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Effects of Differentiating for Readiness, Interest and Learning Profile on Engagement and Understanding

Abstract

Differentiated instruction is a teaching strategy that enables educators to modify their instruction to address the strengths and needs of a diverse set of learners. This study looks at whether differentiating instruction by readiness, interest, and learning profile have an effect on engagement and understanding. Two seventh grade science teachers implement a differentiated unit on the human body systems within their classrooms and measure the effectiveness of the differentiation through assessments and an exit ticket. Students report being highly engaged in the differentiated lessons and evaluation of student assessments reveal a significant increase in their understanding after the implementation of differentiation. The research shows that differentiated instruction by these three methods appears to have a positive effect on both student engagement and student understanding.

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Effects of Differentiating for Readiness, Interest and Learning Profile
on Engagement and Understanding

By

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Submitted in partial fulfillment of the requirements for the degree
M.S. Mathematics, Science and Technology Education

Supervised by

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School of Arts and Sciences

St. John Fisher College

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Abstract

Differentiated instruction is a teaching strategy that enables educators to modify their instruction to address the strengths and needs of a diverse set of learners. This study looks at whether differentiating instruction by readiness, interest, and learning profile have an effect on engagement and understanding. Two seventh grade science teachers implement a differentiated unit on the human body systems within their classrooms and measure the effectiveness of the differentiation through assessments and an exit ticket. Students report being highly engaged in the differentiated lessons and evaluation of student assessments reveal a significant increase in their understanding after the implementation of differentiation. The research shows that differentiated instruction by these three methods appears to have a positive effect on both student engagement and student understanding.

Dedication

To Aldon

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Effects of Differentiating for Readiness, Interest and Learning Style on Engagement and Understanding

American classrooms are more diverse than ever. A typical classroom today may be made up of a multitude of different learners, which includes: students of different ethnicities and religions, students from different socioeconomic backgrounds, students whose first language is not English, students who struggle to keep up, students who are academically advanced, students who lack motivation, students who cannot stay in their seat, students who come from troubled homes, students who possess two or more of these characteristics, and the list goes on. “Students in classrooms across America represent more differences than similarities today than at any time in the history of education,” (Cooper, 2007, p. 14).

The increase of diversity poses new challenges for educators and necessitates new and effective practices that can meet the needs of all learners. One solution to our growing diversity is to foster classrooms that focus on responsive and proactive teaching approaches through the incorporation of differentiated instruction. Differentiated instruction is a set of educational practices that focuses on modifying the way educators approach instruction and student needs. According to Carol Ann Tomlinson, differentiated instruction “is not a recipe for teaching. It is not an instructional strategy. It is not what a teacher does when he or she has time. It is a way of thinking about teaching and learning,” (2000b, p. 6).

Differentiated instruction will be studied in order to glean information necessary to incorporate the practice within two middle school science classrooms. The two classrooms will utilize differentiation for the duration of two weeks in the attempt to

increase student motivation and understanding. Specifically, the classrooms will be differentiated based on student readiness, interest, and learning style to determine if there is any tangible evidence to support increases in student engagement and understanding.

Literature Review

In order to show that differentiated instruction was a solution capable of having an effect on understanding and engagement, it had to demonstrate that it was an effective and efficient approach to teaching. The primary purpose of this literature review was to examine differentiated instruction and its ability to create such an environment. This review included: an explanation of what differentiated instruction is, the rationale for differentiation, differentiation by content, process, and product, differentiation by readiness, interest and learning style, differentiation strategies, guidelines for differentiated instruction, obstacles to overcome in order to utilize differentiated instruction, and the role of assessment in the differentiated classroom. It also included two controversies: concern as to whether differentiated lessons effectively prepare students for standardized tests, and a lack of data to support the effectiveness of differentiated instruction.

Differentiated Instruction

Defining differentiated instruction was not an easy task as there was no set definition and the descriptions that were found varied. Possible problems with this included determining what exactly it meant to differentiate instruction and the purpose of doing so. The definitions that were uncovered fit into three basic categories: those that dealt with the material being differentiated, those that dealt with creating responsive

learning environments, and those that dealt with recognizing the differences among the varied learners.

Differentiated instruction, as it pertained to the material, was in its simplest form described as “shaking things up a bit,” (Tomlinson, 2001, p. 1). This can best be interpreted as changing one’s teaching habits and modifying the way information is presented on a daily basis to a variety of different learners (Nunley, 2006).

“Differentiated instruction does not change WHAT is taught; it changes HOW it is taught,” (Hall, 2009, ¶ 2). It required the teacher to identify the areas of the content that can be modified, as well as activities and processes, the setting, and the assessments used (Cooper, 2007). In addition, “differentiation calls for teachers to have clear learning goals that are rooted in content standards, but crafted to ensure student engagement and understanding,” (Tomlinson, 2008, p. 27). All of these definitions required that the users recognize that the material being covered did not need to be altered, but rather that the formats teachers used needed to be assessed.

In terms of creating responsive learning environments it was pointed out that differentiation was not a one-size-fits-all approach to teaching and that the best methods were those that were student-aware (Dobush, n.d; Tomlinson, 2008). Differentiated instruction focused on teachers meeting students where the students were at (Hall, 2009; Tomlinson, 1999b). Differentiated instruction was also described as, “a set of strategies that will help teachers meet each child where they are when they enter the class and move them forward as far as possible on their educational path,” (Levy, 2008, p. 162).

The final definitions dealt with differentiated instruction as recognition of learner differences. It was described as an approach used to meet the needs of a diverse student

population (Edwards, Carr & Siegel, 2006; Grimes & Stevens, 2009; Hall, 2002).

“Students differ with regards to how they learn best, their strengths and weaknesses, their cultural and family backgrounds, what they are interested in learning about, etc.,”

(Loeser, 2008, p. 1). Finally, it was defined as recognizing students’ varying backgrounds and experiences and reacting in appropriate manners to those differences (Hall, 2009).

Rationale for Differentiation

Research has shown for decades what parents and good teachers have always known; that no two children are alike and that no two students will learn in the same exact manner (Cooper, 2007). “Because learning is a very personal experience, each of us has our own individual needs associated with it,” (p. 14). It was felt that since no two learners are alike, teaching them as if they processed and recalled information in the same manner was not only ineffective, but unfair as it did not promote student success for every learner (Loeser, 2008). It was also said that teaching to students as though they were one homogeneous group was difficult for the teacher, who would struggle to create tasks that challenged each learner (Hall, 2009).

