DIFFERENTIATED INSTRUCTION IN THE SCIENCE CLASSROOM:

STUDENT PERCEPTION, ENGAGEMENT, AND LEARNING

by

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ABSTRACT

Students have varying backgrounds and learning abilities. One philosophy of education, differentiated instruction, seeks to meet this diversity of student needs by offering a variety of learning tasks. In this article, the author examines what differentiated instruction is, how it may be incorporated, and reflects on the data gathered from an elementary school classroom – primarily looking for impacts on student perceptions, engagement, and learning.

INTRODUCTION AND BACKGROUND

Teaching has always been a demanding job, but it has become even more demanding as students come into the classroom with a wider variety of experiences, backgrounds, learning abilities, and perceptions about school and school work than ever before. No longer does one teaching method or one type of homework seem to fit the bill for the variety of students entering schools today. The task of trying to reach this diversity of student needs is challenging enough in a single-grade classroom, but I teach in a multi-grade classroom setting in which 18 students across 6 grades clamor for my assistance and attention. This creates a unique learning situation. I want all of my students to have a positive learning experience, engage in their homework, and retain the information they learn in meaningful ways.

The majority of the students are Caucasian, although a few are mixed Caucasian and Asian. Most of the families of the students are in the upper-middle class financially, but a couple families could be considered lower-middle class. Academically the majority excels, but a few could be considered underachievers, and one has an Individualized Education Program (IEP).

I want to provide for all the diverse needs of my students, and most teachers would probably echo this same thought for their own classrooms. In fact, teaching methods have been created and research has been completed in response to this idea. The answer that many teachers have turned to is differentiated instruction (DI). My research asks the vital question: Does DI alter student perceptions, engagement in classwork, and their ability to learn and retain information in meaningful ways?

CONCEPTUAL FRAMEWORK

Differentiated instruction is a philosophy of teaching built on the belief that because there are a variety of students, there should be variety within teaching instruction and assessment (Tomlinson, 1999). It is a process of changing the curricula, teaching methods, learning activities, and assessments to reach the learning needs of students and thus help them to be able to learn, be motivated to learn, and be able to learn effectively (Chamberlin & Powers, 2010; Subban, 2006; Tomlinson, 1999). Essentially, teachers must consider who they are teaching and consequently adjust what they are teaching (Carver & Bailey, 2004; Smit & Humpert, 2012). Hall (2002) says that "the intent of differentiating instruction is to maximize each student's growth and individual success by meeting each student where he or she is, and assisting in the learning process."

Tomlinson (2001) states that the change takes place with the content, the process, and the product. What is taught, how instruction happens, and in what manner the students demonstrate learning is where it all happens. How they adjust these is crucial and is based largely upon three factors: student readiness, personal interest, and learner profiles – that is, learning styles, culture, and gender (Chamberlin & Powers, 2010; Tomlinson, Brighton, Hertberg, Callahan, Moon, Brimijoin, Conover, & Reynolds, 2003).

For any of these areas - student readiness, personal interest, or learner profiles - teachers must know their students, but particularly as teachers consider what interests their students, they "must learn about their children's lives beyond the school walls" (MacGillivray & Rueda, 2001, page 2). There are obvious reasons for this, but an added

benefit is that by connecting school with what interests the students, they become engaged in school, and assignments become more meaningful to them.

Based on student readiness, learner profiles, and especially student interest, teachers can then "create multiple levels of expectations for assignments to be completed" (Tobin & McInnes, 2008, page 3). This - creating a menu of tasks from which students may choose - has become synonymous with DI. When students have tasks tailored around their interests, and they have a choice in their learning tasks, that is when students begin to take responsibility for their learning – by making choices and pacing their learning (Carver & Bailey, 2004).

A variety of assignments, however, does not mean different tasks but differentiated ones (Tomlinson, 1999). It is not a menagerie of fun activities, but carefully selected assignments based on the needs and interests of the students. Additionally, teachers are there to "provide a balance between teacher-assigned and student-selected tasks" (Hall, 2002, page 4). The teacher facilitates the process of determining when a student will be required to complete a specific task, and when there is freedom to choose.

According to Pham's research (2012), learners can be set into three learner groups: visual, auditory, and kinesthetic. However, he also found that "there is no relationship between learning style classifications and their memory performance. For example, visual learners did not do better than auditory and kinesthetic learners when receiving visual modes of delivery" (p.15). He goes on to say that "teachers should, therefore, present information in the most appropriate manner based on students' backgrounds, prior knowledge, and abilities rather than learning styles" (p.15). Thus, it is

important for the teacher who seeks to implement DI into their classroom to utilize a plethora of tasks and activities which will engage all three learner groups, and not simply cater to the strengths of certain students.

