

THE USE OF FORMATIVE DATA TO TRACK STUDENT
PROGRESSION TOWARDS CLASS GOALS
IN MIDDLE SCHOOL SCIENCE

by

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DEDICATION

I dedicate this paper to my students whom served as excellent subjects in my investigation into how to help them become better students and masters of the 8th grade science content. May you continue to reach the goals you set.

ACKNOWLEDGEMENT

This paper would not be possible without the support of my fellow teachers at Perry Middle School whom assisted me in running the treatment in my classroom. I also would like to acknowledge my children who played quietly while I spent endless hours working on this paper. Without their patience and understanding this paper would not have been possible.

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ABSTRACT

Goal setting has been shown to increase student motivation in science but not to lead to higher performance. The ability of students to perform metacognitive processes has been called into questioning as its use is pushed to younger grade levels. Standards based goal setting was implemented this year in Perry Middle School with mixed results. The purpose of this study was to determine if tracking formative scores helped students to accurately evaluate what they know in science, increase their motivation, and raise achievement in science. Students were evaluated on metacognition, motivation, achievement, and attendance in tutoring sessions during our earth science unit. The data suggested that student used more metacognitive processes but were not more accurate in determining what they knew and did not know. Student motivation and achievement did increase, but not substantially more than the control group. Students tracking formative data did attend more help sessions than students in the control group. However, in interviews and Goal Setting Surveys, students from the treatment group reported greater dissatisfaction with the goal tracking, rated the sheets less helpful to their learning, and reported they took too long to complete compared to the control group. Therefore, it is the determination of this study that using formative scores to track goal progress did not achieve all the goals I hoped it would, but did help my 8th grade honors science students to advance in their metacognitive processes. It is my recommendation that further studies be conducted to determine if tracking progress towards standards goals via another metacognitive strategy is more helpful.

INTRODUCTION AND BACKGROUND

In the middle grade levels, science changes from being a half-year occasional subject to a full year class. The content becomes more rigorous and the standards demand higher level thinking skills. Students reach a point where they find they cannot perform well without additional practice and studying. The additional workload and the complexity of the topic leaves many students disliking the class and feeling powerless to be successful. Students begin to doubt their ability and as a result, they lose focus and stop paying attention. Stefan (2010) found that “51% of students in 8th grade feel science, specifically physics, is difficult for them, and 25% admitted to not studying at all for the class” (p. 9-10). How can we bridge this gap and increase student confidence while still maintaining rigor?

The nation needs more students trained in science. So, we are tasked with changing the momentum and empowering the students to believe they can do science. Students need a way to see what they need to know and how to get there. Armed with this knowledge they will gain increased confidence. Teachers study data to manage and guide students’ learning. Could that not also be the case for the students? What if the students aimed to track and manage their own data? What if they were given the power and the resources to help bridge the gaps and achieve their goals? What if the information was broken down into segments they could understand and master piece by piece? What if students were given the feeling that they were in control of their learning, that they were powerful and capable? Might they then start to see themselves not as

helpless and overwhelmed, but as a soldier marching through the content armed and ready? It was the intent of this study to discover just that.

This study was conducted at Perry Middle School in Perry, Ohio with students in 8th grade honors science. One 8th grade honors science class consisted of 25 students and served as the treatment group. This group received goal-tracking sheets with lines added for them to use formative data to assist with goal tracking (Appendix A). This data included scores on homework, quizzes, and labs. The other honors class consisted of 22 honors students. They served as the control group. The control group completed the standard goal tracking sheet the students were accustomed to using (Appendix B). This sheet has students self-assess their progress towards set standards based goals. Both groups of students used the goal tracking sheets to monitor their success and were provided opportunities to obtain additional help. All learning activities were consistent between the two classes. Perry Middle School is a suburban middle school of approximately 572 students in grades 5th through 8th, 27.8% of the student body is socio-economically disadvantaged and 5.4% are non-English native speakers. This research was specifically devised to determine if student led data tracking towards learning targets would increase student motivation and learning in the 8th grade science classroom. It sought to answer the primary research question: will the addition of formative assessments on the goal tracking sheets contribute to student success?

Additionally, the following sub-questions were developed:

1. Will this treatment increase the accuracy of students' perception of their knowledge and thereby increase their metacognition?

2. Does having a clear understanding of where they are in their learning increase the motivation of students to obtain their learning goals?
3. Will this result in higher levels of achievement in their science classroom?
4. Will students not reaching their goals be more motivated to seek out further assistance?

Through these questions I hoped to increase student achievement, motivation, and metacognition through formative analysis and goal tracking in 8th grade honors science.

CONCEPTUAL FRAMEWORK

There is ample research on how to motivate and focus student learning. The reason for this research is that without focus and interest in the content, students do not learn at the same depth as a student that is motivated to learn. One major aspect of student motivation is the students' attitude about the subject, the class, and their ability to be successful within the context of the classroom. Students need to see and believe they can be successful to develop the motivation to do well.

One method teachers are using to motivate and focus learning is goal setting. Having students set goals can help them to see that the goals of the content are attainable. Setting goals that focus on achieving content and tasks is more conducive to student motivation than setting goals based on student ability (Anderman, 1997). Reaching these goals builds confidence in the student. Other research points to the use of goals as a means to achieve self-regulation for students (Pintrich, 2000). Monitoring their personal progress towards the goals allows students to determine their course of action and focus

their studying. This allows them to develop the ability to self-regulate their learning. Self-regulation and self-assessment can help students see progress and growth in their knowledge and ability and can provide for additional motivation in the classroom setting.

An integral part of motivating students is helping them to develop a positive attitude about both the content they are learning and their ability to achieve mastery of the content. Anderman (1998) wrote about attribution theory as a means of understanding how educational experience motivates students. He states, “The first point to be emphasized is that students' perceptions of their educational experiences generally influence their motivation more than the actual, objective reality of those experiences” (p. 2). It is the student's view of their achievement and their ability that has the greatest impact on their motivation to learn the content. Not only is their opinion of why they are successful important, we must also evaluate their opinion of their reasoning for failure. Anderman (1998) found that “students' attributions for failure are also important influences on motivation” and that “if students attribute their poor performance to a lack of important skills or to poor study habits, they are more likely to persist in the future” (p. 2). Therefore, as educators we must guide students to see both their successes towards competency and provide a structure in which all students can achieve competency in the content studied. If students feel powerless to reach these goals set forth by others, they will begin to feel deflated and lose interest and motivation in the classroom. According to Stefan (2010), “Students’ attitudes are considered to be a key component in the students’ appropriating their competences within Natural Sciences and Math and they include the students’ motivation, interest and sense of self-effectiveness” (p. 7). Helping

students to see their success in the classroom and their growth towards meeting the standards should increase the motivation of the student towards these goals.

