchers defined in part as "the number of steps that a task requires" but also involves "the number of goals to be fulfilled, and the coupling of goals with contextual constraints" showed no conclusive link between more complex—or simpler—tasks and engagement (Mitchell & Carbone, 2011, p. 268).

The Project for Enhancing Effective Learning (PEEL) is an Australian-based group of teachers and academics concerned with the "passive, unreflective, dependent student learning, even in apparently successful lessons" (Lumb & Mitchell, 2009, para. 1). It is a group founded in 1985 which has multiple publications, including their PEEL SEEDS journal, along with a few texts (Lumb & Mitchell, 2009). PEEL is not a fixed pedagogical implementation program.

Rather, the teacher members help generate novel understandings of teaching and learning, and build on the knowledge and wisdom of their colleagues (Mitchell & Carbone, 2011).

Motivational Strategies to Enhance Learning

Wery and Thomson (2013) reviewed ways to encourage struggling students to engage more positively with their learning. Within the context of learning, the researchers defined motivation as "the individual's desire to participate in the learning process; it involves the reasons or goals that underlie their involvement or non-involvement in academic activities" (Wery & Thomson, 2013, p. 103). The two motivational theories the authors focused on were Achievement Theory, and Expectancy-Value Theory (Wery & Thomson, 2013, p. 103-104). The former describes motivation as dependent on how the student defines success in that situation; the student will either approach or avoid the task based on a set of beliefs about the task at hand. The latter theory describes motivation as being influenced by the degree to which the student expects to be able to complete the task successfully along with being influenced by the rewards or benefits of completing the task. Wery and Thomson stress that to understand motivation, one must look past the traditional dichotomy between intrinsic and extrinsic motivation; motivation is much more complex than the two avenues allow provide. For instance, the researcher point out that "there are two types of extrinsic motivation: rewards given by others, and rewards given by oneself" (Wery & Thomson, 2013, p. 105). They purpose that while the goal should be to get students to become more intrinsically motivated, no one is entirely in one domain or the other. To understand and increase motivation of students, Wery and Thomson (2013) begin by understanding the reluctant learner.

Wery and Thomson's (2013) research revealed that many reluctant students often employ

self-handicapping strategies that diminish their role in the failure and provide excuses for lack of engagement or performance in class. This often occurs with students who expect to fail, and these measures are a scapegoat, or a method to justify their subsequent failure. To begin to motivate students, many teachers often find it helpful to initially provide extrinsic motivators. However, to begin to cultivate more intrinsically motivated students, teachers must build an environment that promotes and supports student independence, and allows for small opportunities for successes, which can begin to change their experience from one of failure to one where success can exist and persist. Wery and Thomson (2013) propose the following practical suggestions and applications to begin to enhance reluctant students' motivation:

- Believe your students can learn
- Model enthusiasm and intrinsic motivation
- Create a learning environment that is encouraging and challenging

  Communicate high, but realistic expectations for students.
- Acknowledge the difficulty of tasks

  Just because specific tasks are easy for some does not mean that they are easy for others. Refrain from saying 'this is easy'. Instead acknowledge that specific tasks are difficult, while remembering to acknowledge that students are capable
- Connect learning to the world

  Learners who can see the connection between a project-based task and the real world will be more motivated to understand and solve the problem at hand. Using teaching methods that promote real-life applications, authentic activities, as well as performance assessments would help students better understand the material, process information in a different way and become more effective learners.

- Set goals

  Setting intermediate goals can be self-motivating because it allows students to feel competency as they accomplish smaller goals.

- Involve students in the learning process

  Providing some ownership in the process of task development or assessment gives students valuable experience setting standards.

- Allow for independence

  Offer students choices about what to work on or how to complete assignments.

- Use projects

- Evaluate the task, not the student

  Rather than compare students' performance to the performance of other students, evaluate the task. Evaluating students in a manner that emphasizes individual improvement and growth over social comparison and competition is important. Competition between students has been shown to decrease intrinsic motivation; therefore if it is used it should be based on the outcome of the task, instead of pitting students against each other.

- Promote mastery learning

- 'Immunize' against the negative effects of extrinsic motivation

  Help students find ways to focus on the intrinsically interesting, fun and playful aspects of a task, and encourage them to make even the most routine assignment exciting. Offer strategies to distance themselves from socially imposed extrinsic constraints

- Use priming words

> Words associated with intrinsic motivation include: volunteering, mastering, delighted, autonomous, absorbed, competent and enjoying. Limit the use of words associated with extrinsic motivation including: competitive, obligation, expected, evaluated, constrained, demanded, avoiding, restricted, forced, pressured, controlled, and proving.

- Respond positively
- Praise students

> Praise helps learners develop a feeling of competence and has been found to increase intrinsic motivation. (Wery & Thomson, 2013, p. 106-107)

Landsman, Moore, and Simmons (2008) contend that the key to encouraging students to be more motivated may be encouraging disillusioned teachers to become more motivated about their practice. The reviewers suggest ways that teachers can become reinvigorated with their craft and by doing so can motivate students to become more engaged in their lessons. First, becoming culturally competent is critical to understanding why different learners may feel detached and cynical towards school. By making the classroom more accessible to students, teachers may find that these reluctant learners are more engaged with the curriculum, which will make teaching these individuals more rewarding. The researchers further explain that when teachers make connections and develop caring relationships with their students, both parties are rewarded: the teacher may find it easier to motivate students and cover the curriculum because students feel invested in the classroom, and it aids students by activating the affective domain and giving them an additional reason to pursue successes in the class. They also suggest several classroom management strategies to encourage rather than impede development of motivation. For instance, Landsman, et. al suggested refraining from threatening or forcing a student to

complete a task, because that alienates students, especially reluctant ones. Often times, threatening students will foster additional reluctance, which can discourage teachers and students alike. Instead, the reviewers suggest a full, well-planned lesson that—by virtue of the tasks at hand—requires students to work from bell to bell. Additionally, they contend that when students have a concrete task due at the end of a class, they are more likely to be more diligent and engaged during the class. Making an assignment due the following day allows the students to procrastinate and put off the task for a later time.

Gutmann (2007) discussed ways to engage reluctant learners in his review for the International Journal on School Disaffection. He points out that while encouraging any learner to become engaged in the curriculum is challenging, when teachers are faced with students who are "disaffected perhaps by the system and her/his own negative past experiences," the challenge to help those students learn the material becomes even more challenging. The strategies provided in Gutmann's (2007) summary were compiled from years of teaching and from hundreds of classroom observations as a consultant and assessor for advanced skills teachers. Most germane to the scope of this study are the following notes: first, it is in all parties' best interest to start the curriculum from where the students are with their content understanding. By assuming knowledge, teachers can jump ahead of student understanding, risking further alienation and disengagement from the curriculum. Second, the more formative assessments and feedback a teacher can provide, the better. Teachers sometimes incorrectly believe that if they become involved in assessing student work prior to the work's completion, they are artificially inflating or augmenting the grades. However, Gutmann (2007) argues that by not providing feedback, some students may lose motivation, and get behind in long-term projects, which would certainly adversely affect their learning. However, Gutmann (2007) also cautions that the feedback must

be constructive. By negating the work done or by providing vague feedback, teachers run the risk of turning students off and not taking the opportunity to redirect work or help troubleshoot issues with the students. Finally, with regard to providing feedback to students, Gutmann explains that the more specifically directed feedback, the better the students will perceive and internalize the remarks. Providing individual feedback is a way to differentiate the instruction and provide more critical advice to best improve the students' work.

In Doug Lemov's (2010) influential text *Teach Like a Champion: 49 Techniques that put students on the path to college*, Lemov organizes and describes (in fact, more than 49) pedagogical techniques into different categories to help K-12 teachers improve a variety of essential skills to help their students. The teacher-researcher of this study has employed several of the techniques discussed in Lemov's (2010) text, and revisited the comprehensive list for this study. The techniques in the book are useful for teachers because they are specific, actionable, and concrete, which allow for easier implementation than other esoteric pedagogical strategies. The strategies are organized into different chapters with different objectives, but they really work in concert with each other and there is much overlap. Lemov explains, "…the full array of techniques operates in synergy; using one makes another better, and the whole is greater than the sum of the parts" (Lemov, 2010, p. 5). For instance, while the author places the Exit Tickets (technique 20), one of the engagement strategies utilized in this study, under the third chapter, "Structuring and Delivering your Lesson" it also operates as an engagement strategy by establishing a "productive expectation about daily completed work for students" (Lemov, 2010, p. 106). Lemov lays out the ET strategy by explaining that the most effective ETs are quick (one to three questions), and designed to yield data (the questions are short, and focus on one key part of the lesson's objective).

Hafen, Allen, Mikami, Gregory, Hamre, and Pianta (2012) investigated the effect of providing autonomy to students on student engagement. One of the goals of the study was to "determine the extent to which teacher supports for competence, connection, and autonomy within the classroom environment, as perceived by students at the start of an academic year, predict changes in student-reported engagement and observed engagement across the year" (Hafen et. al, 2012, p. 247). Their participants were 34 teachers and 578 high school students across four Virginian schools. They collected data throughout the course of one school year and collected data through observing student engagement and student reports. Their results indicated a correlation between increased perception of student autonomy on engagement ($r = .55$).

Milne and Otieno (2007) conducted a field study of a chemistry teacher's gas law unit to see how well science demonstrations engaged the students. Because demonstrations do not often provide students with hands on opportunities to learn the material, they are sometimes criticized of creating power differential between students and the teachers doing the demonstration as well as neglecting an opportunity to provide kinesthetic learning opportunities to the pupils.

Measuring Engagement

Fredricks, McColske, Meli, Mordica, Montrosse, and Mooney (2011) reviewed the various characteristics of twenty-one different instruments that measure engagement of upper elementary through high school, along with providing descriptions of each method's proper usage and their psychometric properties. The different measurement methods include fourteen student self-reporting tools, four observational measures, and three teacher reports on students. Because this research paper relies on teacher reports of students, the focus on the description of Fredricks, et. al's work will be mainly on this final method. The teacher report method named,

"Engagement versus Disaffection with Learning (EvsD)," has been identified as the best method from which to guide the research for this paper. One of the other teacher report instruments measured only engagement in reading, so was omitted from consideration, and the final option of teacher reports was inaccessible to this researcher has been omitted from this review. Because the other two teacher report instruments were used for measuring engagement in any subject, both were utilized when designing the teacher report used for research for this paper.

Fredericks, Blumenfeld, and Paris (2004) presented several measures of behavioral engagement (as well as cognitive and emotional engagements) and the limitations behind those measurements. Most of the ways behavioral engagement has been measured, the authors explain, is by completing ratings of student behavior or by having students complete self-report surveys of their engagement levels. While sometimes the scales used to evaluate these reports are disaggregated for different types of behavior and are able to parse out the different nuances of behavioral engagement, more often, there is no such disaggregation, and behavioral engagement is analyzed as one entity (albeit distinct from the other two types of engagement). The authors explain that this can be problematic due to there exist students who are poorly behaved (abiding by class norms and rules is one component of behavioral engagement) but do persist with their in class school work (persistence in the classroom is another component). Conversely, there are students who abide by the class rules, but do not get their work done in class. The researchers propose that many behavioral engagement assessments would view these students as one in the same, but in reality, they arise from two separate cohorts of behavioral engagement. Fredericks et al. also point out that some measures of behavioral engagement only include positive behaviors (e.g. being on task) while failing to measure negative behaviors (e.g. being tardy for class). They also take issue with observation techniques as the only tool used to assess behavioral

engagement because they do not afford information on the quality of effort. They cited an earlier study that found that, "some students judged to be on-task by observers reported in subsequent interviews that they were not thinking about the material. In contrast, many of the students who appeared to be off-task actually were highly cognitively engaged, that is, they were trying to relate new ideas to what they had already learned" (Fredricks et al, 2004, p. 66).

Fredricks, et. al (2011) define engagement as having behavioral, emotional, and cognitive components, and they identify the overarching purpose of their study as being similar to the intention behind this one: to identify students at risk of dropping out of school (because there is a deal of research that shows that most students who drop out of school have a history of disengagement (Finn, 1989). To pursue this goal, the researchers looked into various methods of identifying engagement in the curriculum (their study examined a total of 21 separate instruments). Fredricks, et. al. examined different student self-reports as well as teacher reports and observational methods in their course of study. They describe the teacher reports as utilizing "scores assigned to students based on teacher responses to a set of items using a specified response format (for example, "very true of student" to "not very true of student") (Fredricks et. al, 2011, p. 5). Specifically, the two teacher reports that helped guide the curation of the teacher report utilized in this study, both shared the purpose of continued research on motivation and cognition, while the RAPS teacher report additionally evaluated the intervention methods for the purpose of school reform (Fredricks et al., 2011; Connell, 1998; Skinner et al., 2012; Skinner, 2015, IRRE, 1998). In addition, Wellborn's (1991) Student Achievement-Relevant Actions in the Classroom (SARAC) Teacher Report report, which was identified as a useful measurement device in Fredricks et al's paper was explored and utilized in conjunction with the RAPS teacher report for this study.

Wang, C. Bergin, and D. Bergin (2014) proposed a new way to measure engagement that addressed the three modalities of engagement (cognitive, behavioral, and affective/emotional). They argued that no prior measuring tool could effective measure the three components of engagement, so they developed the Classroom Engagement Inventory (CEI) to fill the void. They conducted two studies: the first, with 3,481 students between 4th and 12th grade to explore and confirm the factor analysis for the inventory. The second study was conducted a year later after revision to the inventory items with 3,560 4th-12th grade students from the same school district. The researchers finally compiled a 24-item CEI with five factors: affective engagement; behavioral engagement-compliance; behavioral engagement-effortful class participation; cognitive engagement; and, disengagement.