Additional components of DI include appropriate modeling (Smit and Humpert, 2012), maintaining high expectations rather than lowering them (MacGillivray & Rueda, 2001, page 3), cooperative learning (Tobin & McInnes, 2008), and providing students with prompt feedback on a regular basis (Pham, 2012). With all of these facets to DI, there are a wide variety of instructional strategies for implementation. In fact, Pettig (2000) suggests that there are as many styles of DI as there are teachers, and as many outcomes as there are students.

Nunley (1998) integrates DI through a strategy called Layered Curriculum. In this, Nunley divides a unit into three layers. Each layer has a variety of tasks, and each task has a weighted score. The students may choose any of the tasks they want. The three layers are the C-layer, gaining knowledge and understanding it; B-layer, problem-solving and using the knowledge; and A-layer, analyzing the knowledge. The students' grades are gained by the complexity of the assignments they choose and are roughly correlated with the layers. The C-layer would gain a grade of C, the B-layer would fetch a grade of B, and the A-layer would get an A grade.

Much literature has been published about the philosophy of DI. Let us look at its impact in the classroom. Smit and Humpert (2012) observed in a study of math classes that students of classes in which DI was implemented did not perform worse on standardized achievement tests. This is important because superintendents, parents,

students, and even the teachers may need to be convinced of the impact that DI will have in the classroom, or at least the absence of a negative one. Smit and Humpert in their studies also noted that DI seems to improve test scores not just for low-achieving students, but for high-achieving students as well. What is more, all of the students were reported to have an increased desire to perform better and improve in math as they gained confidence in their math skills.

A study by Johnsen (as cited in Subban, 2006) revealed that when student teachers differentiated the content and process, students were more engaged and interested. Not only were these results observed, but the teachers also had a rewarding experience when integrating DI. It was not specified if any particular age group benefited most, but students with special needs received more individualized instruction.

In their studies, Martin and Pickett (2013) detected that when students were given the opportunity to choose their own assignments and activities, a hallmark of DI, they were more motivated and engaged, and less likely to behave negatively.

According to Tomlinson et al. (2003), when differentiation occurred for student readiness, benefits were seen in student achievement, study habits, social interaction, cooperation, attitude toward school, self-worth, motivation, and engagement. When instruction and activities were matched with the students' interests, there were increases in student engagement, productivity, achievement, positive attitudes about learning, a willingness to accept challenges, self-determination, and creativity (Tomlinson et al., 2003).

In conclusion, the published literature supports the impact of DI in the classroom. All the articles reviewed gave credibility to DI, suggesting that it makes a positive difference in the classroom for both the students and teachers. Whether the articles insinuated that the impact would be large or small – for various reasons – all made the same claim in the end: DI works. It has been shown to improve test scores for low- and high-achieving students, and promote student growth in a multitude of ways including student engagement, productivity, self-determination, creativity, and a positive attitude. Differentiated instruction can make an impact in student perceptions, engagement, and learning. It "is successful because it is squarely rooted in student engagement plus student understanding" (Tomlinson, 1999).

METHODOLOGY

For six weeks, I taught four lessons in science. For each lesson, I gave pre- and post-quizzes, student surveys, and asked my assistant to observe student engagement and enjoyment. Two lessons were the control lessons, and the other two lessons were the treatment lessons. At the end of the unit I interviewed the students.

The first step in the intervention process was to determine how I would break up my students for group comparison. The solution was to keep the whole class moving through a chapter on the same science topic with each lesson lasting a week and a half. The entire chapter would be completed in six weeks. Lessons one and three were taught without the treatment and served as my control group. Lessons two and four included DI as the treatment.

Participants

I teach 18 students across 6 grades in a 3rd through 8th grade classroom. Most of the students are Caucasian with a few mixed Caucasian and Asian. The majority of the students' families are considered affluent while some are lower-middle class.

Most of the students enjoy school because of their friends, but they also enjoy the challenge and routine that school offers. Academically the majority excels, but a few could be considered underachievers, and one has an Individualized Education Plan (IEP).

Comparison Units

The comparison units were typical lessons. That means I used some lecturing, reading from the book, whole-group instruction, small-group activities, and mandated assignments such as answering questions from the book or doing research on a specific subject.

Intervention

I created a menu of lesson activities from which students completed selected assignments. These were created for lessons two and four – the treatment lessons. I created these classwork menus for the whole class but required varying amounts of points from each group of students. I grouped the students as follows: grades three and four, five and six, and seven and eight. The central topic for our class was weather and climate.

I offered different assignment options for each of the two treatment lessons. The activity options for the treatment lessons followed Nunley's layered curriculum. There were three levels of activities: knowledge, application, and synthesis. Students were required to attempt a certain number of points in the first layer, knowledge, before they

could advance to the application layer. Once in this layer, they again needed to attempt a certain number of points before moving to the top layer, synthesis. Each layer had assignments of increasing difficulty and complexity, requiring more higher-order thinking as the students progressed through the activity sheet. Students chose whichever activities they wanted within those layers. Grades 7 and 8 needed to attempt a total of 100 points for the whole project, grades 5 and 6 needed to attempt 90 points, and grades 3 and 4 needed to attempt 80 points total. See Appendix G and H.