One means of increasing student motivation and developing self-regulated learners is to establish and track student achievement towards specific goals within the classroom. A self-regulated learner is a student that can identify where they are, where they need to be, and then take the necessary steps to get to their goal. The use of goal sheets provides a method to guide students in the goal setting process. Anderman (1998) states the use of “goal theory focuses on the reasons or purposes students perceive for achieving” (p. 2). Students given a particular goal will be more focused on achieving that goal. However, the method and types of goals set does have an influence on student learning and student motivation. Mensah (2015) showed us that students’ typically set grade based goals and not learning goals. The setting of the goals needs to be monitored by the instructor, as Anderman found “studies of students' goal orientations generally find that the adoption of task goals is associated with more adaptive patterns of learning than is the adoption of ability goals” (p. 3). Changing the student focus from getting a good grade to mastering and growing in their content knowledge can affect the students’ motivation towards those goals. Likewise, the environment for goal setting established by the teacher will also play a role in student motivation. Farrell (2015) found that most teachers set up performance oriented classrooms despite the research that this style of goal setting can serve to demotivate student learning. They also found that teachers using performance based goal setting “provided limited opportunity for student involvement, instead showing prepared data displays and telling students how to interpret the

information” (p.19). Teachers provided little guidance about what students should study or revisit in the performance model.

Therefore, based on the research, we need to adopt a mastery based learning model for goal setting. Mensah (2015) advises “Reorienting middle level classroom goal structure to change students’ learning attitudes requires the incorporation of best practices in classroom routines. These routines should guide students to set standards for their own performance, not in terms of how others perform but viewing the development of new skills as a necessary outcome of their learning tasks (p. 29). Anderson agreed and stated, “Students with a task goal orientation focus on their own progress in mastering skills and knowledge, and they define success in those terms” (p. 3). Simply put, allowing students to see their growth towards set task and content goals motivates students and increases their confidence in their ability to reach the content.

Teachers that establish mastery oriented learning, according to Farrell (2015), focus on the belief that “the data will identify gaps in student learning allow for students and teachers to address those gaps” in novel ways (p. 20). In reference to mastery-goal orientation, Eccles states, “teachers emphasize mastery of material, understanding the work, and investment of effort to provide students with meaningful learning” (p.227). Goals set in this environment tend to lead student to higher levels of motivation. Allowing students to set task goals and self-assess their progression towards task mastery may increase the focus and motivation of students eventually leading to a self-regulated learner.

Pintrich (2000) defines self-regulated learning, or self-regulation, as “an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment” (p. 453). Developing a self-regulated learner requires the development of a specific skill set. Schloemer (2006) describes the process of SRL (Student Regulated Learner) as goal setting, self-monitoring, and modifying learning activities. Having students set goals and track their progress allows them to begin the journey to self-regulation.

One aspect of self-regulation is the ability to self-assess. According to Severance (2012) “Students who are able to self-assess become better critical thinkers and are more self-aware” (p. 1). However, it should be noted that in Severance’s research in 2012 she found no correlation between students’ discrepancy value and their scores on the final assessment. This would imply that there is no correlation between students self-assessing their growth towards a goal and their achievement in the course. Severance (2012) went on to question “If students showed their ability to articulate what they know and do not know, then why weren’t the assessment scores higher for those students?” (p. 353). She further extrapolated, “I believe the missing piece is what the students do with this information” (p. 353).

Upon further evaluation, additional steps are necessary in middle school for students to self-regulate their learning. According to Severance (2012) Teachers must use caution as students in middle school can “assess their knowledge, but they may not have the motivation or developmental capability to address those needs independently in

order to influence assessment scores” (p. 354). Frye (2010) addressed this issue in her research by applying a reteach or extend module into her classroom. She had “Students who mastered the identified standards skip the reteach module and were given an enrichment activity consisting of an additional experiment that reinforce the standards” (p. 62), thus providing the what to do with the information link that Severance was missing. Anderman advised, “Teachers can help their students develop their self-regulation by providing limited choices between acceptable options, by assisting with breaking large tasks into manageable pieces, and by providing guidelines for students to use in monitoring their own progress” (p. 5).

Overall, the process of developing the skill set for self-regulation requires multiple steps. Students must have identified goals, assistance with data tracking, and guidance on what to do with this knowledge to make it useful for them. This advising of goals and assisting in monitoring is important as Boller (2008) found that students at the middle grades had difficulty organizing and breaking down assignments and this difficulty led to decreased motivation. Research attempting to motivate students through the use of self-regulated goal setting will need to provide for re-teaching opportunities and specific guided goal setting techniques to direct student learning. Schloemer (2006) advises that when students fall short of goals “Following advice like, “try harder,” may not result in success” (p. 81). Also, McMillan (2014) found that in order for self-regulation to be beneficial towards achievement on assessments, mistakes and errors must be viewed as a part of learning and as a step towards mastery of the content. With

guidance, middle school students can learn to self-regulate their learning and in the process, find success and increase motivation towards learning the science content.

Goal setting with students is a skill that must be refined and practiced. There are many strategies that exist to assist students in setting goals and in monitoring their learning. Patel (2012) suggests that the unit begin with a lesson on goal setting and follow with self-monitoring. Patel states that “Self-monitoring may include student-documented homework logs and student-logged grade record sheets” (p. 2). Patel’s study further used daily informal journaling and weekly reflective logs. In these logs, they asked the students to reflect on “What I can do to make sure I meet my goal next week?” (p. 3). In their work, they found the use of goal setting allowed students to see the connection between their behaviors and the results of their behaviors. Menzies advises, “Students will need instruction on how to complete the form. Consider using modeling, coaching, and role play when explaining the process” (p.30-31). She recommends the teachers use a gentle reminder to students to complete their self-monitoring activity. Menzies further recommends the use of rewards to help encourage students to keep working towards their goal. Further research by Madden shows that SMART goals can also help students to define their goals and identify a clearer path to successful completion of the goal (2014). Smart goals are goals that are specific, measureable, action oriented, realistic, and time based. Madden (2014) also recommends that teachers ensure that goals are displayed in the room and visible to all. These should be referred to throughout the lesson and used “for reflections, before, during and/or after a lesson or unit” (p.7). “These goals assisted students to really think about their learning” (p. 7).

Madden (2014) and his team also set clear reflective scaffold questions for the student goal reflection. “We (Madden 2014) devised three standard questions that could be used to scaffold reflection on any learning task. These were: What were your strengths in this learning task? What challenges did you face and how did you overcome them? What is your goal for future learning?” (p. 7). All three research studies agreed that the process of goal setting and monitoring needed to be explicitly taught, modeled, and revisited throughout the implementation of the goal. Upon completion of the goal setting period the students should reflect on what worked and what did not work for them. This instills a metacognitive strategy that allows them to determine where they have been successful and where they need to further try new strategies to reach success.

In the research on student motivation, goal setting, and self-regulation it was found that student perception of their ability had a great effect on student motivation. Therefore, having students use the research on goal theory to set attainable goals will allow them to see progress and develop confidence as they see their knowledge in standards based topics grow. The goal setting should be content and task specific and the teacher should help guide in the setting goals, align them to the content standards, and ensure a mastery classroom setting. Students will also benefit from self-directed monitoring and assessing as they complete the goal sheets provided that the steps are well taught and there are steps they can take to achieve the goals they have not yet attained. The more they attain the results they seek the further their confidence in their ability to be successful will grow, thus providing additional motivation in their science classroom. Aligning the goals to the assessments allow students to follow the progression of content

and analyze their learning as they progress. This provides validity to the summative assessment at the end of the unit and provides opportunity for them to receive additional help prior to being assessed. This process of goal setting and self-monitoring follows the structure for self-regulated learning. As students grow in their ability to set learning goals, monitor their learning, and identify methods to reach those goals, it will provide them with the skills they need to be successful in high school and beyond.