Summary

The review of the literature on student engagement reveled that while there may be a good deal of research on the importance of engagement and evidence showing a correlation between school success and higher engagement, there is little evidence of many particular strategies to increase said engagement. Many authors and researchers suggest techniques to increase engagement, but few studies have endeavored to gather empirical research to support individual or let alone a consortium of efficacious strategies for teachers to employ to enhance engagement within their classrooms. Nevertheless, numerous studies have supported the prevalent notion that engagement matters, which is a useful premise to have in place for this paper's study.

Method

Research Approach

This study examined the effect of implementing ETs on student behavioral engagement and concept attainment in five integrated science classes. The research relied on a mixed-methods approach utilizing both quantitative and qualitative data. The independent variable for this study was the data post-use of daily ETs at the end of each lesson for three weeks and the control was the data one week prior to the use of daily ETs. While every student in the teacher's classes was asked to complete the ETs to provide equitable learning opportunities, data was collected and analyzed using a random sample of 50 participants within the teacher-researcher's five periods of sophomore science students.

In order to randomize the sample of participants to be measured during the study, the researcher assessed all her students using the RAPS-Teacher report prior to the study. The RAPS-Teacher report is a teacher survey that was developed for research in student behavioral engagement. It is part of the larger RAPS, which has five "separate but integrated measurement tools" of engagement (Institute for Research and Reform in Education, 1998, p. I-1). The RAPS was created and published by the Institute for Research and Reform in Education (IRRE) in 1998. The RAPS uses a Likert scale of "Very True," "Sort of True," "Not Very True," and "Not True At All" to assess three statements: "In my class, this students seems tuned-in," "This student comes to class unprepared," and "This student does more than required" (IRRE, 1998, p. III-4). Answers of "Very True" were awarded four points; "Sort of True" was three; "Not Very True" was given two points, and "Not True At All" was given 1 point. The points were totaled for each participant across the teacher's classes. The second statement about participant preparation was

modified to, “this student comes to class prepared,” in order to make higher total point values reflective of increased engagement levels.

After assessing each of her students, the researcher separated her students into two groups: those that were more frequently engaged (FE) (equal to or more than 9 points on the modified RAPS-T) and those that were more frequently disengaged (FD) (based on scores below 9 points on the modified RAPS-T). While the objective of this study was to engage all students, the teacher-researcher endeavored to initially separate her participants by engagement level to see if there was any significance between the two groups once the independent variable (the implementation of daily ETs) was added. For each class, the researcher numbered each participant in the FE and FD for each pile and used a random number generator to select five FD participants and five FE participants for a total of ten participant participants in each class or a total of fifty participants across her student load. The researcher than created aliases for each participant with the prefix “A” for FE participants and “B” for FD participants, and then sequentially numbering the participants so that the FE cohort spanned “A1” to “A25,” while the FD cohort began with “B1” and finished with “B25.”

There were both quantitative and qualitative dependent variables utilized in this study. The first qualitative dependent variable was the level of behavioral engagement assessed by the teacher three times every class. The RAPS-T was supplemented with items from the Engagement-Behavior section of Wellborn’s “Student’s Achievement-Relevant Actions in the Classroom (SARAC): A Teacher-Report Measure of Student Engagement vs. Disaffection in School” (EvsD) (IRRE, 1998; Wellborn, 1991). This combined qualitative report was completed for each of the teacher’s participants after the control week, and the culmination of the three

weeks of utilizing ETs. The RAPS-T/EvsD report asks the teacher to respond to the following statements using the scale shown in Table 1:

1. In my class, this student seems tuned in.
2. This student comes to class prepared.
3. When we start something new in class, this student participates in discussions.
4. In my class, this student works as hard as he/she can.
5. When I explain new material, this student listens carefully.
6. This student does more than required.

Table 1.

RAPS-T/EvsD Report Scale

Scale for RAPS-T/EvsD Report			
Very True	Sort of True	Not Very True	Not At All True
4	3	2	1

Table 1 presents the RAPS-T/EvsD Report scale. This scale was utilized both to divide the teacher's participants into FE and FD cohorts, and to assess their behavioral engagement after both the control week and after the last week after the implementation of the ETs.

In addition, three times every lesson for the duration of the study, the researcher recorded the extent of each participant's behavioral engagement using the definitions provided below and the following Likert scale developed by the researcher shown in Table 2. The three engagement "snapshots" that were recorded remained relatively constant throughout the experiment and were as follows: the commencement of the Do-Now each day, and the first and last Think-Pair-Shares (TPS) of the lesson. If there were no TPSs in the lesson, then the researcher took the behavioral engagement snapshots at two other distinct moments during the lesson when there was not direct

instruction. The points earned by each of the participants for their level of engagement were summed and recorded into an excel spreadsheet.

Table 2.

Scale for Behavioral Engagement Assessment

Scale for Behavioral Engagement Assessment				
Actively Engaged	Mostly Engaged	Not at all engaged	Not Present	Absent
4	3	2	1	0

The scale for behavioral engagement assessment, shown in Table 2, was used three times during each day of the study to assess participant behavioral engagement.

Definitions to accompany the Scale for Behavioral Engagement Assessment:

(4) *Actively Engaged:* Writing down an answer to the Do-Now, referring to background material or asking questions if stuck; back-and-forth on-task communication during TPS.

(3) *Mostly Engaged:* Writing down an answer to the Do-Now, but appearing to put forth a brief or insincere effort; listening to classmate during TPS, but not offering any feedback.

(2) *Not at all Engaged:* Not completing the task, not writing an answer to the Do-Now, not speaking or listening to classmates during the TPS.

(1) *Not Present:* The participant was absent for the assessment (tardy or in the bathroom) but in attendance for the lesson.

(0) *Absent:* Participant was absent from class for the entirety of the period. (A zero was recorded regardless if the participant was excused or unexcused for the absence.)

The last qualitative data component collected during the research was survey feedback after the culmination of the study. All students were asked to provide feedback to questions relating to the implementation and use of the ETs. Though all responses were read for the

teacher's general knowledge, only the responses from the participants were analyzed for the purpose of this study. The prompts were posed to students who were asked to respond using the Likert scale shown in Table 3:

1. Exit Tickets encouraged me to stay focused during class.
2. Exit Tickets helped improve my engagement in science class.
3. Exit Tickets helped me understand the focus of the class.
4. Exit Tickets added to the stress of science class.
5. Exit Tickets did not have an effect on my behavior in science class.
6. I would like to have Exit Tickets in the future.
7. I would not mind having Exit Tickets if they didn't count in my grade.
8. The Exit Tickets were too hard.
9. Exit Tickets helped me learn the material.

Table 3.

Scale for Students to Respond to Survey on ETs

Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree

Table 3 shows the Likert-scale responses participants could choose from to respond to the nine prompts about the use and effectiveness of the ETs.

There were two quantitative dependent variables collected from this research. The first was comprised of two quiz scores. Each quiz covered only the material addressed over the course of the week in which the quiz was administered. The first quiz was given after the first week (the control week), and the second quiz was given the last week of the ETs.

The scores on the ETs provided the data set for the second quantitative dependent variable. ETs were given each day of class for three weeks, for a total of 12 ETs (each integrated science class meets four days per week).

The constants of this experiment were: the participants of the study, the teacher-researcher, the teacher's daily pedagogical practice (no additional engagement strategies were implemented or removed throughout the duration of this study so as to best test the efficacy of the ETs), the seating chart for the participants, the assessment type and procedure for quizzes and ETs, the protocol for data collection, and the unit of material being taught in class (vertebrate evolution).

Ethical Standards, Access and Permissions

This paper adheres to the ethical standards for protection of human subjects of the American Psychological Association (2010). Additionally a research proposal was submitted and reviewed by the Dominican University of California Institutional Review Board for the Protection of Human Subjects (IRBPHS), approved and assigned number 10324.

Participants' names are not used in this report. When referring to specific participants in the Appendices, participants names are protected by their pseudonyms. The master list of participant names and pseudonyms were stored separately in a locked folder on the researcher's personal computer. A second list included the pseudonym and the data collected. In summarizing data from the study, the researcer reviewed information only included on the second list. Only the resarcher and her advisor saw the raw data referred to here.

The researcher is the teacher of record and the participants of the study are her students in her integrated science classes, comprised mostly of high school sophomores. The principal of the

site has given informed consent to the study. Letters of intent were sent home to the parents/guardians for all students in the classes, regardless of whether or not the students were the participants of the study. Permission was sought voluntarily, with the understanding that the participants could withdraw from the study at any time. The letter of intent and letter of consent by the principal are available in the Appendices.

Sample and Site

The setting for this study was a large, public, mostly affluent, racially homogenous (European-American) high school in suburban Northern California. The participants for the study were all students of the teacher of record. The participants were comprised of a randomly selected group of 50 students enrolled across five separate integrated science classes.

The participants monitored were selected after the teacher completed a RAPS-T for every student prior to the onset of the study. The pool of students was then divided into Frequently-Engaged (FE) and Frequently-Disengaged (FD) categories, assigning each a number, and using a random number generator to select the numbers to create each cohort.

While every student in each of the classes participated in the study, data was collected for only 50 of the 115 total students across the teacher's student load. Ten participants were studied in each of the five science sections. Within each of the cohort of 10 participants, 5 were determined to be consistently behaviorally engaged, while the remaining 5 were determined consistently or frequently behaviorally disengaged with the curriculum, as determined by completing the modified RAPS-T as discussed earlier in the Research Approach sub-section.

Data Collection Procedures

The teacher completed the RAPS-T/EvsD combined report at the end of the first and last week of the study for each of her 50 participants. (The RAPS-T alone was also completed for all 115 students prior to the beginning of the research in order to group and select the cohort for study.) Each day, the three engagement snapshots for each class were recorded on a seating chart during each engagement opportunity (see Appendix O). The first snapshot, during the Do Now, stayed consistent throughout the study. The teacher began each class with a Do Now, which is a student-centered independent learning opportunity for students to reflect or anticipate topic understandings or skills. The following two snapshots were not absolutely consistent due to the changing lesson plans. When there was direct instruction, the teacher made sure to include several Think-Pair-Share opportunities (when students were given a question to think about individually, then discuss with a partner, before sharing their thoughts out to the class), and collected data during the first and last of these opportunities. However, not every lesson plan lent itself well to including multiple TPSs, in which case the teacher monitored engagement while students were working independently or collaboratively (e.g. conducting an experiment, writing responses, individual reading, completing worksheets with their table group, etc.).

The two quizzes were marked, and scores were entered in the teacher-researcher's online grade book over the subsequent weekend the quiz was administered (scores from the Friday quizzes were posted by the following Sunday morning for student and parent access). The teacher utilized a free smartphone application called "Exit Ticket" which all the students downloaded (all students in the study had access to smart phones). The teacher wrote daily ETs using the teacher edition of the application and had students take the assessment with their smartphones at the end of each day. The teacher projected the students' results using the Exit

Ticket website (Exitticket.org) so that the students got real-time feedback on their answers, and were able to see how they were doing in comparison to their classmates.

Data Analysis Approach

The quantitative data (ET scores and Quiz scores) were collected and averaged for the FE and the FD cohorts both as separate groups and together for an overall interpretation of the data. Both the quiz scores and the daily ET scores were examined for trends in the data. The quiz scores pre-ET and after ET were compared to see percent improvement for each cohort and in the group overall.

The qualitative data from the study (RAPS-T/EvsD combined teacher report, snapshots of behavioral engagement, participant feedback) was summed for each participant and the snapshots of engagement were averaged and compared to both the ET scores and the Quiz results. The data was graphed for the FD and FE cohorts individually and aggregated for a look at how the total group of participants performed. The cohorts' snapshots and RAPS-T/EvsD report results were also compared to participant performance before and after the ETs to help determine efficacy of the implemented strategy. Correlation coefficients were calculated and plotted to help indicate if there was a link between the quantitative and qualitative measurements. The teacher report data and the snapshot scores pre-ET and during/after ET were compared by cohort and aggregated to see percent improvement in the group. Finally, the modes for each of the nine questions on the student feedback survey were analyzed for mode and the frequency distribution of the results were plotted to indicate the feelings of the participants.

Findings

This study endeavored to determine if implementing an additional engagement strategy (ETs at the end of the lesson) would improve behavioral engagement and concept attainment. The study was conducted at a suburban high school in suburban Northern California. The participants were fifty sophomore students across five integrated science classrooms. The fifty participants were determined to be either "Frequently Engaged" Or "Frequently Disengaged" prior to the onset of the study. The tables and figures that follow present the various data collected throughout this study.

Table 1.

Summary of Cohort Data

Cohort / **Indices**	FE Pre-ET	FD Pre-ET	FE During or After ET	FD During or After ET	Percent FE Improvement	Percent FD Improvement
RAPS-T/ EvsD Report	20.79	10.56	21.84	14.56	5.05	37.88
Mean Quiz Score (%)	82.89	65.78	88.83	71.2	7.17	8.24
Mean Snapshot Points	10.91	6.45	11.04	8.88	1.19	37.67
Exit Ticket (%)	---	---	87.59	76.35	---	---

Table 1 depicts the averaged results of the disaggregated data. The results for each cohort are represented separately for each of the indices: pre- and post-ETs for the RAPS-T/EvsD combined report, which required the teacher researcher to evaluate the individual participants' behavioral engagement at large; the quiz scores; pre- and post-ET quiz scores; and pre- and during-ET snapshot scores. Also included were the mean percentages for the ETs for each cohort. Finally, the percent improvement for each index for both cohorts was included.