My role during the treatment weeks was primarily to create the assignment menus for the students and explain how the point values worked, the levels of complexity, etc. Additionally, I guided the whole class through a common concept - an instruction time similar to that of the non-treatment weeks but briefer so the students could have more time for their activities. Beyond these, and once the whole-class time was over, I moved around the room helping students when they had questions, making sure they were on task, and ensuring that they were meeting the assignment's requirements.

Data Collection

I used four methods of data collection: surveys, pre- and post-quizzes, a follow-up interview, and my assistant's observations about student engagement and enjoyment for each lesson.

To begin with, I gave surveys to all my student for each of the four lessons. These surveys focused on their perceptions of the science class. The surveys used a Likert scale. In addition, there was a follow-up survey at the end of the unit asking them if they

enjoyed one style over another, if they felt more engaged, and if they believed they were better able to use the information they had learned.

Second, I compared pre- and post-quizzes for each lesson looking for significant differences in knowledge acquisition and retention. To do this I delayed giving the post-quiz until a minimum of three days had passed once the lesson was completed.

Third, I gave a follow-up interview asking each student if they enjoyed the regular classes or the treatment classes more, were engaged in the regular or treatment classes more, or had a favorite layer in which they worked.

Finally, my assistant filled out an observation form about the students' levels of enjoyment and engagement. She would look up from her desk at the students to determine if they were enjoying the lesson by observing their expressions and comments, and determine if they were engaged in the content by looking at their attentiveness to the lesson. When more students were giving me eye contact, she would record a higher score for engagement. If more students complained about the subject or content, she would record a lower score for perception. In this way she gave scores for their enjoyment and engagement as each class progressed. See???

Table 1 shows the triangulation matrix of the data collection instruments.

Table 1
Data Triangulation Matrix

Focus Question: Does differentiated instruction alter student perceptions, engagement in classwork, and their ability to learn and retain information in meaningful ways?			
Sub-Questions	Data Source 1	Data Source 2	Data Source 3
1. Do students enjoy the subject more?	Student surveys	Interview questions	Assistant observations
2. Are students more engaged?	Student surveys	Interview questions	Assistant observations
3. Will student learning and retention be impacted?	Student surveys	Interview questions	Pre- and post-quizzes

DATA COLLECTION AND ANALYSIS

To collect data for analysis, I gave the students survey questions at the end of each lesson with one final follow-up survey. The four general surveys used a Likert scale. I asked interview questions after the whole unit was completed, my assistant completed a form for informal observations, and pre-and post-quizzes were given for each lesson of the unit.

Impact of Differentiated Instruction on Student Enjoyment

Overall, students enjoyed the subject slightly more when DI was incorporated into the lesson. I have data from surveys, interviews, and the assistant's observations to support this claim.

According to the follow-up surveys, when asked if they enjoyed one class style over another and why, of the 14 returned, legible follow-up surveys, more than half of the students noted that they preferred the class which featured DI. Ten of the 14 students indicated that they liked having more options for assignments. One student said, "I like more options because we get to choose what fits our character." Another student stated, "I did like having more options but I did not like having to do it in four days." The

requirement to complete the assignments within a narrow timeframe was perhaps one reason more students did not enjoy having options. For yet another student, they did not like having more options for assignments because, "it's hard when we pick." For this student, the choices were a difficulty.

When interviewed and asked, "Did you enjoy the new lessons more or the regular lessons more?" 8 of the 16 students responded positively that they did enjoy the new lessons more. "New lessons" for the sake of my research is in reference to lessons with DI incorporated. One seventh grader said she liked the new lessons more because they could choose the activities they wanted to do. A sixth grade mentioned liking the new lessons because they could pick the activities that were worth more points.

While only 8 of the 16 interviewed students responded positively, 4 students answered neutrally. A fifth grader said they were about the same, and a sixth grader said they both had their ups and downs. Combined, 12 of the 16 students felt either no change or a positive change had taken place with DI.

For the four students who did not enjoy DI, the responses were, "I'm not really good with change," "regular was better," "I don't like the sheets," and "the activity sheets were too much to do, and they stressed us out because we had to be done in a certain time." Clearly, a major theme for those who did not enjoy DI was related to feelings of stress.

Students appeared to enjoy the treatment lessons more according to the assistant instructor. For each lesson, the assistant was asked to score the student enjoyment level for the six weeks. A scale was used from 1 – "Not at all" – to 10 – "Very engaged." The

assistant was looking for signs of enjoyment through positive expressions and enthusiasm. There was an increase in scores for the two treatment lessons compared with the non-treatment lessons. Using a mean score for each lesson, student enjoyment scores were 7.7 and 7.0 for the non-treatment lessons, but 8.7 and 8.5 for the treatment lessons. From the paraprofessional's perspective the students were enjoying what they were doing more with DI.