Perhaps most compelling of the reviewed literature related to the rationale for differentiation was that which focused on the way in which students learn. Individuals learned best when they are challenged slightly; when an activity pushed them just beyond their comfort and readiness levels (Kapusnick & Hauslein 2001; Tomlinson, 2001).

According to the literature, when a task was too difficult for a student to complete the student tended to feel intimidated and subsequently, frustrated which resulted in the student shutting down (Dobush, n.d.; Kapusnick & Hauslein). This resulted in the student not learning and perhaps even acting out as he or she was forced to spend time coping,

rather than learning (Kapusnick & Hauslein). Conversely, if a student was completing a task that was far below the student's capability level, the student would become bored and his or her brain activity would actually mimic that of the early stages of sleep (Dobush).

Lastly, there was the connection between differentiated instruction and the real world. George (2005) found that the heterogeneous classrooms typical of today's classrooms are more consistent with the rest of the world in terms of demographics and the unique abilities of individuals. He identified a unique opportunity for educators who could utilize these diverse classrooms to prepare students for the real world; however, they needed to incorporate practices that provided opportunities, "for varied types and degrees of academic achievement," (p. 186). In effect, instruction within today's heterogeneous classrooms needs to be differentiated.

Differentiation by Content, Process, and Product

Individuals who have differentiated their instruction or written about differentiation have focused on three key areas: content, process, and products. Each area can be differentiated individually or in conjunction with one or both of the other areas. Teachers were empowered to create classrooms in which all learners met the essential skills and understandings by differentiating the content, process, and products the students utilized to reach those skills and understandings (Tomlinson, 2001; Tomlinson, 1999b).

Content was referred to as the information students needed to learn (Garderen & Whittaker, 2006; Hall, 2009; Tomlinson, 1999b; Tomlinson, 2000a). It included what teachers taught and wanted students to learn (Tomlinson, 2001). Hall (2002) concluded

that content objectives were best when aligned with the standards in order to allow students insight to where they were going, and why. To differentiate the presentation of the content educators utilized several instructional methods rather than just one (Hall). Instruction was focused on broad concepts and addressed the same concepts with all students; every learner could be taught the same material as long as the material was taught in different manners (Hall; Levy, 2008). “Differentiated instruction allows for variation in content without losing sight of the curriculum to which all children are entitled,” (Levy, p. 162).

Process was referred to as the tasks students engaged in to learn and how they gained understanding of the material (Anderson, 2007; Garderen & Whittaker, 2006; Hall, 2009; Tomlinson, 1999b; Tomlinson, 2000a). It included opportunities, “for learners to process the content or ideas and skills to which they have been introduced,” (Tomlinson, 2001 p. 79). It often referred to the activities students completed, which may be whole-class instruction, small group or partner work or individual work (Hall, 2002; Tomlinson, 2001). Levy (2008) noted that activities needed to address the different abilities, learning styles and interests of all students. “A good activity is something students will make or do in a range of modes at varied degrees of sophistication in varying time spans, with varied amounts of teacher or peer support,” (Tomlinson, 2001, p. 80).

Products were referred to as the assessments or evaluation criteria used to determine what students have learned and understand (Garderen & Whittaker, 2006; Hall, 2009; Tomlinson, 1999b; Tomlinson, 2000a). Products typically focused on larger sections of material, unlike activities (Tomlinson, 2001) and, “must reflect student

learning” (Levy, 2008, p. 162). It would be unfair to provide students with an assessment that was not in line with the information they learned or the manner in which they learned it. Before a new unit could be started, there had to be pre-assessments and a variety of ways for students to demonstrate their understanding (Anderson, 2007; Hall, 2002). This included a mix of informal and formal, and formative and summative assessment types (Anderson; Hall). Tomlinson (2001) found that a product could not be completed for pleasure, rather, “it must cause students to think about, apply, and even expand on all the key understandings and skills of the learning span it represents,” (p. 85).

Differentiation by Student Readiness, Interest and Learning Profile

In addition to content, process, and product there were three additional areas in which differentiated instruction was focused: student readiness, interest and learning profile. Typically, differentiated instruction adjusted the levels of teacher and peer support, complexity of assigned tasks, pace of curriculum, and paths to learning based on these three areas (Tomlinson, 1999a). These areas then guided differentiated instruction (Tomlinson, 2001).

Readiness was defined as where the student was at in terms of an understanding or skill (Tomlinson, 1999b). Differentiating by student readiness level required educators to assess prior knowledge and determine what students knew and where students were at (Tomlinson, 2001). A teacher could then utilize this information to differentiate content, process or product, or any combination of the three (Tomlinson, 2001). Students with a lower readiness typically necessitated greater assistance, more opportunities for practice, and more structured activities (Tomlinson, 1999b). Conversely, students with advanced

readiness typically required less practice and could handle more complex, abstract activities (Tomlinson, 1999b).

Interest referred to one's likes and curiosities; it pertained to a specific topic or a general area (Tomlinson, 1999b). Honing in on student interest allowed educators to hook students and engage them in a lesson (Tomlinson, 2001). Stated another way, interest fed engagement, and "engagement is a nonnegotiable of teaching and learning," (Tomlinson, 2001, p. 52). There were three basic goals of identifying student interest: it allowed the student to form connections between personal life and learning, it enabled the student to utilize the familiar, and it fostered intrinsic motivation to learn (Tomlinson, 2001).

Tomlinson (2001) examined learning profiles and noted many important features. Learning profile, sometimes referenced to as just learning style, referred to the manner in which that individual learns best. A student's learning profile could be influenced by learning style preference, intelligence preference, and preferences related to group size, culture and gender. Learning style alluded to the environment a student prefers to learn within. Intelligence preferences are based on the work of Howard Gardner and Robert Sternberg; both suggested that learners of any age have favored modes of receiving and processing information. Examples of intelligence included Gardner's verbal linguistic, logical mathematical, visual spatial, musical rhythmic, bodily kinesthetic, interpersonal, intrapersonal, and naturalistic styles of learning. Intelligence preferences were often determined through the use of Multiple Intelligence surveys which used questions to indicate learning preferences. Grouping and gender preferences referred to the social nature of learning and the learning differences between males and females. Culture

greatly influences human nature, and thus affected learning as well. To determine a student's learning profile all aspects needed to be considered and addressed.