Table 2.

Summary of Aggregated Data

Combined Participants **Indices**	Pre-ET	During or After ET	Percent Improvement
RAPS-T/ EvsD Report	15.68	18.20	16.07
Mean Quiz Score (%)	74.34	80.02	7.64
Mean Snapshot Score	8.68	9.96	14.75
Exit Ticket (%)	---	81.97	---

Table 2 shows the data of the several indices for the participants averaged together. The teacher report, indicating overall behavioral engagement has been averaged and compared prior to and after the implementation of ETs, and the improvement 16% has been calculated. The mean quiz score during the control week was 74% while the quiz taken after the ET was 80%,

for a percentage increase of 7.64% (as compared to the initial score, not calculated as the difference between the two data points). Finally, the average ET score across the fifty participants was almost 83%.

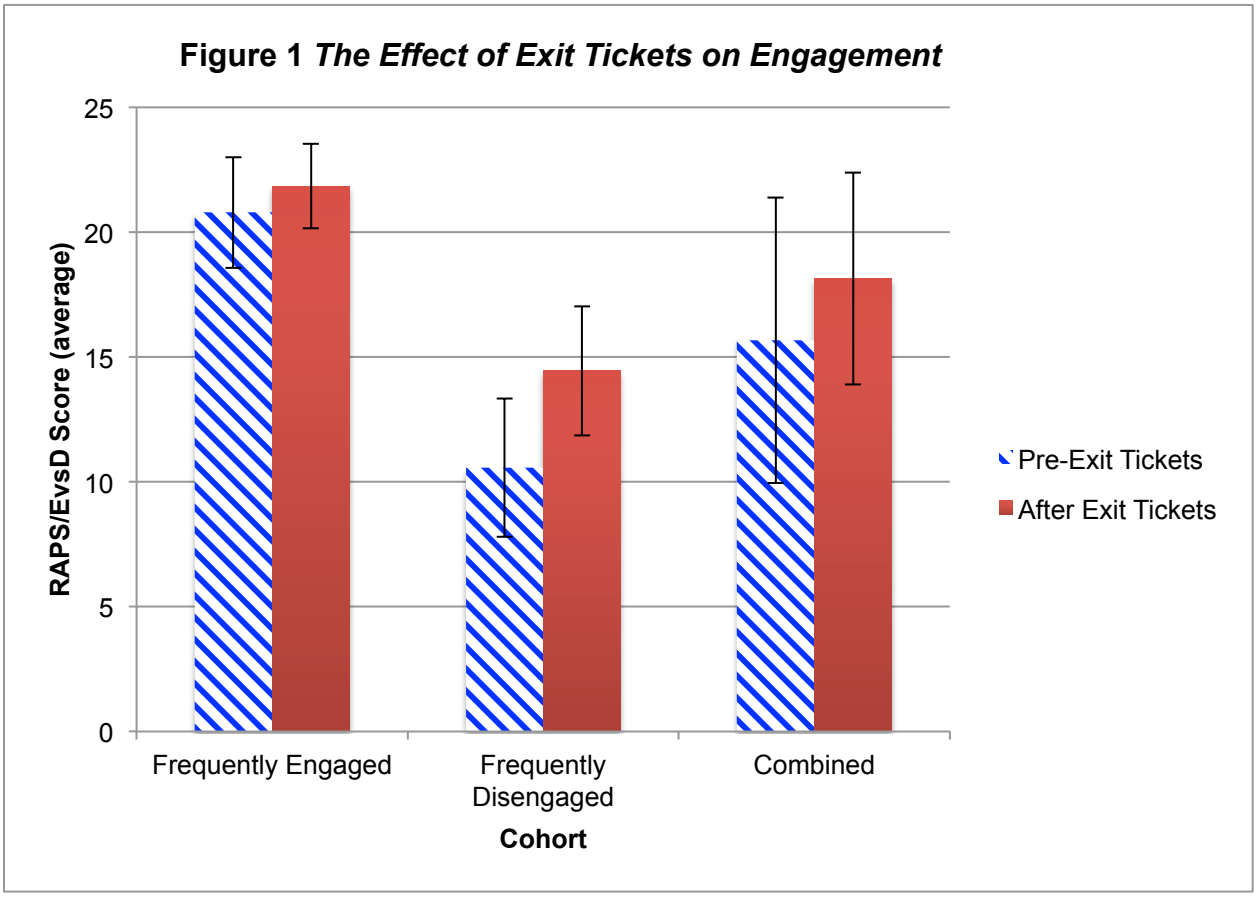

Figure 1 illustrates the change in teacher perception of participant engagement (as evaluated using the combined RAPS/EvsD Teacher Report. The teacher report asked the researcher to evaluate each participant on six different statements reflecting the behavior engagement of the individual participant. A Likert scale with rankings from 1 to 4 was used to numerically represent the results of each of the six statements, with a higher score indicating higher engagement (the lowest score, therefore could be a 6 and the highest possible, a 24).

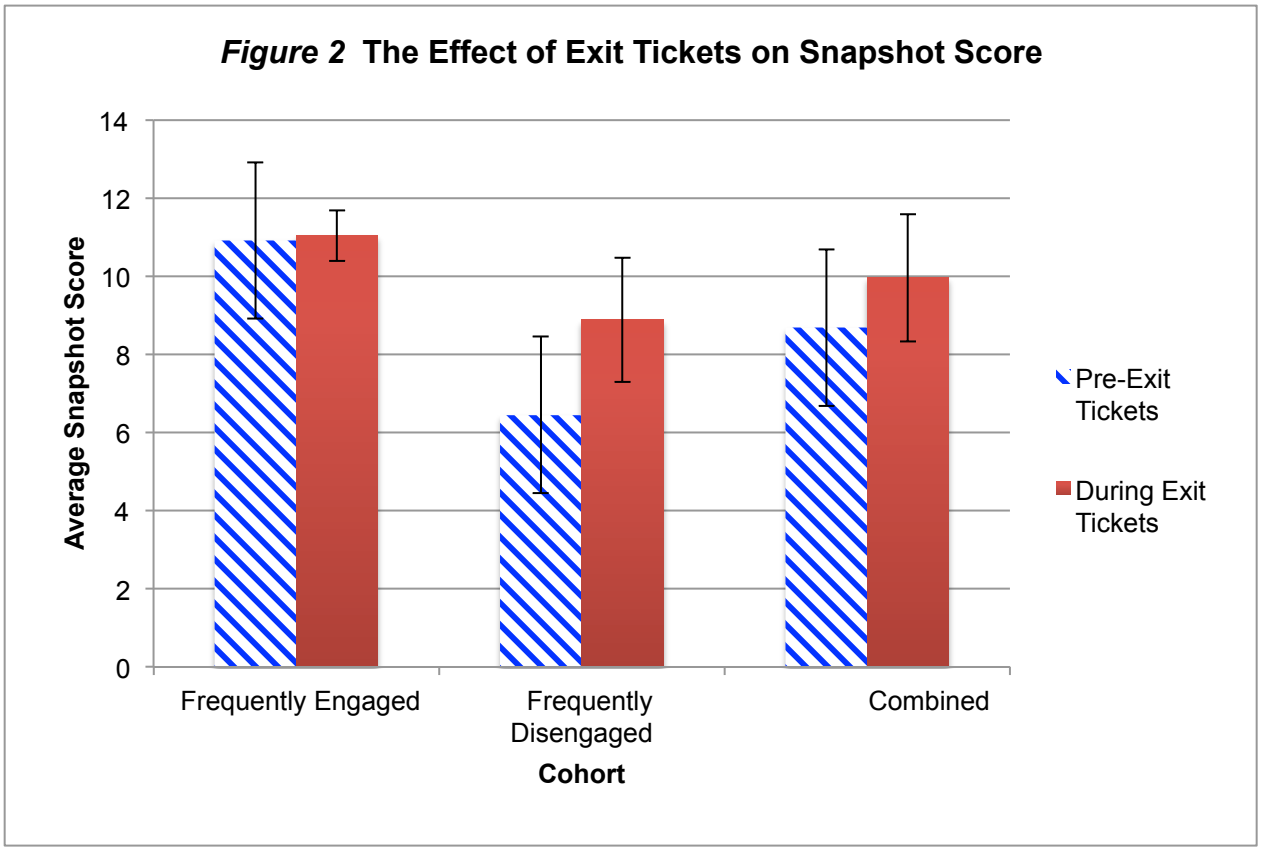

Figure 2 indicates the effect of adding ETs on the level of behavioral engagement as measured by daily "snapshot" points. The snapshot scores were recorded three times for each participant each day. Scores were recorded on a Likert scale from 0 to 4, the higher number reflecting higher behavioral engagement. The points were totaled for each day (for a total possible 12 points), and averaged over the control ("Pre-ETs") week and the three subsequent weeks when ETs were utilized ("During ETs").

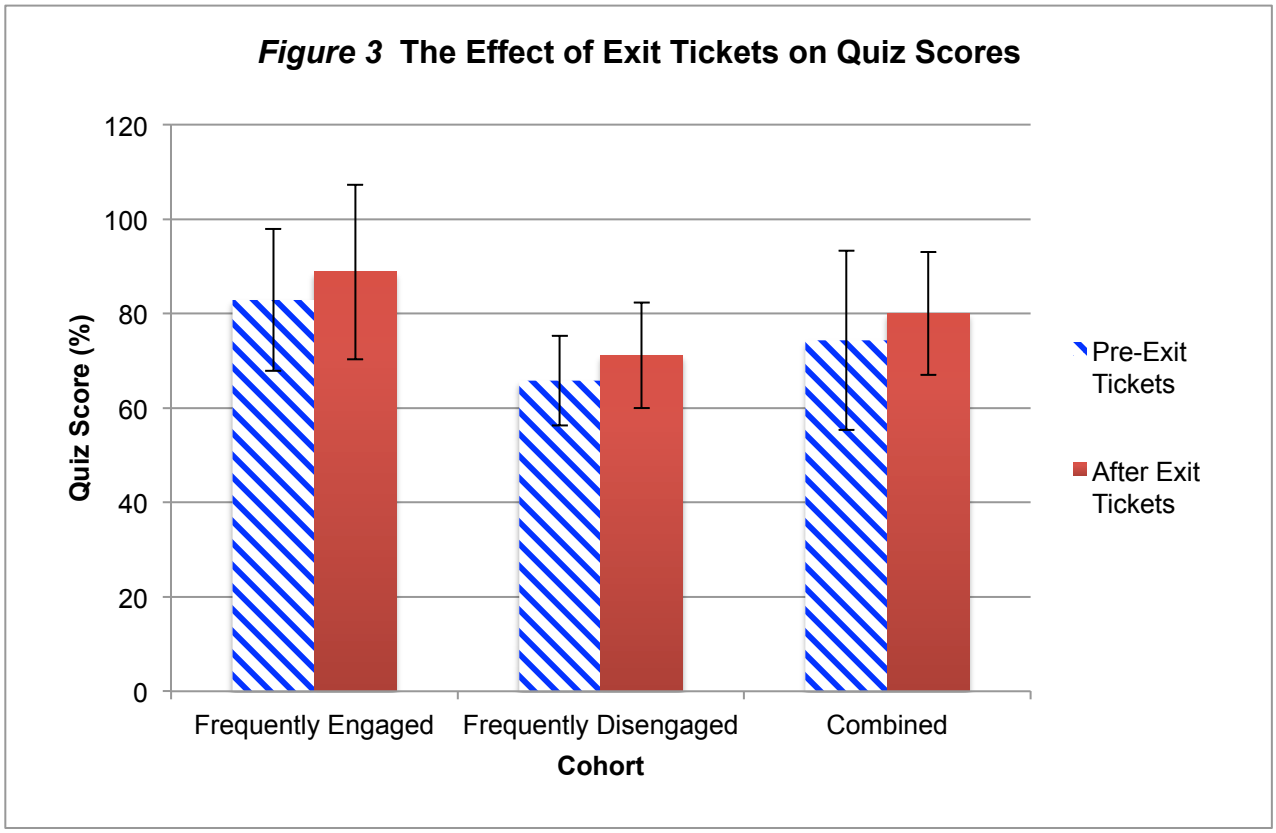

Figure 3 reflects the quiz scores for each cohort before ETs were implemented and after they were utilized for three weeks. The final pairing of bars in the graph are combined cohorts to indicate the overall improvement in quiz scores after ETs were implemented.