It is worth noting that according to the surveys students felt disorganized by the number of assignments to be completed when the menu of assignment options was initially introduced. This occurred in the second lesson. The mode score for the non-treatment lesson went from a five, to a score of two for the treatment lesson when students responded to whether they felt like they turned in all the assignments for that lesson. However, by the final treatment lesson, the mode score was again high, tied for four and five. It is possible that students need a chance to become familiarized with DI to succeed with it.

Impact of Differentiated Instruction on Student Engagement

Students appear to be more engaged in the subject when DI is used. Evidence for this claim comes from student surveys, interviews, and the assistant's observations.

When the students responded to the statement, "This week's science classes made me want to participate," the mode of the data indicated that they wanted to participate more when DI was included. For the non-treatment weeks, most of the students chose three on the Likert scale. During the treatment weeks, most of the students chose four. See Table 2.

Table 2
Survey Scores for Question 2

This week's science lessons made me want to participate.				
Scores	Non-Treatment Lessons		Treatment Lessons	
1=Strongly Disagree	0%	8%	7%	11%
2=Disagree	11	8	21	17
3=Undecided	50	46	29	28
4=Agree	28	30	36	39
5=Strongly Agree	11	8	7	5
	N=18	N=13	N=14	N=18

Looking at the observation of the teacher's assistant about student engagement each day, data suggests that they were more engaged and focused. Using a scale of 1 to 10 in which 1 represented "Not at all", and 10 represented "Very focused," there was an increase in scores for the two treatment lessons compared with the non-treatment lessons, when asked to observe student participation. For student engagement, the mean of the scores went from 7.3 for each of the non-treatment weeks to 9 for both of the treatment weeks. From her perspective the students were engaged in the lesson and its activities.

Student responses in the follow-up survey corroborated this data. The responses can be categorized into three general areas; positive, negative, and neutral. These were given when asked if they felt more engaged in the class and assignments with the new method.

When asked, "Did you feel more engaged in the class and assignments with the new method?" six students answered positively, four responded negatively, and four answered neutrally. This suggests a tendency toward an increase in engagement.

Something interesting in the data came up showing a correlation in engagement and learning. From the follow-up surveys, those students who felt more engaged with the

lessons also felt that their learning would improve through remembrance and better being able to use the information they learned. The same six students who answered positively about their increase in engagement were the same six students who felt they would remember the information better.

Students indicated in the interviews that they were more engaged in the lessons with DI. Sixteen students were interviewed, and of these, nine answered positively, saying they were more engaged in the lessons because of the activity sheets. Five students answered negatively to the question, saying they were not more engaged, but were simply required to work harder. Of these five students, one of them stated that he would rather be told what to do than have the option to pick their assignments. Two students answered neutrally. They did not notice a difference between the regular lesson and the new ones.

In the interviews, students were asked which of the three levels of activities they enjoyed most (level one: knowledge; level two: application; level three: evaluation). Six of the 15 students who responded preferred level 1, most of them citing that it was because they were small, easy assignments with a bunch of points as the reason for this choice; two students chose level 2 because, according to one student, “it wasn’t too easy, but it wasn’t too hard;” five students chose level 3 because it was the most challenging, and they had “fun doing experiments;” while two students either could not remember the different levels or they felt like they were all fun. There was a fairly even mix of answers about why they chose certain levels. About half of the students’ responses related to wanting to get more points, to get the assignments completed, and the other half were

related to enjoyment of the activity – doing an experiment, for example, instead of writing down facts.

This indicates that for students who intend to simply get a good grade the initial challenge of finishing the activities to earn points helps them engage in the content, while for those who are intrinsically motivated the challenge of experimenting and learning more keeps them engaged in the same content for an entirely different reason. According to these responses, students were more engaged in the activities because of the variety of stimulating options.

Impact of Differentiated Instruction on Student Learning and Retention

The data does not suggest any noticeable impact on student learning and retention because of DI. Evidence comes from the student pre- and post-quizzes and surveys.

When the students responded to the statement, "I have remembered everything taught in our science classes this week," they scored low on the survey. This could be in part due to the wording of the statement, "remembered *everything*," which may cause students to answer hesitantly. The survey had six statements on it, and this one of the six received the lowest scores consistently with modes of two or three each lesson out of five, where two represented "Disagree," and three represented "Undecided." There was no change in student responses to this question from lesson to lesson. No indication in the data was given that the students remembered more or less for any given lesson.

Likewise, there was no indicator of improved success based on the pre- and post-quizzes. As expected, student scores consistently increased from the pre-quiz to the post-quiz scores. What I was looking for was a greater gain score during the treatment lessons

when compared with the non-treatment lessons. Although students were spending more time with the content during the treatment lessons they did not score higher on the post-quizzes compared with the non-treatment weeks. See Figure 1.