METHODOLOGY

Goal setting is a required task in Perry Middle School and one that I am striving to make more useful for my students. The purpose of this project is to determine if the use of formative data in goal setting guides student learning. It has been stated in the research that many middle school students are unable to determine how well they know a topic. The project was devised to determine if using formative data would help them in this metacognitive process. To guide this study, the following questions were asked: will the addition of formative assessments on the goal tracking sheets contribute to student success? Additionally, these supporting sub-questions will deepen my understanding of how formative data guides student learning:

1. Will this treatment increase the accuracy of students' perception of their knowledge and thereby increase their metacognition?
2. Does having a clear understanding of where they are in their learning increase the motivation of students to obtain their learning goals?
3. Will this result in higher levels of achievement in their science classroom?

4. Will students not reaching their goals be more motivated to seek out further assistance?

Participants

This study was conducted with 47 8th grade honor students at Perry Middle School in Perry, Ohio. Perry is a rural community with a diverse population including English language learners, gifted students, students with disabilities, and students with low socioeconomic status. The demographics for the forty-seven 8th grade students participating in this study were as follows: 15% Social Economically disadvantaged, 49% gifted students, 13% Hispanic, 6% African American, 2% Asian. In this group of students, 16 were male and 31 were female. This project complies with Montana State University's IRB policy (Appendix C). Students and their guardians were provided a consent form to participate in the project (Appendix D). Not all students completed the consent form. Data from students not completing the form was excluded from this study.

Intervention

Students in 8th grade honors science class at Perry Middle School used goal tracking sheets to monitor their progress towards standard based goals for the relative and absolute dating geology unit. To determine if formative data was useful to students, one class used a new goal setting sheet that included formative data (Appendix A) and the other class served as the control using our traditional goal setting sheets (Appendix B). Both groups were taught the same concepts with the same methods. During Monday meetings the students in the control group self-assessed whether or not they were proficient in a standard. Student in the treatment group recorded their formative

assessment data and used that data to assess if they were proficient at reaching a standard based goal. During the treatment, information was collected from the students to determine if formative data was helping students' self-assessment and goal analysis. Throughout the treatment I noted student comments and conversations as they discussed goal setting. All students took a Goal Setting Survey before the treatment and again after the treatment to determine if attitudes and motivation towards science and goal setting had changed (Appendix E). This survey was created based on the Motivated Strategies for Learning Questionnaire. Johnson (1991) offered tips for using the MSLQ within a classroom to diagnose and treat problems in motivation and learning strategies. The MSLQ can be given at the beginning and end of the study in a shortened form as a survey to determine if students have gained motivation and skill in preparing for their science class. Although it is traditionally used with college level students, Moos (2011) was successful in using the questionnaire to obtain data on middle school students in her study on student learning and motivation. In addition to the survey, three students from each class, for a total of 6 students, were interviewed to gain a deeper understanding of students' level of motivation (Appendix F). To monitor student achievement, a cross-sectional study of student scores on pre and post summative assessments was used. Alias and DeWitt (2014) used the same comparison to determine the gains in student learning in their research. The scores of the treatment group was compared with students' scores from the control group to determine if the treatment increased student learning. Students' evaluation of their knowledge on the goal setting sheets was also compared to post test data to determine the accuracy of students' perception of their knowledge. To determine

if formative goal tracking increases students' attendance in tutoring session, logs were kept of students' attendance along with records of why students attended the session (Appendix G and H). Additional support was available to all students during study hall, before school, and after school twice a week. This treatment ran for one standard in earth science focusing on Power Standard #4: Interpret the evidence of the dynamic changes of Earth's surface through time as found in the geological record. The power standard is the over-arching content statement for the state standard. It encompassed the learning targets: I can determine the relative and absolute age of rocks, I can use index fossils to determine the age of a rock, I can correlate rock strata across distances, and I can determine past events using ice core data. The unit ran for 8 weeks in the third quarter of the 2016-2017 school year.

DATA AND ANALYSIS

In my 8th grade honors science class, the students hold themselves to a high standard. Students understand and work hard to meet the expectations of the class. To guide student learning, my district has implemented Formative Instructional Practices by Battelle. In the 5th module of this program Battelle suggests that having students track their achievement towards class goals will assist them in becoming better self-directed learners. This study initially got underway at the start of the year when I began using goal-setting sheets for my physics unit of study. Students adapted well to the sheets, but I felt they were not as useful as they could be. To these sheets I added an additional component of tracking formative assessment data for my treatment group. To ensure

accurate results the data from the study and guiding questions were triangulated as shown on Table 1 below.

Table 1
Data Triangulation Matrix

Focus Question: Will the addition of formative assessments on the goal tracking sheets contribute to student success?			
<i>Sub-questions</i>	Data Source		
1. Will this treatment increase the accuracy of students' perception of their knowledge and thereby increase their metacognition?	Student goal tracking sheets	Student summative and formative assessment data	Survey and student interviews
2. Does having a clear understanding of where they are in their learning increase the motivation of students to obtain their learning goals?	Survey	Student Interviews	Student goal tracking sheets
3. Will this result in higher levels of achievement in their science classroom?	Pre and post assessments	Student completion of goal tracking sheets	Survey
4. Will students not reaching their goals be more motivated to seek out further assistance?	Tutoring sign in sheets	Student interviews	Survey

The initial question in the study asked, "Will this treatment increase the accuracy of students' perception of their knowledge and thereby increase their metacognition?" To determine if students could accurately assess their own level of understanding, I looked at how students ranked their learning on the goal sheet verses how they scored on the summative assessment. Scores from students' tests were configured on a four-point system with an A being four points and a D being one point. Students self-ratings were changed to a numerical value. Proficient marks were given a four and students rating

themselves IE (Insufficient Evidence) received a one. In this way students goal data and test data could be more easily compared. This data was graphed for the control group in Figure 1 and for the treatment group in Figure 2 and further analyzed to see how accurately students had predicted their outcome on the summative assessment (Figure 1 and 2).

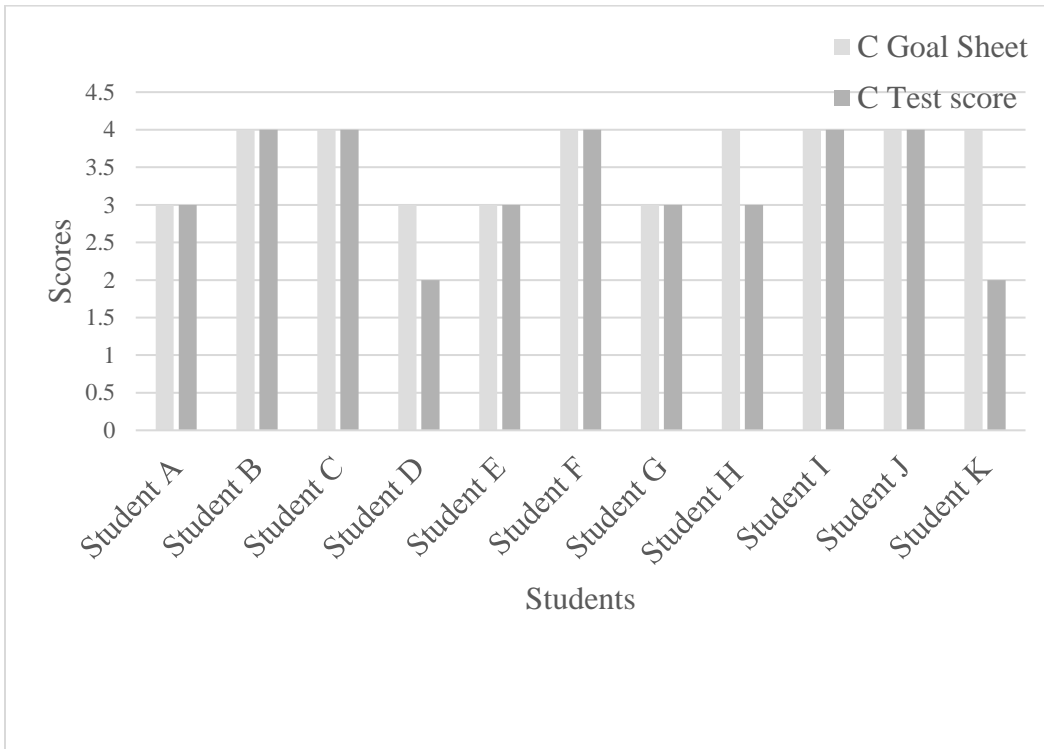


Figure 1. Control group student predicted achievement level on goal sheet vs. actual achievement on test.