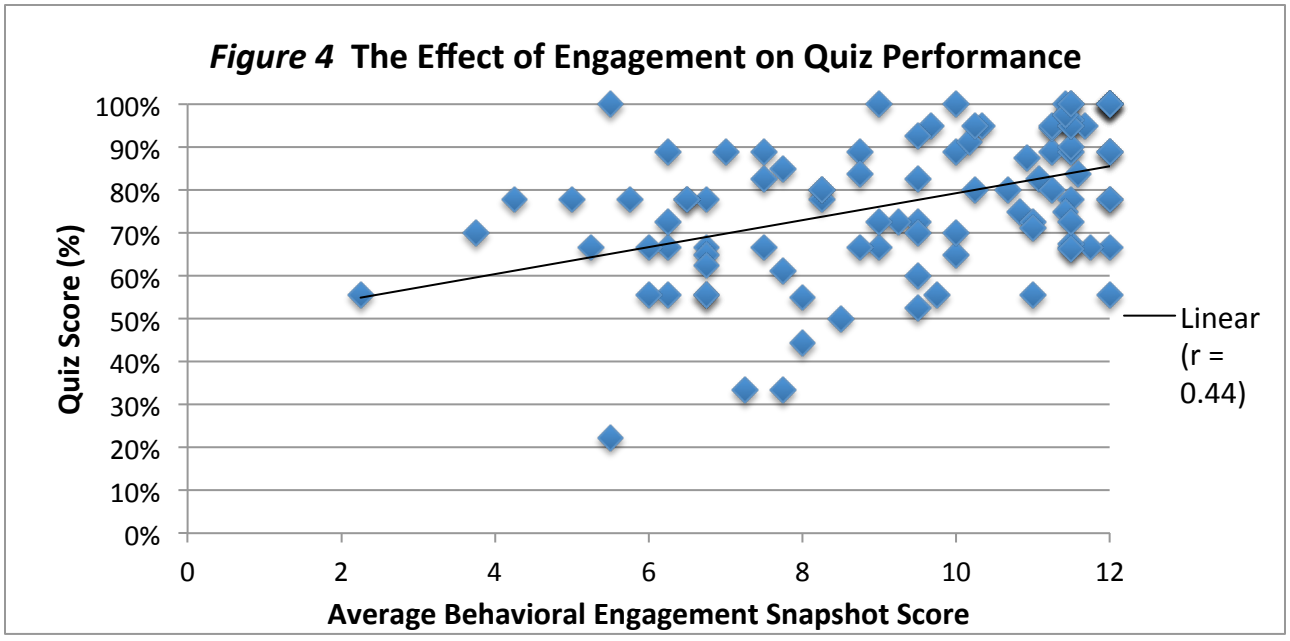

Figure 4 is each of the participants' scores on both of their quiz scores plotted against their average behavioral snapshot of engagement for the week prior to the quiz. There were two quizzes during the duration of the study and fifty participants for a total of 100 data points. The correlation coefficient for the graph has been calculated (r = 0.44) and plotted to indicate an overall trend indicating a relationship between higher engagement and quiz score.

Figure 5 **The Effect of Engagement on Quiz Performance**

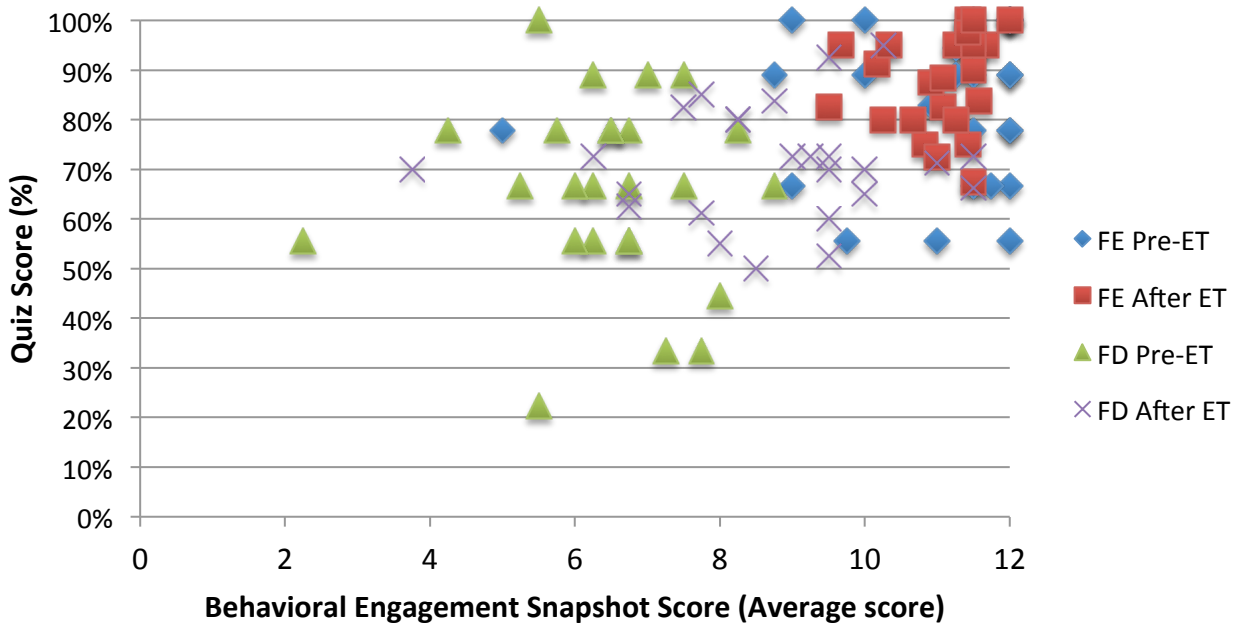

Figure 5 represents the same data as Figure 2, but is disaggregated for the two cohorts (FE and FD) along with the timing of the quiz (pre-ET, and After ET). The blue diamonds indicate the pre-ET quiz results for the FE Cohort, with the red squares indicating the quiz results for the same cohort after the implementation of the ETs. The green triangles represent the FD cohorts' pre-ET quiz scores, with the purple Xs indicating the FD quiz performance after ETs.

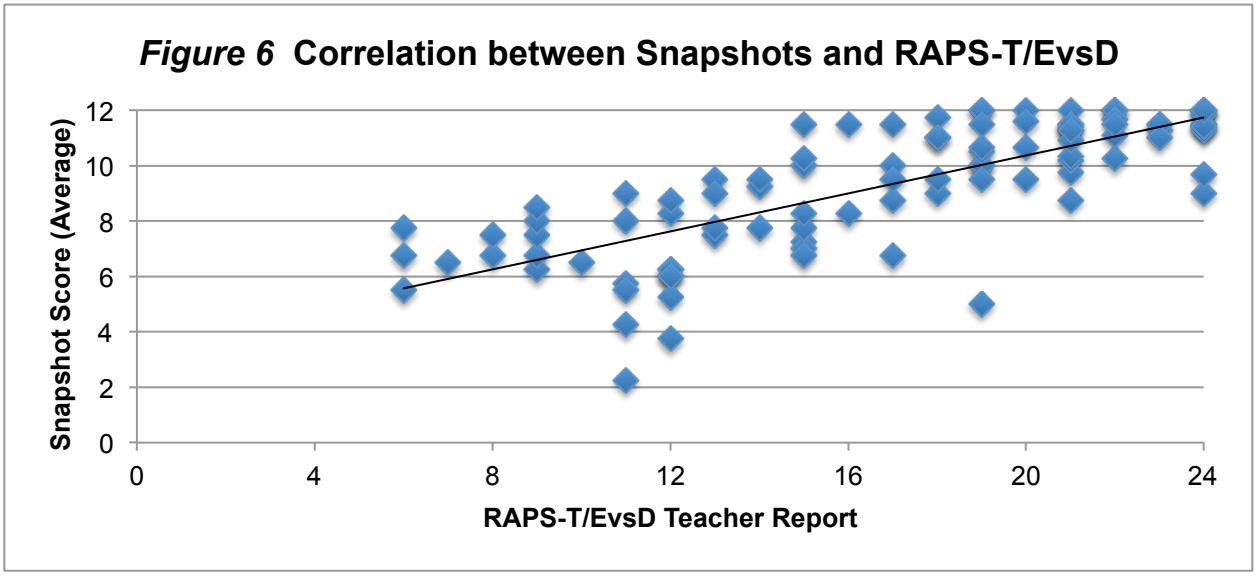

Figure 6 shows the correlation (r = 0.77) between the indications of engagement as measured by the teacher repots (along x-axis), which were completed after the first week of the study (prior to the use of ETs), and snapshot scores of behavioral engagemetns (along y-axis), which were collected after every day of the experiement (scores pre-ETs were averaged for each participant, as were the scores for the period of ET use). This graph represents all the data points for both indices collected and for both cohorts (FE and FD participants).

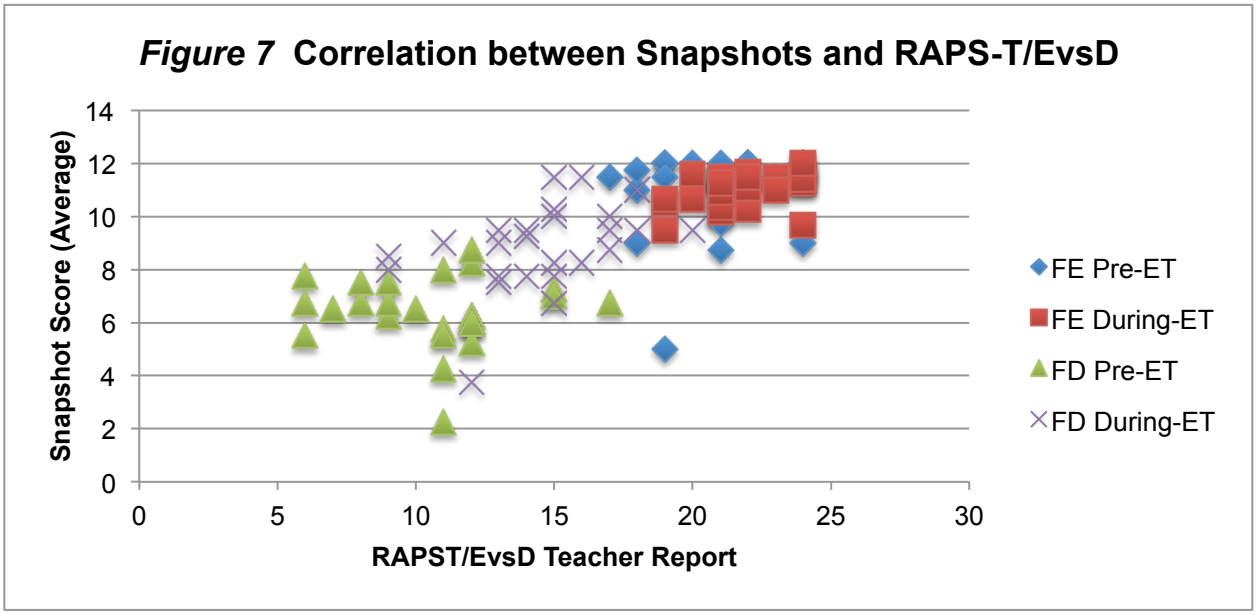

Figure 7 represents the same data as Figure 6, except for the data has been disaggregated for the different cohorts (FE participants and FD participants) and for the time of the data collected (before the implementation of the ETs, and during the use of the ETs).

Table 3 depicts the prompts about Exit Tickets to which students responded using the Likert scale provided at the top of the table. Their responses are graphed below in Figure 8.

Table 3.

Exit Ticket prompts and Likert scale

Exit Ticket Prompts and Scale				
Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
1. Exit Tickets encouraged me to stay focused during class.				
2. Exit Tickets helped improve my engagement in science class.				
3. Exit Tickets helped me understand the focus of the class.				
4. Exit Tickets added to the stress of science class.				
5. Exit Tickets did not have an effect on my behavior in science class.				
6. I would like to have Exit Tickets in the future.				
7. I would not mind having Exit Tickets if they didn't count in my grade.				
8. The Exit Tickets were too hard.				
9. Exit Tickets helped me learn the material				

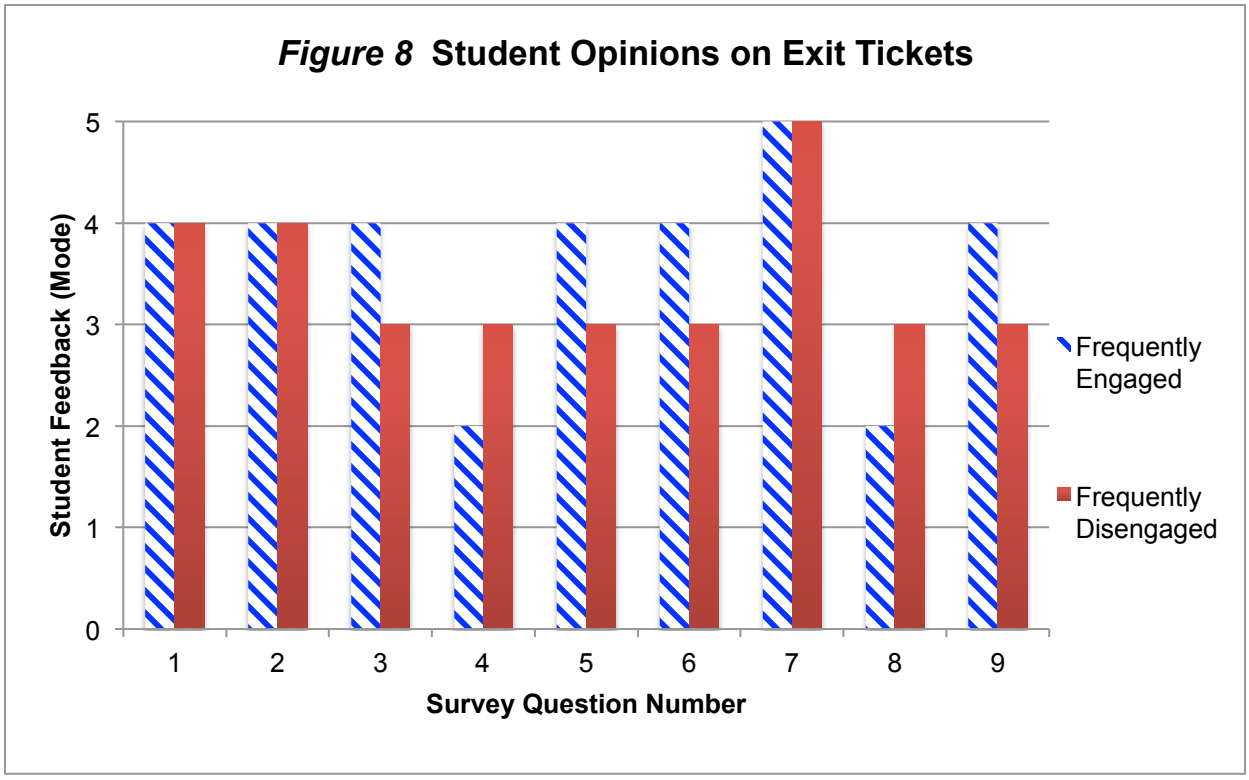

Figure 8 reflects the opinions of participants on the efficacy and use of Exit Tickets. The modes of the opinions are shown. The participants were asked to evaluate nine different statements about the Exit Tickets in their Integrated Science classroom using a Likert scale of four feelings. The prompts and the scale used by the participants to provide feedback about their experience with the engagement strategy are presented in Table 3.