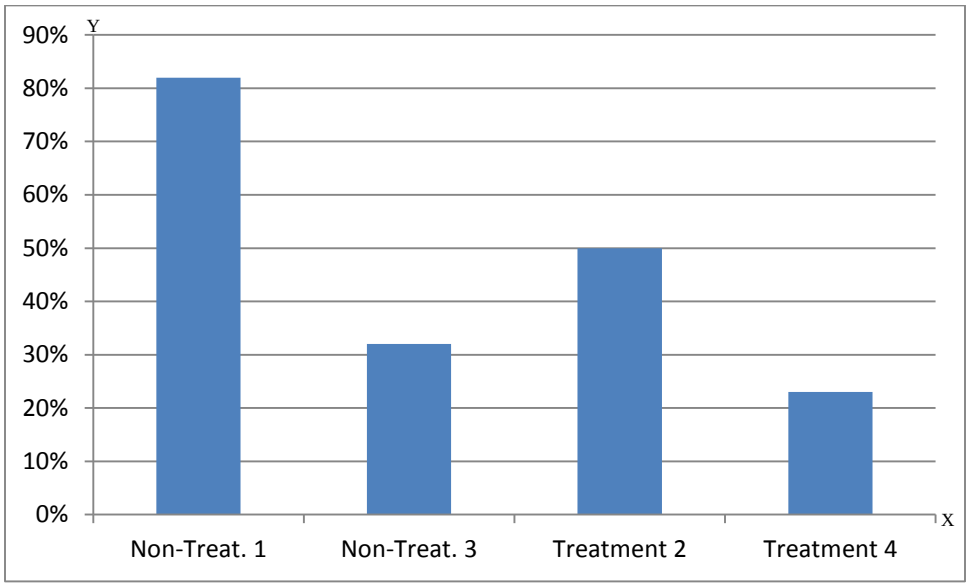


Figure 1. Pre- and post-quiz gain scores.

Based on these quiz results, the data does not conclusively show that students retained the information any more when using DI than during the regular science lessons. My expectations had been that as the students interacted with the content of the lesson in a variety of ways they would retain the information longer, and in more meaningful ways. This may still be the case, as indicated by the current published literature, but these results were inconclusive in this study.

INTERPRETATION AND CONCLUSION

Differentiated instruction has been shown to be an effective philosophy of education in previous studies (Smit and Humpert, 2012). This study supports some, but not all, of their claims. Students have more positive perceptions of the subject and are

more engaged in the subject at hand. What this study failed to support was the impact on student success when it comes to gaining and keeping knowledge of a given subject.

Students enjoyed the options offered to them during the treatment lessons. While opinions were still varied, their general perception of the subjection was slightly more positive because of DI.

Students were more engaged in the classwork when DI was used as Martin and Pickett observed (2013). Some students wanted to get their work done and get a good grade, others liked the variety of activities, and others simply liked working with a partner or alone for certain activities. Differentiated instruction catered to the students' desires and abilities, and helped keep them engaged (Carver & Bailey, 2004).

Student learning was unaffected by DI. Other studies must be done to determine if DI has any significant impact on student acquisition and retention of knowledge.

What I found was a mixture of responses. Overall, the students enjoyed the lessons built around DI and they were more engaged in the content, but they did not remember the content more. While most enjoyed the lessons and engaged in the content, there were still some students that felt stressed by the number of activities and the limited time given with which to finish the project. Some of the students never even finished the activity sheets down through the third level. My younger students had a difficult time pacing themselves to complete the first and second levels, choosing to color and draw extensively rather than work effectively and efficiently. The number of required points and activities overwhelmed many of the under-achieving students instead of spurring them on to completion.

In summary, the students generally enjoyed DI but felt that there were too many activities to complete in too little time. The younger students also felt that not enough instruction was given to start the project well.

From here, I will take what I have done but pare it down. I may keep the same number of activity options but require fewer points. I will also give more time – instead of requiring the project to be completed for each lesson of the chapter, the activity list could be for the duration of the chapter, or unit. Giving students time in class each week to work on the activities would also help them pace along through the activity list, giving students more time to complete their activity sheet before the end of the unit.

Differentiated instruction can bring a positive change in the classroom. Many teachers, however, already feel the pressures of educating a diversity of students and do not feel prepared to change over to a new philosophy of teaching. For teachers who wish to improve their teaching, yet are afraid to change altogether what they already have, it is recommended to try DI in steps, remembering that there are many different looks to DI, as Pettig (2000) notes. If teachers wish to implement DI, they may wish to start with a content area they are familiar with, not a weak subject. Then, introduce an activity menu to the students, explaining the activities, process, and point system, modeling how to work independently in the classroom. They should be sure to include a mixture of teacher-assigned and student-selected activities (Hall, 2002, page 4). Once students and teacher become accustomed to these activity sheets, the teacher will likely find students who desire to perform at a higher level (Smit and Humpert, 2012).

VALUE

I teach in a multi-grade classroom in which DI is a normal part of the classroom learning environment, yet the literature I reviewed and the research I conducted in my classroom has shown me how unintentional I have been about it in the past. If someone had asked me if I used DI in your classroom I would have responded that I do, confident in my abilities as a multi-grade teacher. Now, however, after doing this research, I realize how much room there is to grow as a teacher.