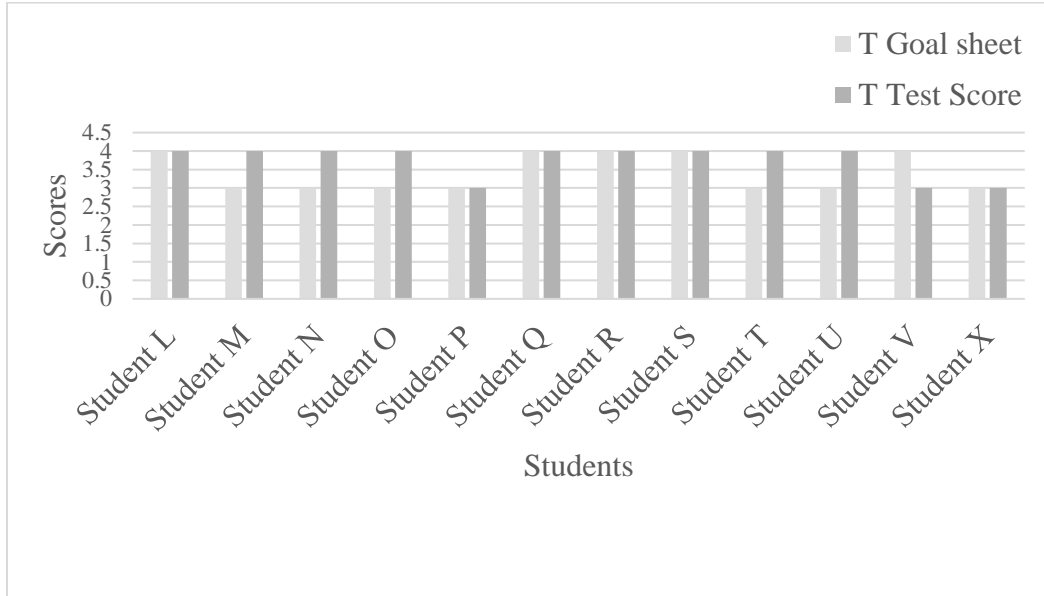


Figure 2. Treatment group predicted achievement level on goal sheet vs. actual achievement on test.

Results of this study suggest that 73% of the control group correctly predicted their knowledge and level of achievement on their goal sheets as shown in Figure 1. In the treatment group 50% of the students accurately predicted their knowledge as shown in Figure 2. I found that students in the treatment group tended to rank their proficiency as less on the goal sheet than their performance on the test indicated. The use of formative data did not help these students to better align what they thought they knew with what they actually knew as the control group was 23% more likely to accurately predict their knowledge.

The goal tracking sheets from the students were further examined for depth of response as a way to determine students' awareness of their knowledge (Appendix A and B). Twenty-six percent of responding students showed detailed reflections on their performance: "I did well with the vocabulary, but may need help when there is an

unconformity”, “I need more practice with intrusions and the layers above them.” These statements show that students are using advanced metacognitive skills and are thinking carefully about what they know and still need to practice. Sixty percent of the students showed some in-depth and some surface thinking in their reflections, these students stated: “I understand how to do this”, “I missed a lot of easy points”, or “I need to review this topic”. Students at this level are beginning to develop metacognitive skills. They are thinking about what they know but are not connecting their learning and knowledge to specific goals. Thirteen percent of the responding students left most reflections blank or only responded with one-word answers such as “ok” or “got it”. This data reveals that when using formative assessments to track goal setting most students will think a little more deeply about their process of learning and show greater metacognition.

Students completed a survey on goal setting and addressed metacognition in questions #9 and #10. In question 9 students were asked when they are studying can they determine what they know and do not know (Appendix E). A summary of the students’ responses is shown in Figure 3 below.

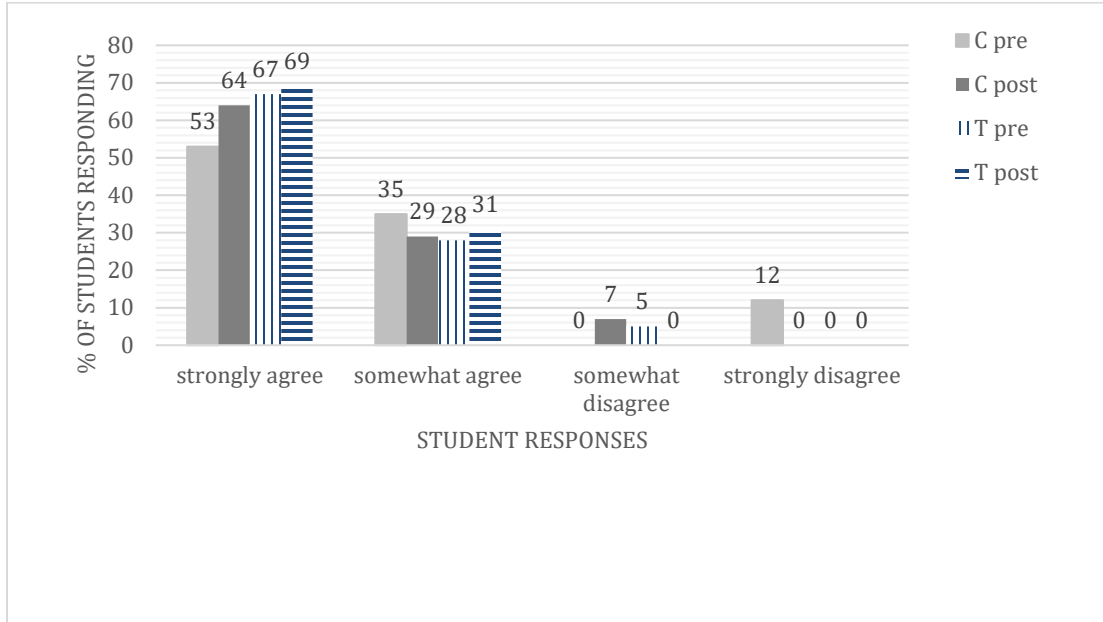


Figure 3. Percentage of treatment group student responses to survey question #9: When I am studying I can determine what I know and what I am unsure of.