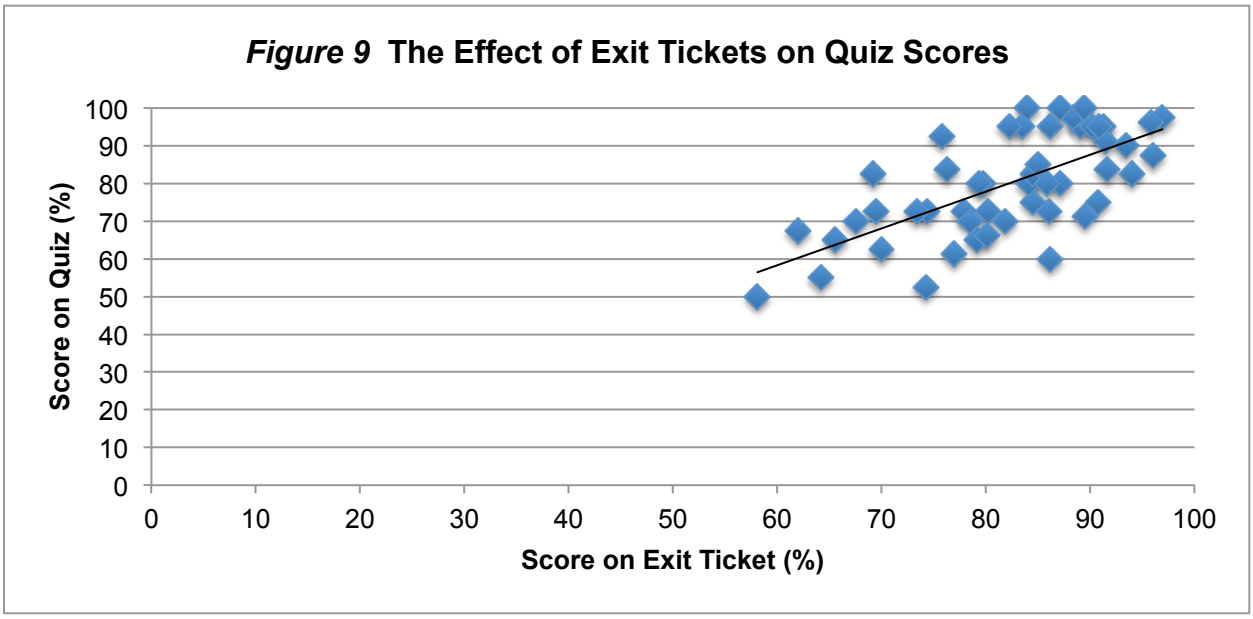

Figure 9 shows the correlation between achievement on quiz score and ET score. Because ETs were only implemented after the first quiz was already taken, this data set reflects only the second quiz score. The correlation between success on ET and quiz score was 0.67.

Themes from the Findings

The findings revealed the following themes for analysis and discussion:

1. There was observed improvement in behavioral engagement in both cohorts after ETs were implemented.
2. Though there was an increase in engagement, it was not large within FE participant cohort.
3. There was an increase in quiz performance after the ETs were implemented for both cohorts.
4. There were 9 absences within the FE cohort during the three weeks of ETs versus 26 in the FD cohort during that time (see Appendix A and Appendix B).
5. There was a correlation between higher engagement and higher quiz scores (correlation coefficient = 0.44).

6. There was a correlation between teacher perceived engagement using the RAPS-T/EvsD Index and the novel "Snapshot Score" index (correlation coefficient = 0.77)
7. The FD cohort was more indifferent in their responses to the cumulative participant survey than the FE cohort, who felt more strongly that the ETs were effective.
8. There was a correlation between success on the ETs and Quiz Scores (correlation coefficient = 0.67).

Discussion /Analysis, Conclusions, and Recommendations

Analysis and Discussion of Major Themes from the Findings

Engaging students is, by no means, an easy task. In fact, even many students who do well academically struggle to sustain their engagement in a given curriculum (National Research Council, & Institute of Medicine, 2004). Nevertheless, studies have shown a strong positive correlation between more engagement in the classroom and better performance on assessments and higher overall grades (Green, J., Liem, G. A. D., Martin, A. J., Colmar, S., Marsh, H. W., & McInerney, D., 2012). The data collected and analyzed in this study reflects this phenomenon. Both FE and FD cohorts benefited from the implementation of ETs, however, the effect was much smaller on the FE cohort. The behavioral engagement improvement as measured by the RAPS-T/EvsD Report was 38% for the FD cohort compared to 5% for the FE cohort, and 38% with the Snapshot index for the FD cohort compared to 1% improvement for the FE. The smaller effect can be hypothesized as follows: first, from a statistical standpoint, the FE participants had little room to "grow" or demonstrate more engagement due to their overall high level of engagement to begin with. Second, because these participants were already engaged with the curriculum, any additional strategy implemented may not have affected their level of engagement.

There was relatively the same increase for the quiz scores for both FD and FE cohorts after the ET were implemented (7% for the FE cohort and 8% for the FD cohort). However, looking at the raw numbers, one must note that though the percent improvement is similar, the FE cohort outperformed the FD cohort on quiz performance both before and after ETs were implemented. For instance, the Pre-ET quiz scores for the FE participants was 83%, and while

they only increased to 89% after the ETs, this was much higher than the data for the FD cohort (66% pre-ET, 71% after-ET). The FE participants therefore had an average Pre-ET quiz score 17% higher than their FD peers, and 18% higher during the Post-ET quiz. This supports previous findings that higher engagement is correlated with higher school performance (Green, et. al, 2012).

When the FE and FD cohort data was combined, the results were still positive. There was an overall 16% increase in behavioral engagement using the RAPS-T/EvsD Report as a barometer, and a 15% increase when looking at the snapshot points earned before and after ETs were employed. Just as before, though there was an increase in quiz scores after the ETs were utilized, when both cohorts' data was combined, this increase was 7.6%.

Another interesting finding was the number of absences recorded during the study. During the three weeks of ETs, participants from the FD cohort were absent 26 times compared to the 9 absences within the FE cohort. This is evidence of further low behavioral engagement, and it is this author's belief that missing valuable instruction in class can have severe ramifications on the learning and later engagement (on all dimensions of engagement) by the absent participant.

Another finding of the study was of a correlation between engagement and quiz scores, albeit a relatively weak one ($r = 0.44$). This correlation coefficient makes sense, however, because although one would expect that being more engaged would help increase quiz scores, it is reasonable to assume that participants who were disengaged during class may have studied at home to prepare for the quizzes. Likewise, participants who were engaged in class may not have retained the material, or completely ascertained the material even though they were paying attention and participating fully during class.

Another correlation was found between the RAPS-T/EvsD Index and the Snapshot score, an index created by the research to monitor daily behavioral engagement. In this case, there was a stronger correlation ($r = 0.77$), indicating that utilizing snapshots may be a fairly effective and accurate way of measuring behavioral engagement because there is a strong correlation between its data and the already-established RAPS-T and Engagement vs. Disaffection indices. Clearly, however, this evaluative measure must be replicated in future studies in order to ascertain its true value as an indicative measure of behavioral engagement of students.

The participants were asked to reflect on the use of ETs as it related to their engagement and learning at the culmination of the study. In general, the FE cohort responded positively to the implementation of ETs, while the FD cohort was more neutral in their responses. The modes of the responses indicated some similarities between the cohorts for some of the measures, but in six of the nine statements, the FD participants most often reported that they "neither agreed nor disagreed with the statements." At no point was the mode for the FE participants the neutral response. The FE and FD similarly responded to the following statements: "Exit Tickets encouraged me to stay focused during class," (mode: "Somewhat Agree"); "Exit Tickets helped improve my engagement in science class" (mode: "Somewhat Agree"); "I would not mind having Exit Tickets if they didn't count in my grade" (mode: "Strongly Agree"). Furthermore, the FE cohort responded with modes of "Somewhat Agree" while the FD responded with modes of "Neither Agree nor Disagree" to the additional four prompts: "Exit Tickets helped me understand the focus of the class"; "Exit Tickets did not have an effect on my behavior in science class"; "I would like to have Exit Tickets in the future"; "Exit Tickets helped me learn the material." For the prompts "Exit Tickets added to the stress of science class," and "The Exit

Tickets were too hard," the FE cohort responded with modes of "Somewhat Disagree" while again, the FD cohort's mode response was the neutral choice.

Many of these responses are understandable and explainable for various reasons. First, it is the researchers' anecdotal experience that teenagers are not overly committal so the idea of choosing "strongly agree" or "strongly disagree" for any one statement is less likely amongst this age group. Second, the one response where both cohorts *did* respond most extensively was to a prompt that negated any effect the ETs would have on their grade (thus, both groups largely responded that they "strongly agreed" that they wouldn't mind doing ETs if it didn't impact their grade). It also makes sense that the FE cohort who scored well on the ETs and by and large perform well on most tasks and assessments in the course would not view the ETs as being too hard or adding to the stress of the course (statements 4 and 8). The overwhelmingly neutral response from the FD participants regarding the ETs is more difficult to comprehend. One explanation may be that the FD cohort is often just that—frequently disengaged—so while the researcher asked them to take the time to read the prompts and honestly respond, they may have chosen the neutral response so as not to commit to a particular side (agree or disagree), or perhaps they interpreted the neutral response as neither right nor wrong and thus an easy choice to make.

Finally, another correlation of the data collected was found between the success on the ETs and the Quiz Scores. The ET scores for each participant were averaged and plotted against their second quiz score (after the ETs were implemented) to find a correlation coefficient of 0.67. This indicates that there is a rough relationship between doing well on the ETs and performing well on the subsequent quiz. The interpretation here is at least twofold. First, it simply indicates that doing well on the ETs is a decent predictor of doing well on the quiz. Second, the

relationship may indicate that the ETs may prepare the participants well for the quizzes acting as a warm-up, preview, or educational practice of the material to be assessed on the formative quiz.

Comparison of Findings to the Literature

While there is a good deal of research on the effect of level of engagement school success, school attitude, and quality of self confidence/being/life, there is much less evidence that supports particular strategies in increasing engagement over a school year (Hafen et al, 2012). This study suggests one method to pursue data to this end. One of the findings in this study clearly supports the previous evidence that engagement matters, and higher engagement is correlated to higher school success (Conner & Pope, 2013; Roorda, et. al, 2011; Green, et. al, 2012). This study supported this earlier research by indicating that the more engaged a participant was, the more likely they were to perform well on a quiz ($r = 0.44$). Furthermore, when deciding what strategy to implement to increase engagement, the teacher researcher turned to the literature to find common suggestions for enhancing engagement. In many cases, the researcher found the need to continually assess student performance (Tanner, 2008; Wery & Thomson, 2013; Gutmann, 2007; Lemov 2010). ETs were therefore chosen to examine the effectiveness of an assessment at the culmination of each class period.

Conclusion

Several conclusions can be drawn from this study. Returning to the research questions, it does seem that using Exit Tickets as a pedagogical strategy did increase the behavioral engagement among both typically engaged and those typically disengaged participant (overall

about a 16.1% increase in engagement using one metric for the combined cohort, 14.8% using the other). In addition, the Exit Tickets served as a learning tool and indicated that they may have served to increase quiz scores (there was a 7.6% increase in the combined cohort's quiz scores after the Exit Tickets were utilized for three weeks).

Additionally, the data presented in this study supports previous findings in engagement theory (Fredericks, Blumenfeld, & Paris, 2004) suggesting that behavior is one modality of engagement. In addition, Bandura's (1977) work which discusses extrinsic motivation seemed to certainly be at play here, by motivating students to pay closer attention and being more behaviorally engaged in order to score more points and be rewarded with a higher grade.

Limitations/Gaps in the Research

While the data from this study is positive, there are limitations within the study that delineate the scope of the conclusions that can be derived. First, the smaller sample size of only fifty participants limits the broader statistical analysis. The classes that were tested were all taught the same material and were relatively homogenous not only in age, but in background (socioeconomic status, race/ethnicity, previous science education). On the other hand, however, the course that was observed is a mandatory, graduation-requirement. Therefore, one element that *was* very diverse was the initial level of engagement. Because enrolling in the integrated science course is obligatory, the interest in science varies widely. The researcher believes that in an elective course, the results would be more similar to those observed in the FE cohort due to it being a choice to enroll in elective courses, and participants typically choose elective courses that they are passionate about and thus would likely be highly engaged.