To utilize DI in the classroom, and utilize it well, takes intentionality. If I want to be as effective in the multi-grade classroom as I can be, I must be earnest in my efforts to create a menu of assignment options that match with the classroom lessons and content.

I want to be the best I can be as a professional educator - most teachers probably have this same mindset. However, considering the time commitment teaching already requires and the daily challenges that arise in the classroom unrelated to academics, I wonder what I can do to efficiently incorporate DI into my classroom. The only way I will ever incorporate it into my teaching is if I find a model that works for my students and me. As I have already mentioned, DI will best be implemented for me as a longer-term, whole-unit included package – perhaps once a quarter for a given class. Few teachers have the time and energy reserves to overhaul their teaching with DI in every class every day. All teachers include DI in some form or fashion, but to use it throughout the whole classroom, intentionally, can take a lot of focused effort. Research and studies indicate, though, that the results of DI in the classroom are worth the effort.

REFERENCES CITED

Carver, A., & Bailey, J. M. (2010). Unit Pages: Differentiation for 200 Students. *Science Scope, 33*(6), 12–17.

Chamberlin, M., & Powers, R. (2010). The Promise of Differentiated Instruction for Enhancing the Mathematical Understandings of College Students. *Teaching Mathematics and Its Applications*, *29*(3), 113–139.

Hall, T. (2002). Differentiated Instruction: Effective Classroom Practices Report. *National Center on Accessing the General Curriculum, Office of Special Education Programs.*

MacGillivray, L., & Rueda, R. (2001). Listening to Inner City Teachers of English Language Learners: Differentiating Literacy Instruction. Retrieved from http://www.ciera.org/library/archive/2001-05/0105McRued.htm

Martin, M. R., & Pickett, M. T. (2013). *The Effects of Differentiated Instruction on Motivation and Engagement in Fifth-Grade Gifted Math and Music Students*. (Unpublished professional paper). Saint Xavier University, Chicago, Illinois. Retrieved June 11, 2015, from http://eric.ed.gov/?id=ED541341

Nunley, K. F. (1998). *What is Layered Curriculum?* Retrieved from http://help4teachers.com

Pettig, K. L. (2000). On the Road to Differentiated Practice. *Educational Leadership*, *58*(1), 14-18.

Pham, H. L. (2012). Differentiated Instruction and the Need to Integrate Teaching and Practice. *Journal of College Teaching & Learning*, *9*(1), 13–21.

Smit, R., & Humpert, W. (2012). Differentiated Instruction in Small Schools. *Teaching and Teacher Education, 28*(8), 1152–1162.

Subban, P. (2006). Differentiated Instruction : A Research Basis. *International Education Journal, 7*(7), 935–947.

Tobin, R., & McInnes, A. (2008). Accommodating Differences: Variations in Differentiated Literacy Instruction in Grade 2/3 Classrooms. *Literacy*, *42*(1), 3–9.

Tomlinson, C. A. (1999). Mapping a Route Toward Differentiated Instruction. *Educational Leadership*, *57*(1), 12-17.

Tomlinson, C. A. (2000). *Differentiation of Instruction in the Elementary Grades*. ERIC Digest. Retrieved from http://files.eric.ed.gov/fulltext/ED443572.pdf

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A., & Reynolds, T. (2003). Differentiating Instruction in Response to Student Readiness, Interest, and Learning Profile in Academically Diverse Classrooms: A Review of Literature. *Journal for the Education of the Gifted*, *27*(2-3), 119-145.

APPENDICES

APPENDIX A

STUDENT SURVEYS

Your participation or non-participation will not affect your grade or class standing. Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time.

1. This week's science lessons were interesting to me.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

2. This week's science classes made me want to participate.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

3. I felt challenged by this week's science activities, but not too much.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

4. I have felt in control of my own learning during this week's science classes.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

5. I have turned in all my assignments on time this week for science.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

6. I have remembered everything taught in our science classes this week.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

APPENDIX B

FOLLOW-UP SURVEY QUESTIONS

Your participation or non-participation will not affect your grade or class standing. Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time.

1. Did you enjoy one class style over another? Why?

2. Did you like having more options for assignments or not?

3. Do you feel like you were more engaged in the class with the new method?

4. Do you feel like you were more engaged in the assignments with the new method?

5. Do you think you'll be better able to remember and use the information you learned with the new method?

APPENDIX C

LESSON 1 QUIZ

Atmosphere

1. What is air pressure?
a. The amount of force in the air because of people breathing
b. The force of air pressing over an area
c. The force of air pressing upward on objects in the sky
d. The force of air as a wind

2. True or false: The ozone layer is important to life on earth. T F

3. Is it easier to breathe on a boat at sea, or on top of Mount Everest? Explain.

4. What is the atmosphere?
a. A group of gases that leave earth
b. A thin layer of water above the Troposphere
c. A blanket of gases surrounding Earth
d. The uppermost layer of the atmosphere