Differentiation Strategies

There were many discussed strategies that educators could utilize to differentiate their classrooms by any of the six criteria previously discussed. Following is a summary of some of the most discussed strategies: descriptions, which aspects of differentiation they target, and how they were implemented within the classroom. One noted limitation of the literature review regarding strategies was that there was no empirical evidence or data to support these strategies which were more speculative in their effectiveness. The overall effectiveness of differentiated instruction will be discussed in more detail at a later point.

Tiered activities allowed every student to achieve the same objectives, but at different levels of difficulty (Gardner & Whittaker, 2006; Hall, 2009). "Tiered activities promote success because the student chooses his or her own level of accomplishment," (Kapusnick & Hauslien, 2001, p. 159). These activities were differentiated based upon student readiness level. To implement tiered activities within the classroom teachers often worked together to design assignments that contained two or three levels of complexity (Lewis & Batts, 2005).

Learning contracts were written agreements between teachers and students in which concepts and skills that needed to be learned were outlined, and a procedure for learning the concepts was agreed upon (Hall, 2009; Kapusnick & Hauslien, 2001). "Contracts combine a sense of shared goals with individual appropriateness and an independent work format," (Tomlinson, 2001, p.76). They were differentiated based on

student readiness and learning profile. Learning contracts were beneficial for the differentiated classroom because the components of the contract varied from student to student (Tomlinson).

Learning centers were described as stations with collections of materials that small groups of students utilize to explore topics, practice skills or reinforce understanding (Kapusnick & Hauslein, 2001; Lewis & Batts, 2005; Tomlinson, 2001). This strategy was differentiated based upon student readiness and interest. Often teachers created a series of stations with varying complexities to challenge students; other times the centers were varied by topic (Lewis & Batts).

Flexible grouping referenced the placement of students within groups based upon student readiness, interest or learning profile (Hall, 2009; Tomlinson, 2001). The key to flexible grouping was that the groups were not stagnant; rather they were changed with new topics and new activities. Depending on the purpose of the activity, flexible grouping enabled students to work with peers with similar or varying interests and readiness levels (Lewis & Batts, 2005). With this strategy it was imperative that the teacher teach and reinforce the routine and guidelines for group work, products, and time frame (Kapusnick & Hauslein, 2001; Tomlinson).

Curriculum compacting was a method of instructional modification in which students who understood a particular topic or mastered a skill set moved beyond the mastered material instead of rehearsing it (Hall, 2009; Kapusnick & Hauslein, 2001). This strategy sometimes required advanced students to study a particular topic on a deeper level or investigate a completely unrelated topic (Kapusnick & Hauslein). Compacting was performed based on student readiness.

Questions may be adjusted based on student readiness, interest or learning profile and may be varied from basic to advanced levels based on the needs of the learners (Lewis & Batts, 2005). This strategy included asking more complex questions or implementing longer wait time, and prompted lively discussions among class members (Kapusnick & Hauslien, 2001). Teachers often utilized Bloom's Taxonomy in the development of questions; this allowed them to create more effective assessments of learning (Lewis & Batts).

Independent study referred to the practice of enabling students who had mastered a set of skills to pursue additional avenues of study that were of interest to them (Lewis & Batts, 2005; Kapusnick & Hauslein, 2001). Typically, independent study was for individual students or occasionally small groups of students (Lewis & Batts). Throughout the course of the independent study the teacher provided guidance, but the student was the one responsible for meeting the benchmarks required for success (Kapusnick & Hauslein).

Guidelines for Differentiating Instruction

According to Tomlinson, "the same skills that help teachers succeed in the complex environment of a classroom can lead them toward success in a differentiated classroom environment, as well," (2001, p. 32). Within the literature there were several major guidelines teachers could follow to manage and create a differentiated classroom. These principles that guided differentiated instruction offer insight into how things work within a differentiated classroom (Tomlinson, 2006).

Guideline one. The starting point for differentiation was the subject matter that was to be covered; educators had to first determine the essential information, and then

they were able to move on to determining how that content would be differentiated (Dobush, n.d.). According to Tomlinson, it was important to have, “clarity about what is essential for students to know, understand and do,” (1999b, p. 17) and doing so ensured that the teacher would be focused on what matters most for student learning (Hall, 2002; Tomlinson, 2006). “Clarifying key concepts and generalizations [will] ensure that all learners gain powerful understandings that serve as the foundation for future learning,” (Hall, p. 4). The reason this was so important was that, “the brain is structured so that even the most able of us will forget more than we remember about most topics. It was crucial, then, for teachers to articulate what’s essential for learners to recall, understand, and be able to do,” (Tomlinson, 1999b, p. 9).

Guideline two. Diversity within a classroom must be understood and appreciated before effective instruction could take place. “In a differentiated classroom, the teacher unconditionally accepts students as they are, and she expects them to become all they can be,” (Tomlinson, 1999b, p. 10). Doing so enabled the teacher to create a safe and comfortable learning environment in which students felt compelled to express their differences freely (Tomlinson, 2006). “It is also a prerequisite for modifying curriculum and instruction in response to unique learner needs,” (Tomlinson, p. 17).

Guideline three. The next reviewed guideline dealt with the inseparability of assessment and instruction. “Teachers are hunters and gatherers of information about their students and how those students are learning at a given point,” (Tomlinson, 2000a, p. 4). The very first assessment any educator should have utilized was the pre-assessment to determine what students already knew (Levy, 2008). After all, “if we do not know where we are, how can we get where we are going?” (Levy, p. 162). Assessments were

required to be ongoing and formative; assessment served as another teaching tool rather than just a way of measuring student understanding (Hall, 2002; Tomlinson, 1999b).

“Assessment always has more to do with helping students grow than with cataloging their mistakes,” (Tomlinson, 1999b, p. 11). Finally, Tomlinson (2006) declared that summative assessments needed to provide students multiple ways to demonstrate their understanding and capabilities regarding a particular topic.

Guideline four. Another guideline had to do with the previously discussed concepts of differentiating by content, process and/or product, as well as, differentiating by student readiness, interest and learning profile. These areas were guidelines for differentiation; varying any of these areas was supposed to increase student engagement and motivation (Hall, 2002). Providing opportunities for students to work with these areas after they have been differentiated enabled educators to create the utmost opportunities for every student to become successful (Tomlinson, 2006).