Second, it would be critical in future studies to increase the length of the study both before and after the implementation of the engagement strategy. The week prior to the use of ETs was important to involve a control or baseline to compare any subsequent change to, however it was only one week, which is not a significant amount of time. Second, while the participants were comfortable taking the ETs within a week of their implementation, lengthening the study would make the engagement strategy become more a part of the routine than what appeared to some participants in passing conversation as a temporary situation.

Another limitation was the use of the two indices to measure engagement. While the RAPS and the Engagement vs. Disaffection teacher surveys have been used in many other studies to measure the level of student engagement, many of these studies have been corroborated with student feedback as well (Fredericks et al., 2011; Connell, 1998). While this study did involve participant feedback, the prompts for participant feedback did not align perfectly (i.e. the indices evaluated slightly different statements).

The snapshots for behavioral engagement were test run to see if they could be a valid measurement of engagement as perceived by the teacher. They were used in conjunction with the established measures (RAPS-T and EvsD indices) for verification purposes and as a safety-net measure. The results of this study indicate a strong correlation between the two overall indices (correlation coefficient, $r = 0.77$). While it might have been most effective to take more snapshots of each participant throughout the lessons, or for that matter, to even video record each class every day and later review the footage for engagement, neither of these options were feasible. While choosing to collect three snapshots each class was an arbitrary number, it was the most reasonable number that would allow for the duality of serving as both researcher and instructor.

The initial division of the participants into FE and FD cohorts must was arbitrary. While the RAPS-T was conducted before the study, this initial division of the participants was done on the basis of memory and anecdotal experiences alone, without the help of hard data. However, the subsequent data collected of the RAPS-T/EvsD report along with the snapshot scores and quiz scores indicates that there was indeed a difference between the cohorts. Even still, it was important to aggregate the data to see if the ETs made any difference at large.

Another limitation was the level of difficulty represented in the composition of the quiz and ET questions. While it was impossible to ensure that the difficulty of each ET was roughly the same, the researcher mitigated the possibility of difficulty with ETs by only using multiple choice and true/false questions, keeping the topics germane to the material covered in that particular class, and limiting the questions to equal or fewer than six such questions. Similarly, there was an attempt to keep the level of difficulty similar between the two quizzes. The researcher maintained some constraints by constructing the quiz questions to reflect only the material covered during the week prior to the quiz. Second, the quiz was announced the same amount of days prior to the assessment so that if participants studied for it, they had the same amount of time to prepare. Finally, the structure of the questions was the limited to multiple choice and fill-in-the-blank questions as another measure of mitigation.

Another limitation of this study was that it only attempted to measure behavioral engagement. We know that behavioral engagement is just one piece of the puzzle. Total engagement in school also includes emotional and cognitive engagement (Connell & Wellborn, 1991; Fredricks, Blumenfeld, & Paris, 2004). By only examining this one facet, ignores the fact that engagement is a three-tiered paradigm and one could argue, negates the importance of the remaining two factors. The researcher believes that there needs to be a concerted effort to engage

all dimensions of engagement, but at this time she found there a lack of reliable ways of measuring the other two facets and thus concluded on measuring ways to increase the most quantifiable dimension of engagement.

Implications for Future Research

This study demonstrates a practical application for measuring the engagement of students in a science classroom. While, the level of engagement throughout her classes varies according to many factors such as innate interest in the topic, interest in the lesson, personal circumstances that exist within the classroom/school context and outside school, it may be worthwhile to include such variables in future studies. The procedures for collecting data and the measurements used to evaluate behavioral engagement can and should continue to be refined to increase validity and reliability of the data. The "snapshots of engagement" can be replicated across many different classrooms across the curriculum with different teachers using various pedagogies to elicit more accurate data related to behavioral engagement.

The use of ETs as a strategy to increase behavioral engagement in this study presents a viable, if preliminary, set of conclusions. While this study supports the notion that ETs can be a valuable tool to increase such engagement, expansion and replication of this work with a greater participant pool can produce conclusions that are more distinctive and statistically significant.

Additionally, this study can be replicated using other engagement strategies that may add to the body of literature on the actual efficacy of engagement techniques, especially of those that are touted as especially effective tools.

While this study specifically addressed behavioral engagement among students, all engagement is related, and thus future studies that examine ways of increasing affective

engagement, cognitive engagement, in addition to purely measurement tools for those critical components in learning are possible avenues for further study.

Overall Significance of the Study

Engagement is an important component to learning. As Seth Peterson states in Sonia Nieto's (2005) influential text, *Why We Teach*, "learning is voluntary; it cannot be mandated" (p. 160). However, we can certainly help influence this choice by finding methods to encourage engagement. While testimony and anecdotal evidence is certainly a tried and true method for finding techniques to help facilitate engagement and thus learning, by finding ways to isolate and specifically identify methods of engagement can be of particular help to novice teachers who are beginning their career and are not aware or haven't developed certain techniques that they know work in the classroom. Conversely, we may be under the impression that some techniques are more efficacious than they really are, and through distilling one's practice and utilizing empirical research, we remove speculation and can potentially ascertain whether a particular technique is actually worth the work it takes to implement it.

On a personal level, this study has helped the researcher see students in new ways. Measuring participant engagement on a daily basis for an entire month demonstrated how engagement—even in the best of her students—can fluctuate depending on factors that are not always apparent immediately. The researcher was able to not only learn more about student engagement at the behavioral level from the participants, but was also able to incrementally and positively affect the learning for the participants.

About the Author

Amy Mastromonaco is a high school science teacher at a San Francisco Bay Area high school. She enjoys being able meld her love of science and passion for teaching together on a daily basis to help educate her high school students. Amy is eager to continue to widen her pedagogical repertoire of engagement strategies to find new ways to engage and teach her students about the natural world. She is excited to share what she has learned through the conclusion of this project with her colleagues.

Amy earned her Bachelor's degree in Behavioral Neuroscience from Lehigh University and her Single Subject Teaching Credential from Dominican University. She lives in San Francisco and enjoys taking advantage of the cultural events and outdoor activities the area is known for. When not grading or lesson planning, you can find Amy spending her free time with friends and family.

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Appendices

Appendix A

Exit Ticket scores for Frequently Engaged participants

Exit Ticket Scores for FE Participants													
Lesson	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Participant													
A1	1	1	1	0.8	0.8	1	0.75	1	1	1	1	0.86	93.42%
A2	1	0	0.5	0.2	0.18	1	0.5	1	0.6	1	0.71	0.75	62.00%
A3	1	1	1	0.6	0.92	1	1	0.75	0.5	1	1	0.92	89.08%
A4	1	1	0.75	0.8	0.8	0.75	1	1	1	0.8	1	0.92	90.17%
A5	1	1	0.75	0.4	0.5	ab	1	0.75	0.83	0.83	0.71	1	79.73%
A6	1	ab	1	0.6	0.75	1	0.89	1	0.9	1	0.9	1	91.27%
A7	1	1	1	0.8	0.83	1	1	1	1	1	1	1	96.92%
A8	1	1	0.5	0.6	0.83	1	1	0.75	0.8	0.86	1	1	86.17%
A9	1	ab	1	0.6	0.92	0.89	1	1	0.8	1	1	0.85	91.45%
A10	1	1	0.5	0.4	1	1	1	1	1	1	1	1	90.83%
A11	1	1	1	0.8	0.8	1	1	0.89	0.89	1	1	0.9	94.00%
A12	1	1	1	1	1	1	1	1	1	0.75	0.75	1	95.83%
A13	1	1	1	ab	1	0.69	0.69	1	1	0.6	1	1	90.73%
A14	1	1	1	0.88	0.88	0.88	0.88	1	1	1	1	1	96.00%
A15	1	1	1	0.8	0.8	0.81	0.81	0.89	0.89	1	1	1	91.67%
A16	1	1	0.5	1	1	0.82	0.82	1	1	0	1	1	84.50%
A17	1	0.5	0.5	0.6	0.6	0.94	0.94	1	1	1	1	1	84.00%
A18	1	0.5	1	1	1	0.75	0.75	1	1	0.6	0.71	0.71	83.50%
A19	1	0	1	0.8	0.8	1	1	1	1	1	1	1	88.33%
A20	1	1	0.75	0.6	0.8	0.92	0.9	1	1	1	0.9	0.86	89.42%
A21	1	1	1	0.6	0.6	0.58	1	1	0.9	0.9	1	ab	87.09%
A22	1	0.5	1	ab	0.94	0.95	0.89	0.9	0.75	0.75	0.9	1	87.09%
A23	1	1	1	0.4	0.5	0.88	0.9	0.78	0.8	ab	0.6	0.71	77.91%
A24	1	1	1	0.4	0.6	0.58	1	1	1	0.75	0.9	0.86	84.08%
A25	1	1	0.75	0.6	ab	0.9	0.2	1	1	ab	1	1	84.50%
												Mean	87.59%
								number of absences: 9				SD	0.0708

Appendix B

Exit Ticket scores for Frequently Disengaged participants

Exit Ticket Scores for FD Participants													
Lesson	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Participant													
B1	1	ab	1	0.8	0.88	0.63	0.89	ab	0.7	0.33	0.8	0.88	79.10%
B2	1	0.5	0.75	0.6	0.7	0.6	ab	ab	ab	0.8	0.75	0.6	70.00%
B3	1	1	1	0.4	0.67	0.6	0.75	0.6	1	0.75	0.85	1	80.17%
B4	1	0.5	0.5	0.6	0.5	0.4	0.75	0.75	1	0.75	0.8	0.75	69.17%
B5	a b	ab	ab	0.67	0.6	0.78	0.5	0.7	0.57	0.7	0.6	0.78	65.56%
B6	1	0.5	1	0.6	ab	0.89	0.89	ab	0.67	1	0.71	0.75	80.10%
B7	1	1	1	0.6	0.6	0.83	1	1	1	1	0.71	1	89.50%
B8	1	0.5	1	0.6	0.58	0.6	ab	ab	ab	0.83	0.75	1	76.22%
B9	1	1	1	0.4	0.5	0.6	0.78	ab	ab	0.85	0.89	0.67	76.90%
B10	1	0.5	0.5	0.6	1	1	0.56	1	0.7	0.71	0.75	0.6	74.33%
B11	1	0.5	0.75	0.8	0.8	0.69	0.69	0.78	0.78	0.7	0.6	0.71	73.33%
B12	1	0.5	0.75	0.6	0.6	0.75	0.75	ab	0.5	0.5	0.4	0.71	64.18%
B13	1	ab	ab	0.6	0.6	1	1	1	1	ab	0.67	0.86	85.89%
B14	1	1	1	0.8	0.8	1	1	0.75	0.75	0.67	1	0.57	86.17%
B15	1	0.5	0.75	0.4	1	1	0.89	0.89	1	1	0.9	1	86.08%
B16	1	1	0	0.8	0.8	0.58	0.6	1	1	0.8	0.8	0.71	75.75%
B17	1	0.5	0.75	ab	0.25	0.25	ab	0.5	0.5	0.6	0.6	0.86	58.10%
B18	1	1	0.5	0.6	0.6	0.69	1	1	0.75	0.75	0.67	0.86	78.50%
B19	1	1	0.5	0.4	0.4	1	1	1	1	0.86	0.8	0.86	81.83%
B20	1	0.5	0.5	0.8	0.8	0.69	0.7	0.71	0.71	1	1	0.5	74.25%
B21	1	1	0.75	0.8	0.75	0.8	1	1	1	0.34	0.88	0.88	85.00%
B22	1	1	0.75	0.6	0.6	0.75	0.8	0.4	0.4	0.5	0.88	0.65	69.42%
B23	1	0.5	ab	0.6	0.6	0.5	0.8	0.75	0.45	0.88	ab	ab	67.56%
B24	1	1	1	0.8	0.8	ab	0.6	0.6	0.5	ab	0.88	0.75	79.30%
B25	1	0.5	1	0.4	0.4	0.69	1	1	1	1	0.88	1	82.25%
												Mean	76.35%
								number of absences: 26				SD	0.0769

Appendix C

RAPS-T/EvsD report pre-Exit Tickets for FE participants

RAPS-T/EvsD Report Pre-Exit Tickets for FE Participants							
Item	1	2	3	4	5	6	Total Points
Participant							
A1	4	4	3	4	4	3	22
A2	3	4	2	4	3	2	18
A3	4	4	4	4	4	3	23
A4	4	4	4	4	4	4	24
A5	3	3	4	3	3	2	18
A6	4	4	4	4	3	3	22
A7	4	4	4	4	4	4	24
A8	4	4	3	4	4	3	22
A9	3	4	3	3	4	2	19
A10	3	4	4	3	3	4	21
A11	4	3	3	3	4	2	19
A12	4	4	4	3	3	3	21
A13	3	4	2	2	4	2	17
A14	4	4	4	3	4	2	21
A15	3	4	3	3	3	2	18
A16	4	4	4	4	4	4	24
A17	3	3	3	3	4	3	19
A18	4	4	3	4	4	2	21
A19	4	4	4	4	4	4	24
A20	4	4	4	4	4	4	24
A21	4	3	4	3	4	2	20
A22	3	4	4	2	4	2	19
A23	4	4	4	3	4	4	23
A24	3	4	4	2	4	2	19
A25	3	3	4	3	4	2	19
					Mean		20.79
					SD		2.22