5. Which is a pollutant?
a. air
b. nitrogen
c. water
d. dust

6-10. List the layers of the atmosphere in order from nearest to farthest from the earth.
List: Mesosphere, Stratosphere, Thermosphere, Troposphere, Exosphere

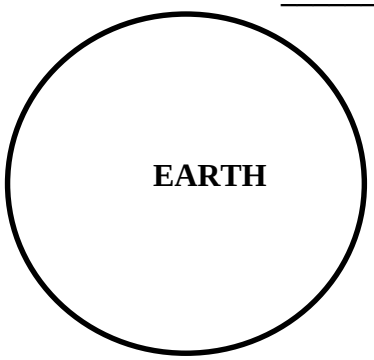
_____

_____

_____

_____

_____



APPENDIX D

LESSON 2 QUIZ

Water Cycle

1. Define the water cycle.

2. Water that fills cracks between rocks and within soil is called _____.
a. water table
b. runoff
c. groundwater
d. springs

3. True or False: Almost all of the planet's freshwater is stored in aquifers. T F

4. The highest level in an aquifer is called the _____.
a. runoff
b. groundwater
c. water cycle
d. water table

5. What is a stomata?
a. tiny hole in a leaf
b. underground water reserve
c. an organ inside the body
d. similar to an oasis

6. What are some forms in which water can fall to Earth?
a. rain and snow
b. sleet and hail
c. both A and B
d. neither A or B

Directions for 7-10

Fill in the blanks with words from the Word Bank.

Word Bank: evaporation, transpiration, condensation, precipitation

7. Water that falls to Earth in different forms is called _____.
8. _____ is the process by which a gas changes into a liquid.
9. When water changes from a liquid to a gas it goes through a process called _____.
10. Water can evaporate and enter the air from the leaves of plans in the process of - _____.

APPENDIX E

LESSON 3 QUIZ

Meterology

1. What is meteorology?
a. The study of meteors
b. The study of meters
c. The study of rain
d. The study of weather patterns

2. True or false: A sea breeze is wind from the sea that moves over land. T F

3. A border between moving air masses is called a _____.
a. meteor
b. front
c. air mass
d. coriolis effect

4. What refers to the amount of water vapor in the air?
a. humidity
b. temperature
c. land breezes
d. coriolis effect

5. Would you expect to find more clouds in air with high or low humidity? Explain.

6-10. Write whether the following clouds would be consider *low, middle,* or *high* clouds.

Stratus –

Altocumulus –

Cirrus –

Cirrocumulus –

Cumulus –

APPENDIX F

LESSON 4 QUIZ

Climate

1-10. Fill in the blanks with words from the Word Bank.
Word Bank: Tropical, Temperate, Polar, Latitude, Elevation, Ocean Current, Rain Shadow, Biome, Greenhouse Effect, Greenhouse Gases

1. Earth's ability to use clouds and gases in the atmosphere to trap heat is called _____.

2. A _____ is an ecosystem and geographical community adapted to the temperature and precipitation of an area.

3. An area of dry land on the far side, or leeward side, of a mountain is a _____.

4. _____ are gases that trap radiant energy.

5. _____ refers to how far you are north or south of the equator.

6. The average weather in an area over a long period is known as _____.

7. _____ is a hot climate most of the year with wet and dry seasons.

8. _____ is a cold and dry climate.

9. _____ climates have warm summers and cool winters, usually with deciduous trees.

10. _____ refers to how high above sea level a location is.

APPENDIX G

LESSON 2 ACTIVITIES LIST

Activities List – Must attempt at least 75 pts.

First Level (25-35 pts before going to next level)

a. Define each key term (write the definition for each vocabulary term). 9 pts
b. Draw and label the water cycle (p.256). 8 pts
c. Draw and label a picture comparing an aquifer and spring (p.257). 4 pts
d. Draw and label a stomata and guard cells (p.258). 3 pts
e. Take notes during class. 5 pts
f. Make flashcards of the lesson's key terms. 9 pts
g. Create a word search using the lesson's key terms. 5 pts
h. Fill in the water cycle worksheet. 8 pts
i. Tell how the water cycle works to someone in your family (an adult) and have them sign a paper saying they heard to you (make sure to include all 6 terms on p.256). 8 pts

Second Level (25-35 pts before going to next level)

a. Complete the Scripture Spotlight on p.253 and illustrate it (draw a picture, and write the Bible verse with the picture). 6 pts
b. Complete the Scripture Spotlight on p.255 and illustrate it (draw a picture, and write the Bible verse with the picture). 8 pts
c. Complete the Scripture Spotlight on p.257 and illustrate it (draw a picture, and write the Bible verse with the picture). 6 pts
d. Answer each of the blue questions throughout this lesson (p.252, 253, 255, 256, 257, 258). 12 pts
e. Describe a local example of the water cycle (within Tennessee). 5 pts
f. Write a story in which the entire water cycle is mentioned (1/2 page minimum). 8 pts
g. Write a skit in which the entire water cycle is mentioned. 8 pts
h. Create a 10-question quiz based on this lesson (supply an answer page). 20 pts
i. Complete the Concept Check on p.259 #1-5. 12 pts