Guideline five. A key focus of differentiated instruction was the creation of assignments that epitomized respect and appreciation for individual differences. “For students to hold themselves, one another, and the work they do in high regard, it is necessary for the teacher to hold each of them in high regard,” (Tomlinson, 2006). Essentially, the teacher had to determine what each student required to feel challenged and then needed to assign each and every student tasks that would accomplish this by being engaging and relevant (Tomlinson, 1999b).

Guideline six. Students and teachers collaborated as a team to create a differentiated classroom. “Teachers are chief architects of learning, but students should assist with the design and building,” (Tomlinson, 1999b, p. 12). Students played integral

roles in differentiating lessons and creating successful environments; they informed teachers of the difficulty level of their tasks, and provided feedback about their understanding (Tomlinson). Additionally, collaborating with teachers meant that students had ownership of their learning and thus became better at making choices about their education (Tomlinson).

Guideline seven. Teachers attempted to balance instruction between individual students and the entire class. “An effectively differentiated classroom is a community of learners in the richest sense of the word,” (Tomlinson, 2006, p. 18). The entire classroom, teachers and learners, worked together to create the best possible learning opportunities for students as individuals and as a class (Tomlinson, 2006). Every student worked to the best of his or her abilities, rather than being labeled by his or her weaknesses. To accomplish this goal the teacher utilized an array of instructional practices, assessments, and feedback (Tomlinson, 1999b).

Guideline eight. Flexibility was a requirement of the differentiated classroom; materials, tasks, and groups had to be flexible (Tomlinson, 1999b). “It is this quest for flexibility that is at the heart of differentiation,” (Tomlinson, 2006, p. 19). The goal of flexibility was to ensure that every learner was being addressed with appropriate tasks, to ensure the development of understanding and skills related to the topics being covered (Tomlinson, 1999b). Since every classroom has a diverse student body whose needs vary from task to task, flexibility was an essential principle of the differentiated classroom.

Guideline nine. Effective differentiation caused learners to be pushed further and for their understanding to be increased (Tomlinson, 2006). “Differentiation must always be ‘a way up,’ never ‘a way out,’” (p. 19). It would not be effective if educators used

differentiated instruction as a means of providing students with lower quality assignments and assessments. Instead, there was the supposition that every student was capable of achieving greatness if provided with the necessary support (Tomlinson).

Guideline ten. The outlined goal of differentiated instruction was to promote the highest measure of growth and success for all learners (Tomlinson, 2006). To do this students were evaluated against themselves and not against other students who may have differing capabilities and skills (Tomlinson). Doing this led to the likeliness that students would be motivated to push themselves further every day (Tomlinson) since they knew they only had themselves to surpass.

Barriers to Differentiation

The most discussed barrier to differentiation was the educators themselves. Many educators have utilized a plethora of excuses to avoid having to face the concept of differentiated instruction, let alone the idea of differentiating their own classrooms (Nunley, 2006). The excuses stemmed from the multitude of problems educators already face and from the uncertainties associated with this relatively new teaching approach (Nunley).

Many teachers assumed that by utilizing a variety of teaching strategies that they were differentiating (Nunley, 2006). Differentiation means that different strategies were utilized within a single lesson, not a single week (Nunley). Tomlinson has stated, “teachers tend to adopt and use only a limited number of instructional approaches,” even though research has suggested that a variety of instructional methods was more successful (2006, p. 22). According to Nunley, “we are not really differentiating if most of our teaching activities still involve some type of worksheet... as the chief mode of

processing and assessment,” (p. 11). It goes back to what was said about differentiating by content, process and product.

Many educators feel overwhelmed by the idea of differentiating, and thus do not differentiate at all simply because they did not know where to start (Nunley, 2006).

Another concern educators were faced with was the lack of planning time (Lewis & Batts, 2005); it takes time for learning profiles to be created and assessed, and time for lessons to be differentiated. Educators have looked at the amount of information they needed to address within a year and have decided upon utilizing the fastest ways to cover the content which included textbooks and lectures (Nunley). “However, covering material does not necessarily mean you have taught it. Or to be more accurate, it doesn’t mean students have learned it,” (Nunley, p. 35).

According to Nunley it is best to, “start with small choices in how students learn,” (p. 13). This has been accomplished by maintaining the same learning objectives for all students, and varying the process by providing two or three choices (Nunley, 2006). Nunley suggested looking for areas within the content that could be differentiated, and that process differentiation did not mean chaos in the classroom, rather it meant students were provided with choices.

Differentiation and Assessments

Assessment is an integral part of learning in any classroom. According to Moon, “current thinking has evolved to understand that student performance is at least a partial reflection of the quality of the curriculum and instruction,” (2005, p.226). Therefore it has been stated that assessment and instruction must be closely aligned (Moon). In order to ensure that assessment practices were aligned with differentiated instruction three

guidelines were created. These guidelines focused on the following areas: planning, guiding, and evaluating instruction.

Planning instruction. The first phase involved determining what was going to be taught and how it was going to be taught (Moon, 2005). This was accomplished through the utilization of pre-assessments that determined student needs. “High-quality pre-assessment data can facilitate a teacher’s differentiating instruction by establishing instructional baselines... that affect how the instruction is carried out,” (Moon, p. 228). According to Moon, pre-assessment data allows an educator to, “start a new instructional unit that begins where the students are,” (p. 228).

Guiding instruction. The second phase referred to the link between instruction and ongoing assessment, and regarded how assessment guided instruction. Assessment guided instruction through the incorporation of ongoing evaluation practices (Moon). According to Moon, “gathering data during an instructional sequence allows teachers to make in-process decisions about students’ level of mastery, misconceptions, insights and resulting needs,” (2005, p. 229). The results of ongoing assessment were used to determine the necessity of change to the instruction via differentiation (Moon). According to Moon, for students, “to accomplish mastery, the teacher provides whatever support is necessary – increasing structure, varying resources use, modifying the complexity of the context, and so on,” (p. 232).

Evaluating instruction. The final phase of assessment during differentiated instruction referred to the evaluation of the effectiveness of instruction and learning outcomes (Moon, 2005). While differentiation and grading appeared to be contradictions of one another, “they share a need for reliable and valid data,” (p. 230). The evaluations

consisted of a variety of post-assessments, including authentic ones, and all assessments focused on promoting student reflection.