Appendix D

RAPS-T/EvsD report pre-Exit Tickets for FD students

RAPS-T/EvsD Report Pre-Exit Tickets For FD students							
Item	1	2	3	4	5	6	Total Points
Student							
B1	1	2	1	1	2	1	8
B2	2	2	1	1	2	1	9
B3	1	3	3	2	2	1	12
B4	1	1	1	1	1	1	6
B5	2	3	2	2	2	1	12
B6	3	2	3	1	2	1	12
B7	3	3	2	2	3	2	15
B8	2	1	4	1	2	1	11
B9	2	1	3	1	3	1	11
B10	1	1	2	1	1	1	7
B11	2	1	1	1	3	1	9
B12	1	1	1	1	1	1	6
B13	2	1	2	2	2	2	11
B14	3	3	2	3	3	3	17
B15	2	2	2	2	2	2	12
B16	2	2	2	1	2	1	10
B17	1	1	1	1	1	1	6
B18	3	3	2	2	3	2	15
B19	2	2	2	2	2	2	12
B20	2	2	2	2	2	1	11
B21	3	1	3	1	2	1	11
B22	2	2	1	1	2	1	9
B23	2	1	1	1	2	1	8
B24	3	2	3	1	2	1	12
B25	2	1	4	1	3	1	12
					Mean		10.56
					SD		2.77

Appendix E

RAPS-T/EvsD report after-Exit Tickets for FE students

RAPS-T/EvsD Report During Exit Tickets for FE Participants							
Item	1	2	3	4	5	6	Total Points
Student							
A1	4	4	4	4	4	3	23
A2	4	4	3	4	4	2	21
A3	4	4	4	4	4	4	24
A4	4	4	4	4	4	4	24
A5	4	4	3	4	4	3	22
A6	4	4	4	4	4	4	24
A7	4	4	4	4	4	4	24
A8	4	4	3	4	4	3	22
A9	4	4	3	4	4	2	21
A10	3	4	4	3	3	4	21
A11	4	4	3	4	4	3	22
A12	4	4	4	3	4	3	22
A13	4	4	3	2	4	2	19
A14	4	4	4	3	4	2	21
A15	4	4	4	3	3	2	20
A16	4	4	4	4	4	4	24
A17	4	3	4	3	4	3	21
A18	4	4	3	4	4	2	21
A19	4	4	4	4	4	4	24
A20	4	4	4	4	4	4	24
A21	4	3	4	3	4	2	20
A22	3	4	4	2	4	2	19
A23	4	4	4	3	4	4	23
A24	4	4	4	3	4	2	21
A25	3	3	4	3	4	2	19
					Mean		21.84
					SD		1.69

Appendix F

RAPS-T/EvsD report after-Exit Tickets for FD students

RAPS-T/EvsD Report During-Exit Tickets for FD students							
Item	1	2	3	4	5	6	Total Points
Participant							
B1	2	2	2	1	3	1	11
B2	3	2	3	3	3	1	15
B3	3	3	4	3	4	1	18
B4	3	2	2	2	3	1	13
B5	3	3	3	2	4	2	17
B6	3	2	4	2	3	1	15
B7	3	3	4	2	4	2	18
B8	3	1	4	2	4	3	17
B9	4	1	4	1	4	1	15
B10	2	2	3	2	3	1	13
B11	3	2	3	1	3	2	14
B12	1	1	1	2	3	1	9
B13	4	1	2	3	4	2	16
B14	3	4	3	3	4	3	20
B15	3	3	3	2	3	2	16
B16	2	3	3	1	3	1	13
B17	2	1	1	1	3	1	9
B18	3	3	3	3	3	2	17
B19	3	2	3	2	3	2	15
B20	3	2	3	2	3	1	14
B21	4	1	4	1	3	1	14
B22	3	3	1	2	3	1	13
B23	2	2	3	1	3	1	12
B24	3	2	4	1	3	2	15
B25	3	2	4	2	3	1	15
						Mean	14.56
						SD	2.59

Appendix G

Quiz scores for FE Participants

Quiz Scores for FE participants					
Participants	Pre-Exit Raw	Percentage	After ET Raw	Percentage	Percentage Change
A1	9	100.00%	36	90.00%	-10.00%
A2	6	66.67%	27	67.50%	0.83%
A3	8	88.89%	38	95.00%	6.11%
A4	9	100.00%	38	95.00%	-5.00%
A5	5	55.56%	32	80.00%	24.44%
A6	7	77.78%	38	95.00%	17.22%
A7	6	66.67%	39	97.50%	30.83%
A8	8	88.89%	38	95.00%	6.11%
A9	8	88.89%	36.5	91.25%	2.36%
A10	5	55.56%	38	95.00%	39.44%
A11	8	88.89%	33	82.50%	-6.39%
A12	8.5	94.44%	38.5	96.25%	1.81%
A13	6	66.67%	30	75.00%	8.33%
A14	8	88.89%	35	87.50%	-1.39%
A15	6	66.67%	33.5	83.75%	17.08%
A16	9	100.00%	30	75.00%	-25.00%
A17	9	100.00%	40	100.00%	0.00%
A18	5	55.56%	38	95.00%	39.44%
A19	9	100.00%	39	97.50%	-2.50%
A20	9	100.00%	40	100.00%	0.00%
A21	7	77.78%	32	80.00%	2.22%
A22	8	88.89%	40	100.00%	11.11%
A23	7	77.78%	29	72.50%	-5.28%
A24	9	100.00%	32	80.00%	-20.00%
A25	7	77.78%	33	82.50%	4.72%
	Mean	82.89%	Mean	88.35%	5.46%
	SD	0.15	SD	0.09	0.16

Appendix H

Quiz scores for FD students

Quiz Scores for FD Participants					
Partcipant	Pre-Exit Raw	Percentage	After ET Raw	Percentage	Percentage Change
B1	7	77.78%	26	65.00%	-12.78%
B2	6	66.67%	25	62.50%	-4.17%
B3	7	77.78%	29	72.50%	-5.28%
B4	2	22.22%	33	82.50%	60.28%
B5	8	88.89%	26	65.00%	-23.89%
B6	5	55.56%	26.5	66.25%	10.69%
B7	3	33.33%	28.5	71.25%	37.92%
B8	7	77.78%	33.5	83.75%	5.97%
B9	5	55.56%	24.5	61.25%	5.69%
B10	7	77.78%	29	72.50%	-5.28%
B11	6	66.67%	29	72.50%	5.83%
B12	5	55.56%	22	55.00%	-0.56%
B13	7	77.78%	32	80.00%	2.22%
B14	5	55.56%	24	60.00%	4.44%
B15	6	66.67%	29	72.50%	5.83%
B16	7	77.78%	37	92.50%	14.72%
B17	3	33.33%	20	50.00%	16.67%
B18	8	88.89%	28	70.00%	-18.89%
B19	6	66.67%	28	70.00%	3.33%
B20	4	44.44%	21	52.50%	8.06%
B21	9	100.00%	34	85.00%	-15.00%
B22	8	88.89%	29	72.50%	-16.39%
B23	6	66.67%	28	70.00%	3.33%
B24	5	55.56%	32	80.00%	24.44%
B25	6	66.67%	38	95.00%	28.33%
	Mean	65.78%	Mean	71.20%	5.42%
	SD	0.19	SD	0.11	0.18

Appendix I

Snapshot points for FE students pre-Exit Tickets

Behavioral Engagement Snapshot Points Pre-Exit Tickets for FE students							
Lesson	1	2	3	4	Total Points		Mean
Student							
A1	12	12	12	12		48	12
A2	0	12	12	12		36	9
A3	10	12	12	11		45	11.25
A4	12	12	12	12		48	12
A5	12	12	10	10		44	11
A6	12	12	12	12		48	12
A7	12	12	12	12		48	12
A8	12	12	12	12		48	12
A9	10	10	10	10		40	10
A10	12	9	9	9		39	9.75
A11	12	12	12	12		48	12
A12	12	11	10	12		45	11.25
A13	11	12	12	11		46	11.5
A14	0	12	12	11		35	8.75
A15	11	12	12	12		47	11.75
A16	0	12	12	12		36	9
A17	12	12	12	12		48	12
A18	12	12	12	12		48	12
A19	12	12	12	12		48	12
A20	10	12	12	12		46	11.5
A21	12	12	12	12		48	12
A22	12	10	12	12		46	11.5
A23	12	12	11	11		46	11.5
A24	10	10	10	10		40	10
A25	10	0	0	10		20	5
		number of absences: 5			Mean	43.46	10.91
					SD	6.41	1.60

Appendix J

Snapshot points for FD students pre-Exit Tickets

Behavioral Engagement Snapshot Points Pre-Exit Tickets for FD students							
Lesson	1	2	3	4	Total Points		Mean
Student							
B1	4	9	5	9		27	6.75
B2	4	7	7	7		25	6.25
B3	9	8	7	9		33	8.25
B4	4	7	7	4		22	5.5
B5	7	9	5	4		25	6.25
B6	7	6	6	6		25	6.25
B7	9	8	6	6		29	7.25
B8	9	0	6	8		23	5.75
B9	0	0	0	9		9	2.25
B10	7	7	7	5		26	6.5
B11	6	8	7	6		27	6.75
B12	6	8	6	7		27	6.75
B13	8	9	0	0		17	4.25
B14	6	6	8	7		27	6.75
B15	4	10	0	10		24	6
B16	10	0	8	8		26	6.5
B17	8	8	8	7		31	7.75
B18	7	7	7	7		28	7
B19	6	8	0	7		21	5.25
B20	10	6	9	7		32	8
B21	6	5	6	5		22	5.5
B22	8	7	7	8		30	7.5
B23	6	9	8	7		30	7.5
B24	6	5	5	8		24	6
B25	12	6	9	8		35	8.75
		number of absences: 8			Mean	25.8	6.45
					SD	5.24	1.28

Appendix K

Snapshot points for FE students during-Exit Tickets

Behavioral Engagement Snapshot Points During-Exit Tickets for FE students														
Lesson	1	2	3	4	5	6	7	8	9	10	11	12	Total pts	Avg
Student														
A1	12	11	12	10	12	12	10	11	12	12	12	12	138	11.50
A2	11	11	12	11	11	11	11	12	12	12	12	12	138	11.50
A3	12	9	12	11	12	10	12	11	10	12	12	12	135	11.25
A4	12	12	12	12	10	10	12	12	12	12	11	11	138	11.50
A5	12	12	10	11	12	0	10	11	12	11	11	11	123	10.25
A6	10	0	11	12	12	8	9	12	10	10	10	12	116	9.67
A7	12	9	12	12	12	11	11	10	12	12	12	12	137	11.42
A8	12	11	10	12	12	11	12	12	12	12	12	12	140	11.67
A9	12	0	11	10	12	12	12	12	12	9	9	11	122	10.17
A10	12	9	10	12	9	9	9	10	12	12	10	10	124	10.33
A11	12	12	11	12	9	12	11	12	12	9	9	12	133	11.08
A12	12	11	11	12	12	11	11	11	12	11	12	12	138	11.50
A13	12	11	11	0	12	12	12	12	12	10	10	12	126	10.50
A14	10	11	11	12	12	9	12	10	12	11	10	11	131	10.92
A15	12	12	10	12	10	12	11	12	12	12	12	12	139	11.58
A16	12	12	12	12	12	12	11	11	12	12	12	12	142	11.83
A17	12	10	10	11	12	12	12	12	12	12	11	11	137	11.42
A18	12	10	12	12	12	12	12	12	12	11	12	9	138	11.50
A19	12	10	10	11	11	12	11	12	12	12	12	12	137	11.42
A20	12	12	12	12	12	12	12	12	12	12	12	12	144	12.00
A21	12	12	12	12	11	11	12	10	12	12	12	0	128	10.67
A22	12	10	10	0	12	12	12	12	12	12	12	12	128	10.67
A23	12	12	12	12	12	12	12	12	12	0	12	12	132	11.00
A24	12	10	10	10	12	11	11	11	12	12	12	12	135	11.25
A25	12	12	10	11	0	12	12	12	11	0	12	10	114	9.50
						number of absences: 9						avg	132.52	11.04
												SD	7.79	0.65

Appendix L

Snapshot points for FD students during-Exit Tickets

Behavioral Engagement Snapshot Points During-Exit Tickets for FD students														
Lesson	1	2	3	4	5	6	7	8	9	10	11	12	Total pts	Avg
Student														
B1	7	0	7	8	10	8	10	0	9	8	10	9	86	9
B2	7	7	8	7	8	8	0	0	0	10	9	8	72	6.75
B3	9	9	9	8	9	10	9	11	10	12	8	8	112	9.5
B4	7	7	6	8	11	8	9	9	7	8	8	7	95	7.5
B5	0	0	0	8	11	10	9	8	9	9	12	10	86	10
B6	10	11	9	9	0	10	9	0	12	12	12	10	104	11.5
B7	9	9	9	10	12	12	11	10	9	12	11	12	126	11
B8	8	8	8	12	12	11	0	0	0	12	11	12	94	8.75
B9	7	8	10	12	9	11	10	0	0	10	10	11	98	7.75
B10	6	8	8	9	8	9	9	8	6	7	10	8	96	7.75
B11	6	10	10	10	8	6	7	10	11	9	7	10	104	9.25
B12	11	9	8	10	7	8	5	0	10	6	9	7	90	8
B13	12	0	0	11	9	9	10	10	12	0	12	9	94	8.25
B14	12	10	11	10	8	9	10	9	9	9	9	11	117	9.5
B15	10	10	11	10	9	11	10	10	11	12	11	12	127	11.5
B16	8	9	9	10	9	10	11	11	11	9	9	9	115	9.5
B17	9	9	10	0	8	8	0	9	10	9	9	6	87	8.5
B18	8	9	9	10	10	9	10	9	9	9	10	10	112	9.5
B19	6	8	8	9	9	9	8	8	12	10	9	9	105	10
B20	8	7	8	7	7	8	8	7	9	8	10	11	98	9.5
B21	6	6	8	6	6	12	12	6	12	6	6	7	93	7.75
B22	8	8	8	9	10	9	8	9	10	10	8	8	105	9
B23	8	7	0	8	10	8	8	10	5	10	0	0	74	3.75
B24	12	10	9	9	9	0	10	10	12	0	10	11	102	8.25
B25	9	9	12	10	11	10	10	9	11	10	9	11	121	10.25
							number of absences: 27					avg	100.52	8.88
												SD	14.17	1.59