Both before and after the treatment most students remained relatively consistent in determining what they knew and what they did not know. Before the treatment, students in the treatment group felt 94% confident they knew what they had learned and what they had not. After the treatment 100% of the students felt confident assessing their knowledge. The same survey was given to the group serving as a control. At the start of the unit 88% of the control group could determine what they knew and did not know. After the treatment period 92% of these students were aware of what they knew and what they did not know. Both groups increased in metacognition and in being aware of their learning. The treatment group increased by 6% and the control group by 4%. This yields a gain of 2% for the treatment group. This data suggests that for 2% more of the treatment group, the use of formative data did increase their metacognition.

Finally, I analyzed student responses to question #10 in the student survey: Can you identify what needs to be studied without a study guide. The survey responses are summarized in the Figure 4 below.

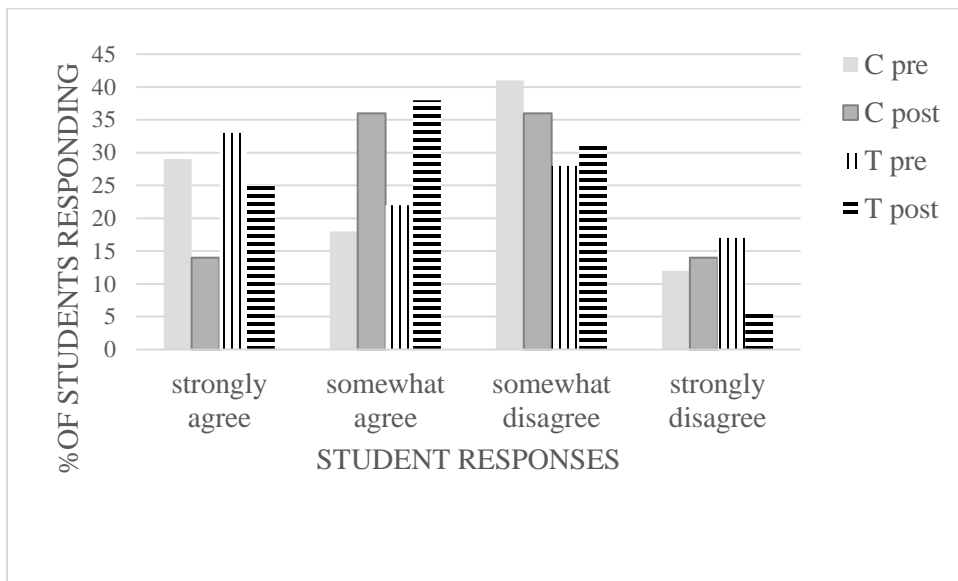


Figure 4. Percentage of student responses to survey question #10: I can identify what I need to study without a study guide.

Students in the treatment group initially reported that 55% of students felt confident preparing for a test without a study guide. After the treatment period 62% of students felt confident studying without a study guide. Overall the students using the formative analysis reported feeling 7% more confident in determining what they knew. These results were then compared to the results from the control group. Initially 47% of the control group was confident they could study without a study guide. After the unit 50% of the students felt confident. The control group also saw a shift towards greater confidence in knowing what they knew although the shift was only 3% for this group. Both groups experienced some growth with the treatment group experienced a 4% greater growth in confidence in learned material and the ability to self-assess learning.

Therefore, this data suggests using formative assessments to guide goal setting resulted in a 4% increase in metacognitive ability for this group of students.

When taken as a whole, results from this study indicate the students had an increase in confidence in their ability, and an increase in metacognition. Yet they were less accurate in reported knowledge on goal tracking sheets when using formative assessments. Students also reported confidence in their metacognition during the student interviews. When asked how they know, most reported that they remember their scores on formative assessments and judge how well they can answer in class. No students reported specifically using the goal setting sheets or recorded formative data to help them make that determination, yet that data was still used. Half of the students interviewed reported liking the goal tracking sheets and half did not, however, all of the students interviewed reported that completing the sheet helped them to see where they were in understanding the content. Reviewing all data sources for this question leads to the determination that for question #1 in this study, the formative assessments increased students' confidence and metacognition, but did not increase their accuracy in determining their knowledge.

The second question addressed in this study was "Does having a clear understanding of where they are in their learning increase the motivation of students to obtain their learning goals?" Motivation was analyzed in questions 5, and 11-15 in the Goal Setting Survey given before and after the treatment (Appendix E). The survey results for the treatment group are summarized in Figures 5 below.

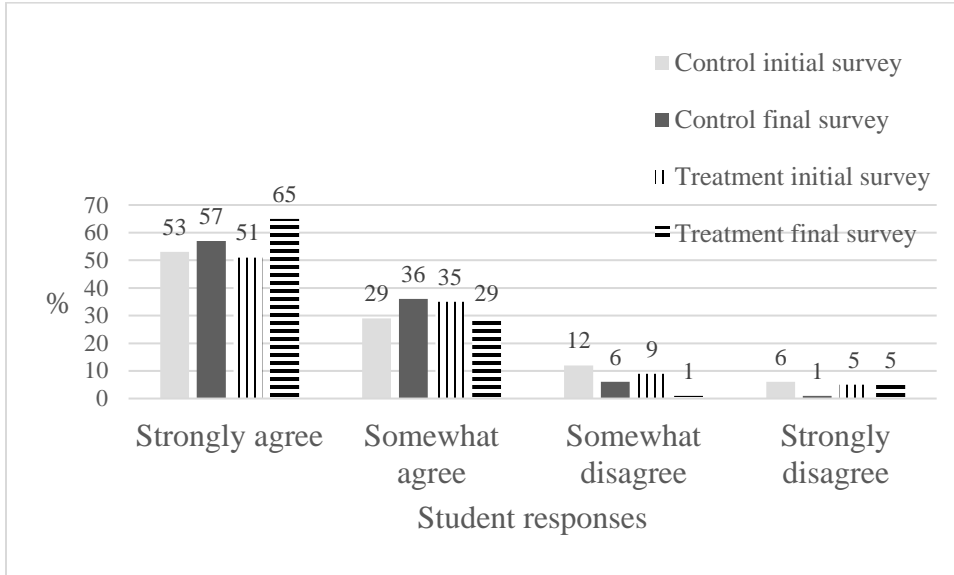


Figure 5. Percent of student responses to survey questions #5, 11, 12, 13, 14 on motivation in science class.

To compare the treatment group to the control group, the same questions were analyzed. Before the treatment began 86% of students in the treatment group felt motivated to learn science. After treatment 93% of these students reported they were motivated to learn. The treatment group reported an increase in motivation of 7% during the treatment period. The control group began the study with 82% of students motivated. After the unit 91% of the students in the control group were motivated to learn science. The control group reported a 9% increase in motivation. These results indicate that both groups of students reported an increase in motivation during the treatment period with the control group reporting greater gains. As both groups reported increases in motivation, the improvement could be related to factors other than the treatment. These factors might include the students' ability to understand this content or the teaching methods used. Further data was obtained through student interviews. All of the students interviewed reported positive feelings and motivation when reaching Proficiency in a standard

(Appendix F). All but one student reported feeling more confident as a result of the goal setting sheets. Students monitoring formative scores did not report any different or unique insights compared to the control group. In class the students in both groups were eager to understand this content. They worked equally as hard on the topic and the control group was noted to generally ask for more help in class than the treatment group. The results of this study indicated that the use of formative scores on goal setting sheets did not increase my students' motivation to learn science.