Differentiation and Standards

Some educators were fearful that differentiated instruction would not allow them to address the requirements of state standards and they felt a great deal of pressure to ensure that they did (Tomlinson, 1999b). McTighe and Brown supported the coexistence of differentiated instruction and standards-based education, and stated that the two practices functioned together as a necessity (2005). Differentiated instruction was seen as the method for successfully achieving the goals of the standards and other state mandated requirements, such as those directed by No Child Left Behind legislation (McTighe & Brown).

Many educators and parents feared that students would be unprepared for standardized assessments if they were provided with differentiated instruction rather than traditional instruction. Wormeli has argued, “students will do well on standardized assessments if they know the material well, and differentiated instruction’s bottom line is to teach in whatever way students best learn,” (2006, ¶ 2). When mastery did not need to be demonstrated through a state mandated format there was no harm in alternative assessments being offered (2006). According to Wormeli, “if a student can express what he or she knows more accurately by using an alternative format, get out of their way and let them do it,” (¶ 5).

Measuring the Effectiveness of Differentiation

There was a lot of speculation that differentiated instruction increased student understanding, engagement, and performance by providing multiple opportunities for

success. However, there was very little actual data within the reviewed literature to support the claim. The data that was provided pertained specifically to a study performed by individuals for their personal purposes. While this literature review was being conducted there was no indication of any large scale review of differentiated instruction's effectiveness having been performed. Nor was there any indication that the strategies and practices that guide differentiated instruction had been evaluated to measure their effectiveness.

In one study conducted by Grimes and Stevens, they found that differentiated instruction within a mathematics classroom improved scores for low and high achieving students (2009). They also found that differentiated instruction strengthened motivation and confidence through increased engagement for low and high achieving students (Grimes & Stevens). It is worth noting that the study did not include data on the average achieving student.

According to Grimes and Stevens student motivation created a can-do attitude and "the belief that they could succeed," (2009, p. 679). Low-achieving students had a nine percent increase on assessments after they received differentiated instruction (Grimes & Stevens). In addition to improved grades, there was a twenty-five percent increase in motivation; after differentiation students reported more positive feelings toward mathematics as well. High-achieving students had similar results; after they received differentiated instruction their test scores increased by eleven percent. Similarly to the low-achieving students the high-achieving students also reported a twenty-five percent increase in motivation and confidence towards mathematics (Grimes & Stevens).

Summary

Differentiated instruction was described as a theory of practice that allowed educators to meet the needs of a classroom full of diverse learners by modifying their instruction (Hall, 2009) and the way they approached teaching. Its primary purpose was to promote the success of all students through the recognition of individual strengths and needs (Loeser, 2008). In addition, differentiated instruction pushed all students slightly beyond their comfort levels in order to most effectively challenge them (Kapusnick & Hauslein, 2001; Tomlinson, 2001).

The rationale for differentiated instruction was that no two learners were alike and therefore all learners would require educations that recognized their individual abilities and needs (Cooper, 2007). To achieve its purposes, differentiated instruction could be modified by content, process or product, as well as by readiness level, interest, and learning profile (Tomlinson, 2001). Additionally, there were many discussed strategies and guidelines that have been incorporated into the practice of differentiated instruction to aid educators and promote successful differentiation.

While differentiated instruction appeared to be a promising approach to teaching, there were several notable barriers (Nunley, 2006). In addition, there was a lot of speculation that the teaching to the middle or one-size-fits-all approach used in many classrooms has not provided adequate learning opportunities to students and that differentiated instruction would be a better method. Yet there was little data within the reviewed literature to support the claim. There were, however, several articles that supported the incorporation of differentiation within classrooms as ways of increasing

student engagement and the relevance of subjects, as well as targeting individual differences among learners.

Methodology

Differentiating instruction may have an effect on student motivation and understanding. To determine if differentiated instruction indeed effects student engagement and/or understanding, several lessons were differentiated by student readiness level, student interest, and student learning style. Students were surveyed after each differentiated lesson and were asked questions that assessed their engagement and understanding. In addition students were given several informal and formal assessments that evaluated their understanding.

Participants

The population included within this study consisted of seventh grade science students who attended a Western New York suburban middle school. The students were split into two teams with separate science teachers. Each teacher had a similar mix of students within five class sections; each section ranged in size from eleven to twenty students. There were 157 students taking seventh grade science, of these 110 participated in the study.

The students who participated in the activities ranged in ages from eleven to thirteen, and came from a diverse set of cultural and socioeconomic backgrounds. Approximately eighteen percent of students were African American, one percent American Indian or Alaska Native, seven percent Asian or Pacific Islander, seventy-one percent Caucasian, and three percent Hispanic (New York State Education Department,

2008). In addition, the students comprised a heterogeneous mix of ability levels and included some students who received accommodations for language or other needs.

Procedure

To determine the effectiveness of differentiation within the classroom, lessons were differentiated using three methods: student readiness level, student interest, and student learning profile. The three techniques were utilized in conjunction with one another, but each was addressed independently through different activities. This was done in order to determine which was the most effective at increasing student engagement and understanding within the context of a seventh grade science curriculum. Each method was utilized within lesson planning and classroom instruction over a period of two weeks while the students learned about the muscular and skeletal systems of the human body. This allowed all three techniques to be covered during the same unit which lessened the affect any variable material would have on the results, particularly student interest.

Differentiating by student readiness level meant the teacher had to first determine the key topics and concepts to be covered during a set of lessons. Following this the teacher composed a set of questions regarding the key ideas and created a pre-assessment to be completed by the students. Student responses were then analyzed by class to determine the level of understanding students brought to the class regarding each topic. With this information the teacher formatted her lessons accordingly. The pre-assessment information allowed the teacher to design whole class activities for topics the majority of students had little prior knowledge or understanding of, and smaller group activities for topics in which students had varying levels of understanding and knowledge. This

technique enabled the teacher to appropriately challenge all students and ensured that the students were able to work and learn at a pace best suited for them as individual learners.

To differentiate by student interest, the teacher had to first determine what the student's interests were. Once the teacher knew what the students within a particular class were interested in she was able to utilize that information to target the students and increase their levels of engagement. This was accomplished through the incorporation of activities that linked student interests and connections to the material being covered. The students were also encouraged to share connections between the material and their lives and interests. Doing so allowed the teacher to cultivate a setting in which the material was more relevant to the students, based on their interests.