Third Level

a. Research ways to conserve water and create a poster of your findings. 15 pts
b. Design a working model of the water cycle. 20 pts
d. Design an experiment to test how wind speed will affect evaporation rate (based off of the Surface Area and Evaporation experiment on p.254). 25 pts
e. Use a source (and list it) to answer one of the following questions (3-sentence minimum) for 15 pts:

1. What would happen to the water cycle if one part of it were polluted?
2. Which plant would give off more water vapor; a houseplant or a cactus plant?
3. What would happen to the water cycle if one of its parts were missing?
4. Estimate how much water our classroom (18 students) would use in one week if each student took a 10-minute shower daily. Then estimate the same with 30-minute showers daily.

APPENDIX H

LESSON 4 ACTIVITIES LIST

Activities List – Must attempt at least 75 pts.

3^{rd}-4^{th} = 80 pts 5^{th}-6^{th} = 90 pts 7^{th}-8^{th} = 100 pts

First Level (25-35 pts before going to next level)

a. Define each key term (write the definition for each vocabulary term). 7 pts
b. Draw and label the climate zones (p.271). 7 pts
c. Draw and label a picture of the rain shadow effect (p.275). 6 pts
d. Draw and label a map of the major Atlantic currents (p.274). 6 pts
e. Take notes during class. 5 pts
f. Make flashcards of the lesson's key terms. 7 pts
g. Copy the Land Biomes of the World chart without essential information (p.277). 12 pts
h. Describe the difference between weather and climate to someone in your family (an adult) and be sure to get their signature saying you explained it well or a note. 4 pts
i. Draw and label a map of the world biomes (p.276). 9 pts

Second Level (25-35 pts before going to next level)

a. Complete the Scripture Spotlight on p.274 and illustrate it (draw a picture, and write one of the verses with the picture). 6 pts
b. Complete the Faith Connection on p.276 and include an illustration of the answer. 4 pts
c. Complete the Scripture Spotlight on p.277 and illustrate it (draw a picture, and write one of the verses with the picture). 6 pts
d. Complete the Faith Connection on p.280 and include an illustration of the answer. 4 pts
e. Answer each of the blue questions throughout this lesson (p.271, 74, 75, 76, 78, 79, 80). 14 pts
f. Describe our local climate. 4 pts
g. Write a story in which climate and/or weather is mentioned (1/2 page minimum). 8 pts
h. Write a skit in which climate and/or weather is mentioned. 8 pts
i. Create a 10-question quiz based on this lesson (supply an answer page). 20 pts
j. Complete the Concept Check on p.281 #1-5. 14 pts
k. Complete each of the objectives on p.270. 10 pts
l. Create a poster showing the difference(s) between weather and climate. 8 pts
m. Design a model of one aspect of this lesson (example: the rain shadow). 10 pts

Third Level

a. Research ways to reduce you "carbon footprint" and create a poster of your findings. 15 pts
b. Design a small-scale greenhouse. 15 pts
c. Follow the experiment at the bottom of p.273 (Explore-a-Lab). 8 pts
d. Follow the experiment at the bottom of p.275 (Explore-a-Lab). 8 pts
e. Using a source (list it) answer the following question with a minimum of 3 sentences: How might a major change in climate affect people?
f. Complete the Lesson Activity on p.279. 10 pts
g. Design an experiment to shows the effect of increased greenhouse gases and if there is a change in temperature. 25 pts

APPENDIX I

ASSISTANT OBSERVATION FORM

Date: ______________

1. Students seem engaged during the lesson (whether on the teacher or in the book, etc).

1	2	3	4	5	6	7	8	9	10
Not at all								Very focused	

2. Students seem to enjoy the lesson.

1	2	3	4	5	6	7	8	9	10
Not at all								Very engaged	

Date: ______________

1. Students seem engaged during the lesson (whether on the teacher or in the book, etc).

1	2	3	4	5	6	7	8	9	10
Not at all								Very focused	

2. Students seem to enjoy the lesson.

1	2	3	4	5	6	7	8	9	10
Not at all								Very engaged	

Date: ______________

1. Students seem engaged during the lesson (whether on the teacher or in the book, etc).

1	2	3	4	5	6	7	8	9	10
Not at all								Very focused	

2. Students seem to enjoy the lesson.

1	2	3	4	5	6	7	8	9	10
Not at all								Very engaged	

Date: ______________

1. Students seem engaged during the lesson (whether on the teacher or in the book, etc).

1	2	3	4	5	6	7	8	9	10
Not at all								Very focused	

2. Students seem to enjoy the lesson.

1	2	3	4	5	6	7	8	9	10
Not at all								Very engaged	