The third question analyzed was “Will this result in higher levels of achievement in their science classroom?” To determine if this would result in higher levels of achievement students took a pre and a posttest on the Earth Science content taught in this unit. These results are summarized in Figure 6

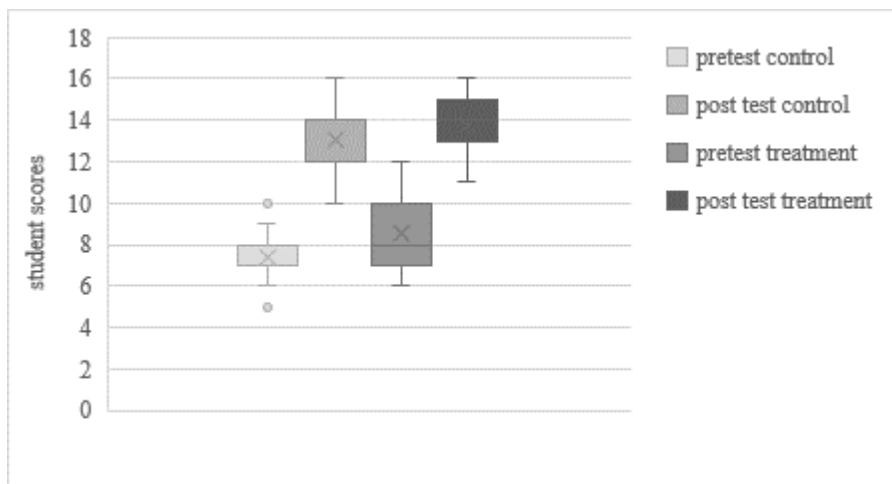


Figure #6: Pre vs post test scores as a measure of student achievement for treatment and control group.

The results show the control group started the unit with an average pretest score of 7.4 they ended the unit with the mean post-test score at 12.875 with a standard deviation of 3.186. This shows a 30.2% growth in learning for the control group. The

treatment group started the unit with an average test score of 8.4 and ended the unit with an average test score of 13.69 with a standard deviation of 1.83. This group showed a 29% growth in learning. Both groups of students had improved over all. The control group had a 6.45-point average gain and the treatment group had a 6-point average gain. Since the control group had a slightly higher average gain we can conclude that the use of formative scores to track students' progress towards content goals did not likely increase their content knowledge. Normalized gains show a .55 for the control group and .54 for the treatment group, which is a .01 difference between the two groups. Together these data sets do not support that formative tracking on goal sheets contributed to academic success for the treatment group.

The fourth question investigated in this study was “Will students not reaching their goals be more motivated to seek out further assistance?” To answer this question, I took attendance at the after-school help sessions and asked students what had motivated them to come to the sessions (Appendix G and H). My initial help sessions contained one or two students depending on the day. Most of the students I saw came in to make up missing work due to absences or to make up work they did not complete for homework. During the treatment period, I had four honor students start attending these sessions the day before tests. The three from the treatment group reported that they came because they were “confused in class and wanted to do well on the assessment”. One of them also reported attending due to “receiving a low grade”. One student attended from the control group and stated she was there because she was “confused in class”. Therefore, the data

suggests that the addition of formative data on goal tracking sheets did motivate three additional students to seek out extra help.

INTERPRETATION & CONCLUSIONS

This study was established following the guidelines of researchers before me. Schloemer (2006) advised students should learn to become self-regulated learners through goal setting, monitoring progress, and modifying learning activities. Students in my class used set goals to monitor their learning and had opportunities for additional support throughout the unit. Since Boller (2008) advised that middle grade students could not organize and break down tasks, the goal sheets were designed to help them with this process. Mensah had also advised that the mastery of goals was necessary for learning a task and would result in increased focus and motivation. Following their lead my students monitored their learning using goal sheets.

The first question undertaken was evaluating the accuracy of students' ability to determine their progress in learning and to increase student metacognition. This study found that formative data led to students being less accurate in determining their level of proficiency. Stefan (2010), stated "Students' attitudes are considered to be a key component in the students' appropriating their competences within Natural Sciences and Math" (p. 7). Since the treatment group did not typically analyze their formatives, finding that they knew less than they thought they did may have decreased their confidence and caused them to rate themselves lower on the goal sheet. It is also possible that after reviewing the goal sheet and seeing the lower ranking they may have studied

more for the summative test. This would have resulted in their summative scores and goal setting sheets not being aligned.

The second and third question found my findings not completely aligned with other researchers. Severance (2012) found that motivation was increased in her students but achievement was not. I found that motivation and achievement were both not substantially increased by the goal setting in my science class. It is possible that students' decreased motivation may have been due to the time required to complete the goal setting sheets. Patel had warned in his 2012 study that the use of goal sheets would be ineffective if "it requires too much time that could be spent on learning the required content. Second, students would quickly tire of this and would likely cease to provide thoughtful comments" (p8). In my student interviews one of my students directly stated that the goal sheets took up time that could have been spent reviewing and learning content. Checking in on the sheets more than once a week did become a time-consuming matter in our class.

General observation of the Goal Setting Survey Responses revealed student motivation in science remained high both before and after the treatment, but that student motivation was higher after the treatment period. Student interviews implied this motivation was not linked to goal tracking, yet many interviewed students reported when they did not reach Proficiency they "studied more" or "worked harder". The data revealed that the control group saw more gains in motivation than the treatment group; this led me to determine that tracking formative data may lead to decreased motivation in some students. Perhaps as Anderman (1997) suggested, when students' perception of

how well they are doing is disproven and they discover they do not know what they thought they knew, it may discourage them and decrease their motivation instead of motivating them to reach their goals.

Students did take advantage of additional study resources provided to them during the treatment period. Emails had gone home to parents informing them of the additional opportunities for students to study and prepare for the assessments. Severance (2012) had stated that students lack the motivation to address their learning needs. This may have been the reason more students did not attend the help sessions. However, this study found that for my group of honor students the additional attention to poor formative scores and goal tracking did lead to increased attendance in these after school sessions.

Overall this study found that using formative assessment scores to help students track their progress towards goals in science is effective at increasing student metacognition. Also, the goal setting sheets were found to be useful in encouraging students to seek additional assistance. However, motivation and achievement were not strongly impacted in this study. Some students saw great benefit while others found the sheets tedious and a waste of their time. In my class I will continue to use goal setting sheets and will start the year using formative data to help guide student metacognition. As the year progresses I will discontinue using formative data on goal tracking sheets as I do not feel the benefits are worth the time involved in completing them.

This study was undertaken with the intent of furthering student knowledge and motivation in science. Possible detractors to the study include teacher absences, formative data not being returned the following class, and not checking in every time a

paper was returned. Goal setting sheets appear to have the greatest impact on increasing student metacognition. Other forms of metacognitive analysis should be compared to goal setting to determine which technique is the most effective.

VALUES

Formative assessment and goal setting still have a place in the middle school classroom. Using the data from formative assessments to track learning is helpful to guide student metacognition but may not lead to stronger motivation or achievement. Formative data may be more useful to the teacher to determine student needs and plan for differentiation. Students' reflection on their learning can provide meaningful feedback for the teacher. Teachers could have students reflect on what they know and do not know and then use the details to determine interventions and extensions for student learning. It is recommended these extensions and reteaching opportunities take place during class time. To achieve the most success with goal sheets the time spent on them should be limited to once a week, as more frequent check-ins may have resulted in decreasing student motivation.