Student learning profiles were determined through the use of a Multiple Intelligences Survey (see Appendix A); students completed the survey prior to the teacher differentiating lessons based on learning profile. After completion of the survey, the teacher analyzed the results and determined the different learning styles present within each class. The information obtained from the surveys allowed the teacher to structure her lessons accordingly. The teacher created lessons in which the material was covered in multiple modes, including the mode most preferred by each student within a particular class, and incorporated activities that addressed the different learning profiles.

Data Collection

Data for the research consisted of student scores on assessments during the period of differentiation, as well as student feedback in the form of an exit ticket (see Appendix B). The exit ticket was a short questionnaire students completed at the end of the lesson, before they left the classroom. The assessments utilized included quizzes, warm-ups, and

activities that checked for understanding. Student performance on these assessments was evaluated to determine the effect of differentiation on student understanding. Students filled out the exit ticket as a closure to the differentiated lessons. The exit ticket used for student feedback consisted of seven questions that evaluated how engaged the students were during the lesson, and how well they felt they understood the presented material. Each exit ticket was completed anonymously and dropped into a bin as students exited the classroom. The exit tickets were gathered by the teacher at the end of the day.

Question one. The first question on the exit ticket was a yes or no question that asked students if they liked the format of the lesson. This question allowed the teacher to determine if students had enjoyed the way the material was presented and tapped into student learning profiles, as well as student interest. It permitted the teacher to determine how well the lesson fit with the student's learning needs.

Question two. The next question on the exit ticket was a similar yes or no question that asked students if they would like to have more lessons structured in that manner. This question was a follow up to question one, and provided additional feedback on student preferences regarding lesson format. Again, it permitted the teacher to determine how well the lesson fit with the student's learning needs, as well as the teacher's perceived notions of student interest and learning style.

Question three. The third question on the exit ticket was another yes or no question. It provided an opportunity for the students to admit to the teacher if they liked the material that was covered during the lesson. This particular question addressed student interest. It allowed the teacher to gather data on whether the lesson was indeed meeting student interest or not.

Question four. The following question on the exit ticket regarded the students' perceived difficulty level of the lesson and provided feedback on how well the lesson matched student readiness. This question was a rated question; students rated the difficulty of the lesson by selecting a corresponding number one through three. Three represented a difficult lesson, two represented that the lesson difficulty was appropriate for the student, and one represented a lesson that was too easy.

Question five. The fifth question asked students to rate their level of engagement in the lesson. Engagement referred to how interesting and motivating the lesson was for the student. Student responses were rated from five to one, with five being the highest rating. A rating of five meant that the student was very engaged in the lesson. Subsequent declining numbers indicated less engagement with one representing that the student was not engaged at all. This question allowed the teacher to gauge how involved the students were with the lesson; it corresponded to student interest and learning profile. This information was compared to the teacher's perceived levels of student engagement and focus during the lesson.

Question six. This question dealt with the student's perceived level of understanding; students were asked to rate their level of understanding of the material covered by the lesson. Student responses were rated from five to one, with five being the highest rating. A rating of five meant that students were very confident in their understanding of the material based on the lesson, and felt that they would perform well on an assessment. Similarly to question five, declining numbers represented less understanding of the material. A rating of one meant that students felt they had little understanding of the material based on the lesson.

Question seven. The final question was a multiple choice question that regarded the helpfulness of the lesson. Students were asked to choose all answers that applied to what they perceived to be helpful aspects of the lesson. Students were also given the option to reply that no part of the lesson was helpful either because they did not like the lesson or because they did not feel they learned from the lesson. These particular choices related to questions three and six respectively, but differed in that questions three and six pertained to the lesson material while question seven pertained to the overall lesson.

Data Evaluation

The data, from the exit ticket and assessments, was collected in order to allow the teacher to perform analysis. The results from each question were tallied and added to the compiled data to allow the teacher to determine the successfulness of the utilized differentiation methods, establish any trends and draw conclusions. Limitations of the methodology were also noted and are discussed.

Student feedback was essential in driving the instruction and the creation of lessons that enabled student success on assessments. The teacher utilized the student feedback, both from discussions and the exit ticket, in an effort to evaluate student engagement and understanding. To quantitatively measure replies from the exit ticket, the teacher assigned numerical values to student responses. Replies of “yes” were represented by the number one and replies of “no” were represented by the number zero. In question four which asked students to rank how difficult they felt the assignments were, a reply of “too easy” was represented by the number two, “just right” was represented by the number one, and “too difficult” was represented by the number zero.

Questions five and six also ranked students' responses, which were represented by numerical quantities between one and five.

Assessment grades played a large role in measuring the success of the differentiated lessons as well. To determine the level of success of differentiation by readiness level, learning profile and student interest results from a pre-assessment taken prior to beginning the differentiated lessons were compared to post-assessment scores taken after the differentiated lessons were completed. Additionally, the three different methods of differentiation were compared to each other to determine which one the students found most helpful to their learning. Conclusions about the effectiveness of a particular differentiated technique could then be drawn, and success or improvements could be determined.

Trends could be found between lessons, between classes, or between differentiated methods. They could be related to a particular lesson format or lesson topic. There could be a trend in which a particular class had a preferred learning style or possessed similar interests. Trends could also involve the helpfulness of different aspects of a particular lesson or even an entire differentiated technique.

It must be noted that there were two significant limitations within this methodology. The material being covered during the implementation of the differentiation techniques varied slightly, and this could have impacted the results. To accommodate for this all of the methods were utilized together during the same unit; this lessened the effect of the content on the method's results, but did not eliminate it. In addition, the attitude a student brought to class, such as whether he or she liked the particular subject, class or teacher, could have impacted his or her feedback and even his

or her performance on assessments. To lessen this effect, the teacher strove to create a safe and comfortable learning environment, encouraged students to be honest, and had all students maintain their anonymity on their feedback questionnaire.

Results

Prior to beginning the differentiated unit a Multiple Intelligences survey was given to the students. The results of the survey showed that the majority of students learned best when information was presented in a visual manner. Additionally, a large percentage of the students had kinesthetic and/or linguistic strengths.

On the first day of the differentiated unit students were given a pre-assessment of the material they would learn about during the next two weeks (see Appendix C). The mean score on the pre-assessment was an 81.73. At the end of the differentiated unit the students took a post-assessment (see Appendix D); the mean score was a 94.91. Student scores on both assessments were graphed for comparison (see Figure 1). The results of a t-test indicated that the post assessment scores were significantly different from the pre assessment scores ($p < .05$).