Appendix M

FE Participant feedback on Exit Tickets

Participant Feedback										
#	1	2	3	4	5	6	7	8	9	comments
FE Ss										
A1	3	3	4	2	4	3	3	2	4	na
A2	5	4	5	3	3	4	4	3	4	I thought they really helped figure out how well I actually knew the material, and where I stood in terms of how much to study
A3	2	2	3	1	5	1	4	1	1	I have had exit tickets in other classes, and I don't think they help me that much. I would rather use the extra five minutes to study or start homework.
A4	5	5	5	1	1	4	5	1	4	I like having Exit Tickets but don't want to push for it if the majority says no.
A5	5	4	5	2	4	na	1	3	5	at first I thought the exit tickts were going to be annoying but once we downloaded the app I thought they were super nice and effective. It made me want to stay focused and engaged. It hink they are a good addition to the class and I think they should be worth points
A6	4	4	4	2	5	1	4	2	3	No opinion for them
A7	4	2	2	1	4	3	5	2	4	Nope.
A8	4	4	5	3	3	3	4	2	5	n/a
A9	4	3	4	1	4	na	4	1	4	not bad…don't really mind them
A10										
A11	4	4	4	2	3	5	3	2	5	I liked having exit tickets and thought they were a good way to conclude class and review main concepts from the material we learned.
A12	3	2	4	3	5	2	4	2	4	x
A13	2	2	3	3	4	1	5	3	3	x
A14	3	3	4	3	2	4	5	2	4	I liked to get 100% because they were pretty easy in small amounts, an it was stuff we had learned that day, and was fresh in my mind.
A15	2	2	4	1	4	4	4	1	2	x
A16	4	3	2	5	5	2	5	4	1	x
A17	5	5	5	5	3	1	5	3	5	I hate them but they help. It makes you pay attention but not be able to relax in class.
A18	2	2	2	2	5	1	3	2	3	x
A19	4	4	4	4	2	3	5	3	4	x
A20	3	3	4	2	4	3	4	2	4	I don't mind them, but I'm not sure they are having an impact on my learning.
A21	4	4	5	5	2	2	5	2	4	seeing our scores on the exit tickets right away was helpful--if we could go back and review the answers that would help us learn too
A22	1	2	4	1	5	4	4	1	1	Don't really see much of a point, I didn't really care about it.
A23	4	3	4	1	2	4	3	4	4	x
A24	5	5		5	2	4	5	5	5	Would be fine if they did not negatively impact my/other's grade. Would be more useful if you could go back and review them before an exam
A25	5	4	4	2	3	5	5	4	5	I liked them, some questions were too specific to the class that day.
Mode	4	4	4	2	4	4	5	2	4	

Appendix N

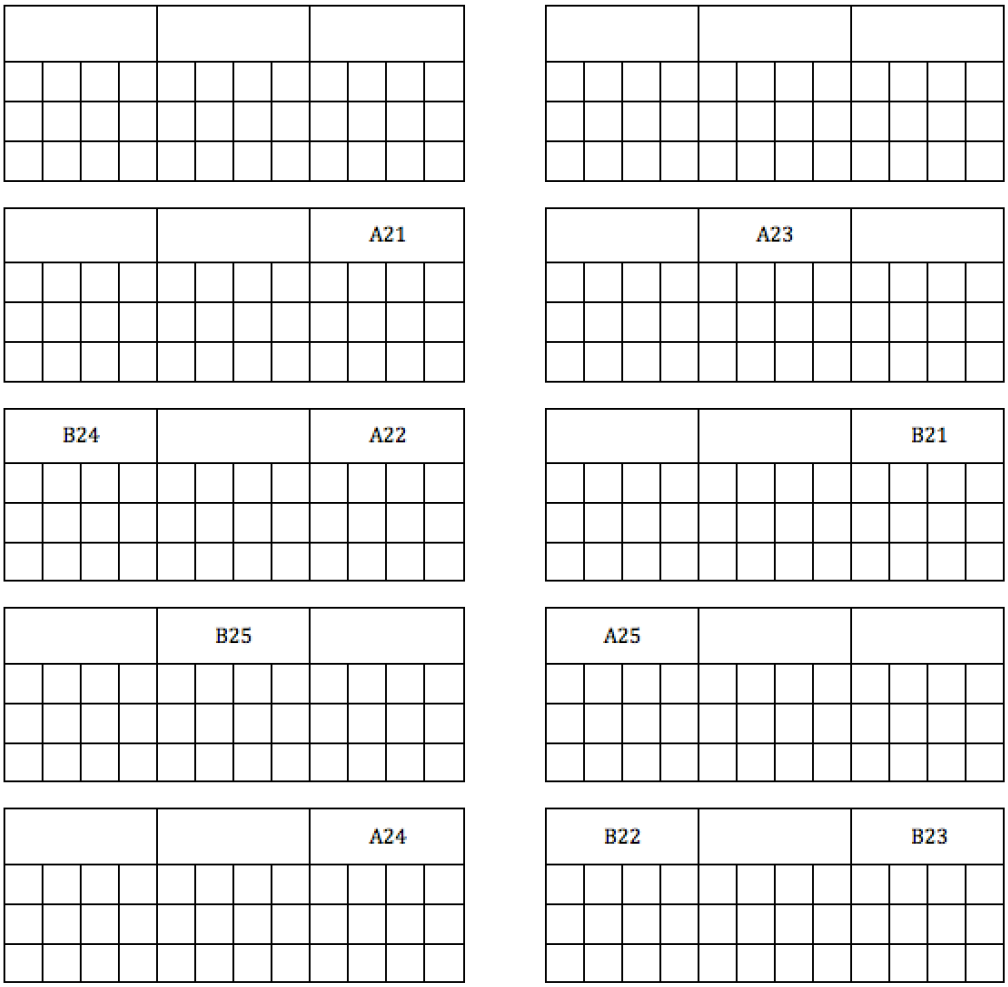
FD Student feedback on Exit Tickets

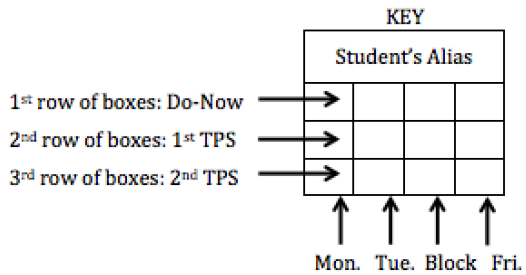
Student Feedback										
#	1	2	3	4	5	6	7	8	9	comments
FD Ss										
B1	4	4	4	4	4	4	4	4	4	x
B2										
B3	1	3	3	3	3	3	3	3	3	No
B4	4	3	3	4	3	2	5	5	3	too hard something I would really pay attention and still fail on it
B5	4	4	3	3	3	4	4	3	5	they helped me a lot to learn the material better
B6	4	4	3	2	2	4	5	3	4	Keep them but make them more interesting
B7	2	2	3	3	2	1	4	2	2	I always just ended up doing it with someone to ensure a good grade. I didn't actually think about them.
B8	3	2	3	3	4	2	5	4	3	We needed more time to do them
B9	4	3	4	3	3	3	3	2	3	I had a lot of trouble with the app and I forgot my password and it didn't save my password.
B10										
B11	3	3	4	4	4	3	3	1	3	x
B12	4	4	2	3	5	3	5	4	3	x
B13										
B14	5	5	5	4	1	5	5	3	5	I really liked them and I hope you keep doing them! I liked them because they were a good conclusion to the class day. It showed me the key points. I liked it.
B15	2	1	2	3	4	3	5	3	2	They started off extremely hard, which stressed me out because I was failing them, then they got easier. I think they can be very beneficial to you as a teacher so you know what we do or don't know. Maybe don't grade them. Also- people easily search answers up on the internet or use their notes in front or ask other people --> defeats purpose. if you told people it is for your own benefit so you can be better informed about where we are at, then i think people wouldn't cheat--> because that would be in everyone's best interest
B16	3	3	3	4	2	1	3	3	3	I don't believe they help us learn, and the time could be better spent.
B17	2	2	4	3	5	1	5	3	4	for exit ticket I don't think they should count towards our grade but I think they are helpful and I wouldn't mind doing them if it didn't' go towards our grade
B18	4	4	4	1	2	3	5	3	2	I didn't know that they were graded at first so I BS-ed my way through the first few before I realized that they were.
B19	4	3	3	3	2	3	5	2	5	I like them :)
B20	4	3	3	4	3	2	4	3	3	x
B21	1	1	2	3	5	3	3	1	1	x
B22	4	4	4	4	4	3	5	2	2	x
B23										
B24										
B25	4	4	5	3	3	5	3	2	5	No
Mode	4	4	3	3	3	3	5	3	3	

Appendix O

Example of weekly seating chart for recording snapshot scores.

Week 1 – Pre-Exit Tickets Seating Chart – 7th Period





Appendix P

Participant and Participant Guardian Introduction Letter

January 7, 2015

Dear Student and Parent/Guardian,

This semester I will be conducting a study on the effectiveness of different engagement strategies for my Integrated Science 4 students. This study will take place during the Vertebrate Evolution unit of study. This research project will be part of my thesis work, a requirement for the Master's in Education program at Dominican University of California.

Studies have shown that student engagement can increase student learning (and therefore performance and grades), so I intend to find and implement strategies that facilitate consistent engagement in my science classes. I will determine through observation, informal student feedback, and student work, whether or not the strategies have been helpful to student learning.

No additional work is required of the students; I will not be handing out surveys, or asking them to do any extra work that is for my benefit. All the strategies being implemented will be with the objective of increasing engagement and thus learning. Ideally, I will identify strategies that are particularly helpful in student learning and continue to utilize them in subsequent lessons. All of my students' identities and any work collected will be kept confidential.

If you have any questions or concerns regarding this project, please feel free to contact me directly.

I will be working closely with my advisor, Dr. Madalienne Peters, who may be reached at 415-485-3285. You may also contact the Dominican University of California Institutional Review Board for the Protection of Human Subjects (IRBPHS), which is concerned with the protection of participants in research projects. Participants and/or their parent/guardian may reach the IRBPHS Office by calling (415) 482-3547 and leaving a voicemail message, by FAX at (415) 257-0165 by writing to the IRBPHS, Office of the Associate Vice President for Academic Affairs, Dominican University of California, 50 Acacia Avenue, San Rafael, CA 94901.

Thank you,

Amy Mastromonaco

Appendix Q

Principal Consent To Conduct Study

PRINCIPAL CONSENT TO CONDUCT STUDY

1. I understand that Amy Mastromonaco is requesting my approval to conduct a Teacher Action Research at Redwood High School. This research is part of the effort of Ms. Mastromonaco to understand the efficacy of engagement strategies within the context of a Vertebrate Evolution unit taught in her classes to her students.
2. I understand that allowing Ms. Mastromonaco to conduct her research involves the implementation of engagement strategies that may affect the learning of the students.
3. I understand that student participation in this study will be as part of normal teaching occurring during a group lesson, and may be beneficial to student learning.
4. Student responses to the lessons will be analyzed for themes. Only the researcher and her advisor will see analysis. One year after the completion of the research, all written materials will be destroyed.
5. I am aware that Ms. Mastromonaco will provide a written summary of the relevant findings and conclusions of this project to me and to any interested participants. Such results will not be available until June 1, 2015.
6. I understand that if I, participants, or participants' parents or guardians have any further questions about the study, I/they may contact at Dr. Madalienne Peters 415-485-3285. If I/ participants/participants parents /guardians have any further questions or comments about participation in this study, I/they may contact the Dominican University of California Institutional Review Board for the Protection of Human Subjects (IRBPHS), which is concerned with the protection of volunteers in research projects. Participants may reach the IRBPHS Office by calling (415) 482-3547 and leaving a voicemail message, by FAX at (415) 257-0165 by writing to the IRBPHS, Office of the Associate Vice President for Academic Affairs, Dominican University of California, 50 Acacia Avenue, San Rafael, CA 94901.
7. All procedures related to this research project have been satisfactorily explained to me prior to my permission to allow the researcher to implement the study.

I HAVE READ AND UNDERSTAND ALL OF THE ABOVE EXPLANATION REGARDING THIS STUDY. I VOLUNTARILY AGREE TO GIVE MY CONSENT FOR THE RESEARCHER TO CONDUCT THE STUDY. A COPY OF THIS FORM HAS BEEN GIVEN TO ME FOR FUTURE REFERENCE.

Signature

2/23/15

Date