My class will begin the year with a unit on goal setting that includes tracking of formative data. As students become more familiar with determining their level of learning, the formative data will be removed from the goal tracking sheets. Standards will be broken down by learning targets. These will be established for students to evaluate where they are in their learning. These targets will remain on the board as is required in many school classrooms today. Continuing to have these targets on students' personal goal sheets provides a way for students to connect to the learning.

The next step in developing a self-regulated learner is to include the what to do with the information piece. I intend to add a review or extend day each week to help students reach the standards based goals. On this day students will use their goal sheets to determine what level of study they will undertake the learning targets at. Adding this addition to my classroom may help students to achieve higher and feel more confident for the summative assessment. This will provide the “in house” what to do with the knowledge that many researchers say needs to be in place.

This study has provided me with the opportunity to explore a new concept in greater detail. We are often told to try this new technique without the guidelines and research needed to make it successful in our classroom. Researching goal setting and formative assessment allowed me to discover how to make goal setting more efficient and helpful for my students. It also allowed me to see whether students were able to assess their own learning or if teacher guidance was required. In my classroom I will continue to advance this research.

Future research would include determining if typical science students have the same ability to monitor their growth as my honor science students did. I will also be looking to determine how best to implement a differentiated learning day to address the needs of all my students. I will continue to look for ways to build self-regulation into the middle school student to help prepare them for the rigor of high school and college. By working with other professionals in my district and in my grade level across districts I will be able to learn how others work to establish the same in their students.

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APPENDICES

APPENDIX A

PO#4 GOAL SHEET FOR TRACKING FORMATIVE

ASSESSMENT DATA

Determining the age of the Earth

Third Quarter 2017

Overview/standards

PO#4 Interpret the evidence of the dynamic changes of Earth's surface through time as found in the geological record

- a. Analyze observations of the geologic record and ice core sampling that Earth's history is based upon and how the processes observed at present day are similar to those that occurred in the past (uniformitarianism).
- b. Develop a geologic sequence using relative dating methods, including but not limited to: Law of Superposition, crosscutting relationships, and index fossils.
- c. Estimate absolute age through radiometric dating
- d. Identify past environmental and climate conditions based on fossil evidence to interpret the geologic record.

Remember if you are absent to check the notebook and with me to see what was missed**

Unit Vocabulary: Uniformitarianism, relative dating, law of superposition, law of cross cutting relationships, index fossil, half-life,

Assessments: Correlating rock layers formative, relative dating formative, absolute dating formative, summative unit test

Resources

Relative dating: <http://pubs.usgs.gov/gip/fossils/rocks-layers.html>
<http://sciencelearn.org.nz/Contexts/Dating-the-Past/Science-Ideas-and-Concepts/Relative-dating> http://www.thisoldearth.net/Geology_Online-1_Subchapters.cfm?Chapter=4&Row=2

Absolute dating: <http://sciencelearn.org.nz/Contexts/Dating-the-Past/Science-Ideas-and-Concepts/Absolute-dating> http://www.geologyclass.org/absolute_dating.htm

Ice cores: http://climatechange.umaine.edu/icecores/IceCore/Ice_Core_101.html

Personal Quarter Goal: I will _____
 by _____

Steps to meet goal:

Goal met / not met and why?

Standard Goal I can determine the relative ages of rocks	Self Formative	IE	NM	IP	P	Reflection What can you do to reach goal?
I can place rock layers in order using the law of superposition	Pre test	self				
		test				
	Formative #1	self				
		F1				
	Formative #2	self				
		F2				
I can place rock layers in order using the law of cross cutting relationships	Pretest	self				
		test				
	Formative #2	self				
		F2				
	Formative #3	self				
		F3				
Found in geologic columns	Pretest	self				
		test				
	Formative #3	self				
		F3				
	Formative #4	self				
		F4				

Standard/Goal I can determine the absolute ages of rocks	Self Formative	IE	NM	IP	P	Reflection What can you do to reach goal?
I can decide and differentiate between when to use relative and when to use absolute dating	Pre test	self				
		test				
	Formative #1	self				
		F1				
I know what a neutron is and what an isotope is	Pretest	self				
		test				
	Formative #2	set				
		F2				
I can calculate the half-life of a radioactive element	Pretest	self				
		test				
	Formative #2	self				
		F2				
	Formative #3	self				
		F3				
I can use the half-life of an element to determine how old a rock layer is	Pretest	self				
		test				
	Formative #3	self				
		F3				

Standard/Goal I can analyze the geologic record to observe changes in the past and predict future changes.	Self Formative	I missed this section IE	I do not understand this NM	I am starting to get this but still need help IP	I understand this and can teach it to others P	Reflection What can you do to reach goal?
I can analyze ice core data to determine past events in Earth's history	Pre test	self				
		test				
	Formative #1	self				
		F1				
	Formative #2	self				
		F2				
I can identify past environments by using clues from the rocks and fossils found in the rock layers	Pretest	self				
		test				
	Formative #2	self				
		F2				
	Formative #3	self				
		F3				

APPENDIX B

PO#4 GOAL TRACKING SHEETS

Determining the age of the Earth

Third Quarter 2017

Overview/standards

PO#4 Interpret the evidence of the dynamic changes of Earth's surface through time as found in the geological record

- a. Analyze observations of the geologic record and ice core sampling that Earth's history is based upon and how the processes observed at present day are similar to those that occurred in the past (uniformitarianism).
- b. Develop a geologic sequence using relative dating methods, including but not limited to: Law of Superposition, crosscutting relationships, and index fossils.
- c. Estimate absolute age through radiometric dating
- d. Identify past environmental and climate conditions based on fossil evidence to interpret the geologic record.

Remember if you are absent to check the notebook and with me to see what was missed**

Unit Vocabulary: Uniformitarianism, relative dating, law of superposition, law of cross cutting relationships, index fossil, half-life,

Assessments: Correlating rock layers formative, relative dating formative, absolute dating formative, summative unit test

Resources

Relative dating: <http://pubs.usgs.gov/gip/fossils/rocks-layers.html>
<http://sciencelearn.org.nz/Contexts/Dating-the-Past/Science-Ideas-and-Concepts/Relative-dating> http://www.thisoldearth.net/Geology_Online-1_Subchapters.cfm?Chapter=4&Row=2

Absolute dating: <http://sciencelearn.org.nz/Contexts/Dating-the-Past/Science-Ideas-and-Concepts/Absolute-dating> http://www.geologyclass.org/absolute_dating.htm

Ice cores: http://climatechange.umaine.edu/icecores/IceCore/Ice_Core_101.html

Student Goal Tracking

P										
IP										
NM										
IE										
Standard	I can place rock layers in order using the law of superposition	I can place rock layers in order using the law of cross cutting relationships	I can put rock layers in order using index fossils	I can correlate rock layers over distances using the law of horizontality	I can calculate the half-life of a radioactive element	I can use the half-life of an element to determine how old a rock layer is	I can decide and differentiate between when to use relative and when to use absolute dating	I can identify past environments by using clues from the rocks and fossils found in the rock layers	I can analyze ice core data to determine past events in Earth's history	I can analyze the geologic record to observe changes in the past and predict future changes.

Personal Quarter Goal: I will _____
by _____

Steps to meet goal:

Goal met / not met and why?