Scores on the post assessment for the differentiated lessons on the human body systems were compared to scores from a post assessment on natural selection, which was not differentiated. The mean score on the natural selection post assessment was 88. Student scores on both assessments were graphed for comparison (see Figure 2). The results of a t-test indicated that the post assessment scores for the differentiated human body unit were significantly different from the post assessment scores for the non-differentiated natural selection unit ($p < .05$).

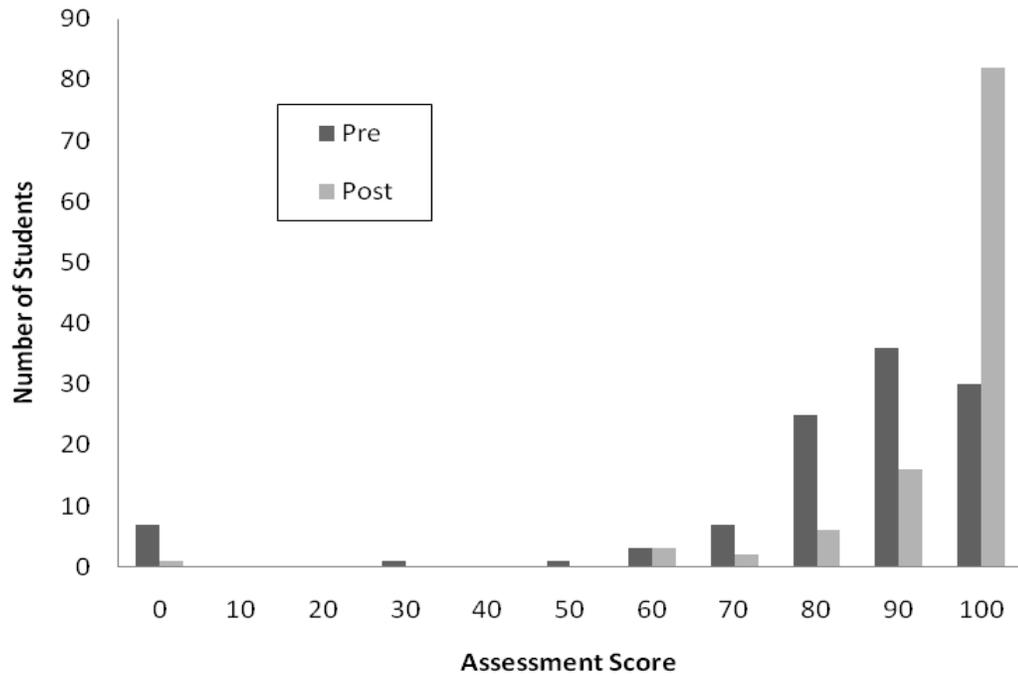


Figure 1. Assessment scores for the differentiated muscular and skeletal systems.

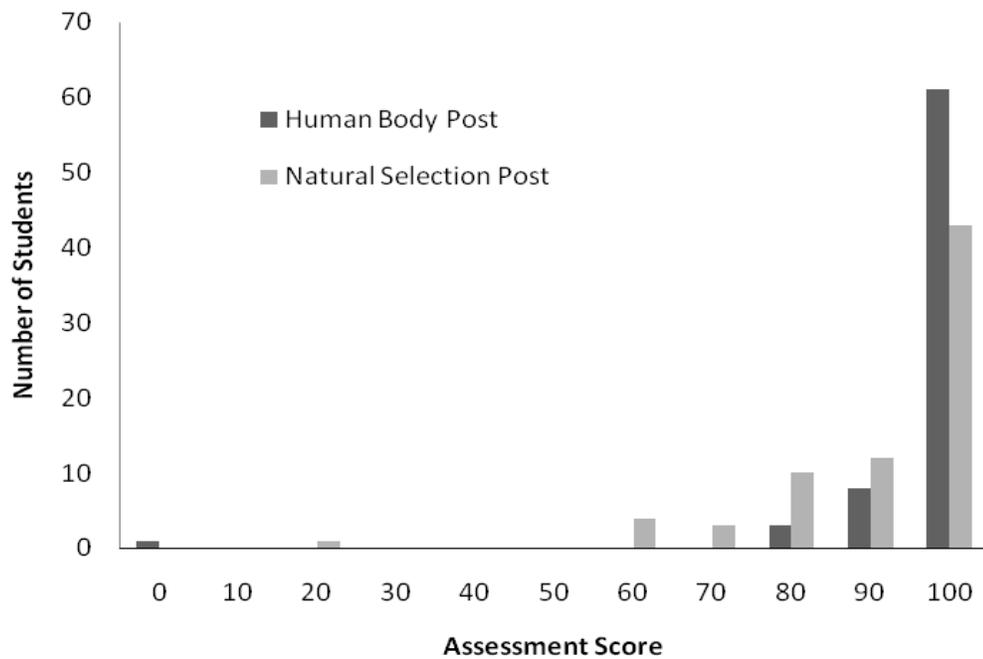


Figure 2. Scores on post assessments from a differentiated unit on the human body systems and a non-differentiated unit on natural selection.

The exit ticket was given at the end of the differentiated lessons to gather feedback from the students (see Appendix B). It showed that seventy-seven percent of students indicated themselves as being “engaged” or “very engaged” in the lesson. Eighteen percent of students felt that they were only “somewhat engaged” in the lesson. Less than five percent of students felt little or no engagement in the lesson. Students who felt a high level of engagement reported being more engaged in the differentiated lessons than traditional, non-differentiated lessons, stating, “I loved this style of learning” and “I prefer this format because I like working at my own pace. I think this is a very effective way to present the information.” Students who were somewhat engaged stated they liked the hands-on activities and the pace, and students who felt little or no engagement chose not to comment.

According to the exit ticket, eighty-four percent of students liked the format of the differentiated lessons. The correlation coefficient (r) between student opinion on the differentiated lessons and student desire to have more differentiated lessons was 0.74. This demonstrated a fairly strong positive relationship (see Figure 3). Eighty-seven percent of students felt that the level of difficulty of the material was just right. The correlation coefficient (r) between student perceptions on the levels of difficulty of the material and student perceptions on the challenge of the assignments was 0.51. The graph of this correlation exhibited a positive relationship (see Figure 4). Eighty-nine percent of students enjoyed the material covered by the lessons. The correlation coefficient (r) between student enjoyment of the material and student connections was 0.45. This illustrated a positive medium strength correlation (see Figure 5). Finally, the correlation coefficient (r) between student engagement and student confidence in their understanding

of the material was found to be 0.95. This demonstrated a strong correlation between the two factors (see Figure 6).