APPENDIX C
IRB CERTIFICATE

**COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COURSEWORK REQUIREMENTS REPORT***

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

• **Name:** Terri Olix (ID: 5427094)
 • **Email:** terriolix@gmail.com
 • **Institution Affiliation:** Montana State University (ID: 1096)
 • **Phone:** 440-382-2523

• **Curriculum Group:** Social and Behavioral Research Investigators/ Faculty
 • **Course Learner Group:** Social & Behavioral Research - Basic/Refresher
 • **Stage:** Stage 1 - Basic Course
 • **Description:** Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in Social/Behavioral Research with human subjects.

• **Report ID:** 18857745
 • **Completion Date:** 02/28/2016
 • **Expiration Date:** 02/27/2019
 • **Minimum Passing:** 80
 • **Reported Score*:** 85

REQUIRED AND ELECTIVE MODULES ONLY

DATE COMPLETED

Cultural Competence in Research (ID: 15166)	02/27/16
Belmont Report and CITI Course Introduction (ID: 1127)	02/27/16
Students in Research (ID: 1321)	02/28/16
History and Ethical Principles - SBE (ID: 490)	02/28/16
Defining Research with Human Subjects - SBE (ID: 491)	02/28/16
The Federal Regulations - SBE (ID: 502)	02/28/16
Assessing Risk - SBE (ID: 503)	02/28/16
Informed Consent - SBE (ID: 504)	02/28/16
Privacy and Confidentiality - SBE (ID: 505)	02/28/16
Conflicts of Interest in Research Involving Human Subjects (ID: 468)	02/28/16

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
 Email: citisupport@miami.edu
 Phone: 305-243-7970
 Web: <https://www.citiprogram.org>

Collaborative Institutional
Training Initiative
at the University of Miami

**COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COURSEWORK TRANSCRIPT REPORT****

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Terri Olix (ID: 5427094)
- **Email:** terriolix@gmail.com
- **Institution Affiliation:** Montana State University (ID: 1096)
- **Phone:** 440-382-2523

- **Curriculum Group:** Social and Behavioral Research Investigators/ Faculty
- **Course Learner Group:** Social & Behavioral Research - Basic/Refresher
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in Social/Behavioral Research with human subjects.

- **Report ID:** 18857745
- **Report Date:** 03/02/2016
- **Current Score**:** 92

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT
Students in Research (ID: 1321)	02/28/16
History and Ethical Principles - SBE (ID: 490)	02/28/16
Defining Research with Human Subjects - SBE (ID: 491)	02/28/16
Belmont Report and CITI Course Introduction (ID: 1127)	02/27/16
The Federal Regulations - SBE (ID: 502)	02/28/16
Assessing Risk - SBE (ID: 503)	02/28/16
Informed Consent - SBE (ID: 504)	02/28/16
Privacy and Confidentiality - SBE (ID: 505)	02/28/16
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	02/28/16
Cultural Competence in Research (ID: 15166)	02/27/16

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
 Email: citisupport@miami.edu
 Phone: 305-243-7970
 Web: <https://www.citi-program.org>

APPENDIX D
IRB CONSENT FORM

SUBJECT CONSENT FORM FOR PARTICIPATION IN HUMAN RESEARCH AT MONTANA STATE UNIVERSITY

STUDENT MONITORED GOAL TRACKING: A TOOL TO INCREASE STUDENT MOTIVATION AND ACHIEVEMENT IN SCIENCE

You are being asked to participate in a research study in education. This research may help us to determine if student led goal tracking is beneficial to the learning of your student. Specifically, we are looking at whether tracking formative assessments in addition to student self-assessment helps students to determine their level of understanding. This research is being conducted in four 8th grade science classes during the 3rd quarter of the 2016-2017 school year in our Relative Dating unit. This unit runs approximately 4 weeks. Classes will be randomly selected to be either the control group, which will proceed with the current method of goal setting, or the intervention group that will be introduced to the additional method of monitoring goal setting.

Participation is voluntary. If you agree to participate you (the student) will be asked to complete a survey at the beginning and end of the research. A few students will be interviewed regarding their thoughts about goal setting in science. For both the survey and the interview participation is voluntary and you can choose to not answer any questions you do not want to answer and you can stop at any time. There are no known risks associated with this research. Completion of the survey will take approximately 10 minutes and is conducted at the beginning and end of the study. There are no known benefits to the participant at this time.

Confidentiality: No individual student information will be included in this research. All information will be reported as class data and individual student work submitted for example will have student's names removed and the work will be labeled as student A or student B. Participation or non-participation will not affect the student's grade or class standing.

AUTHORIZATION: I have read the above and understand the discomforts, inconvenience and risk of this study. I, _____ (name of parent or guardian), related to the subject as _____ (relationship), agree to the participation of _____ (name of subject) in this research. I understand that the subject or I may later refuse participation in this research and that the subject, through his/her own action or mine, may withdraw from the research study at any time. I have received a copy of this consent form for my own records.

Parent or Guardian Signature: _____

Child's Assent Signature: _____

Signed: _____

Investigator: _____ Mrs. Terri Olix _____

Date: _____

Should the participant(s) have questions about the research, you can contact Mrs. Olix at 440 259 9500 ext. 9560. If you have additional questions about the rights of human subjects you may contact the Chair of the Institutional Review Board, Mark Quinn, (406) 994-4707 [mquinn@montana.edu].

APPENDIX E
GOAL SETTING SURVEY QUESTIONS

Goal setting survey for science

Please choose the best answer for each of the questions below. This survey is anonymous; emails will not be collected.

* Required

Goal setting

Decide if you agree or disagree with each statement.

1. **I am comfortable setting goals ***

Mark only one oval.

1	2	3	4	
strongly agree				strongly disagree

2. **I set goals for myself outside of school ***

Mark only one oval.

1	2	3	4	
strongly agree				strongly disagree

3. **I set goals for myself at school ***

Mark only one oval.

1	2	3	4	
strongly agree				strongly disagree

4. **I am motivated to reach my goals ***

Mark only one oval.

1	2	3	4	
strongly agree				strongly disagree

5. **Setting goals is helpful to my learning ***

Mark only one oval.

1	2	3	4	
strongly agree				strongly disagree

APPENDIX F
STUDENT INTERVIEW QUESTIONS

1. What is your name?
2. What core do you have science?
3. Do you complete the goal tracking sheets in science?
4. What topic are you currently studying in science?
5. Do you like completing the goal tracking sheets? Why or why not?
6. Do the goal tracking sheets help you to see where you are in understanding the content?
7. How do you feel when you reach a P in a standard?
8. How do you feel when you are a NM in a standard?
9. How do you feel when you see yourself moving up the sheet?
10. How do you feel if you do not move up the sheet?
11. Have you ever not made it to a P?
12. Did you know what steps you could take to get there?
13. (if yes on question 12) How did you know?
14. Do you think tracking your progress helps you?
15. How effective do you think you are at knowing what you know and don't know for science?
16. How do you make that determination?

Additional questions for the treatment group

1. Do you think there is any benefit to using your formative scores?
2. Do you think /Did the addition of formative scores cause you to do anything differently?
3. Did you seek help when you were not at a P prior to a summative?
4. Do you think/ Did your grade improve as a result of tracking formative assessments?

APPENDIX G
STUDY GROUP SIGN IN SHEET

APPENDIX H
STUDY GROUP CHECK IN SHEET

Name:

Core:

Study group check in sheet

What topic do you need help with?

How can we best help you reach your goal?

How did you determine you needed help?

(Circle one or more of the following choices)

Received low grade / want to reach a P on goal sheet /
confused in class / needed help on homework / scored
below P on goal sheet / want to score well on summative