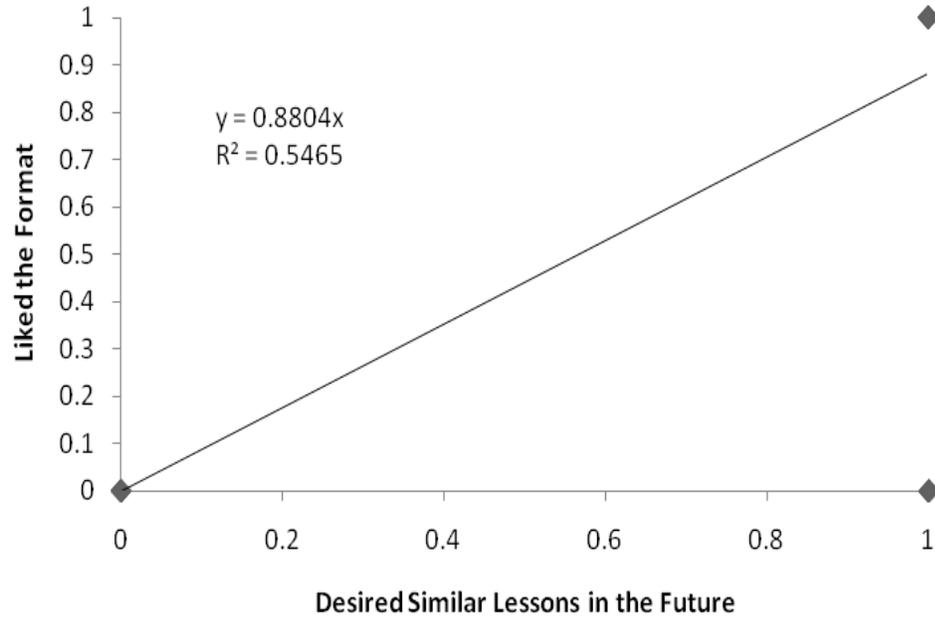


Figure 3. Correlation between whether students liked the format of the lesson and their desire to have similar lessons in the future.

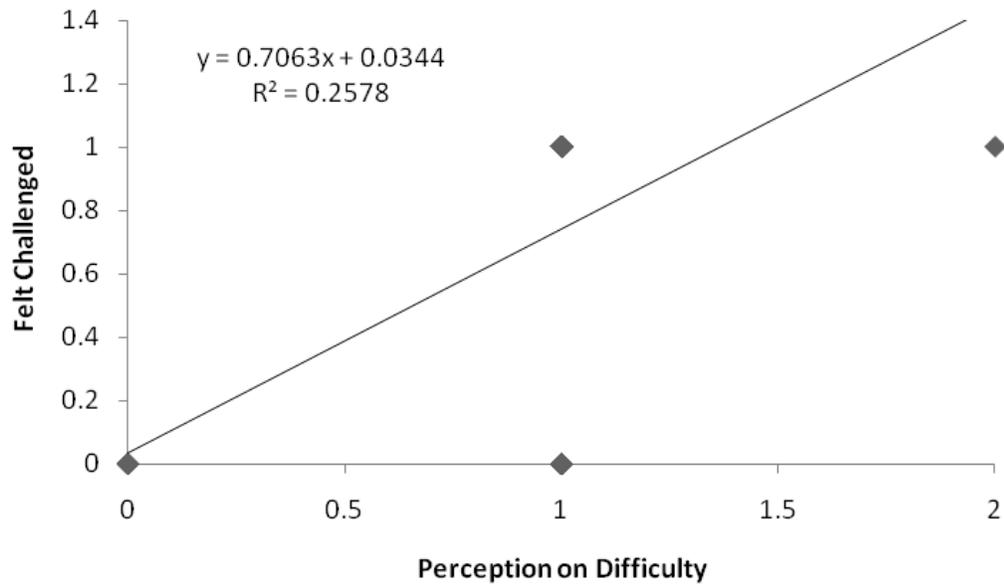


Figure 4. Correlation between the students' perceived level of difficulty and whether they felt appropriately challenged by the material.

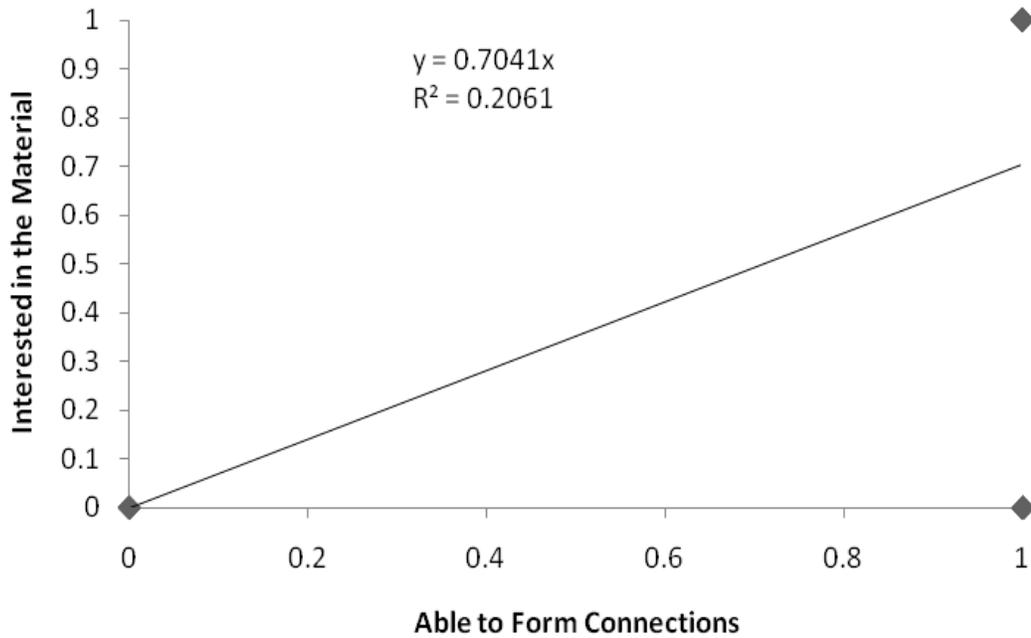


Figure 5. Correlation between the how interested in the material students were and whether they were able to form personal connections to the material.

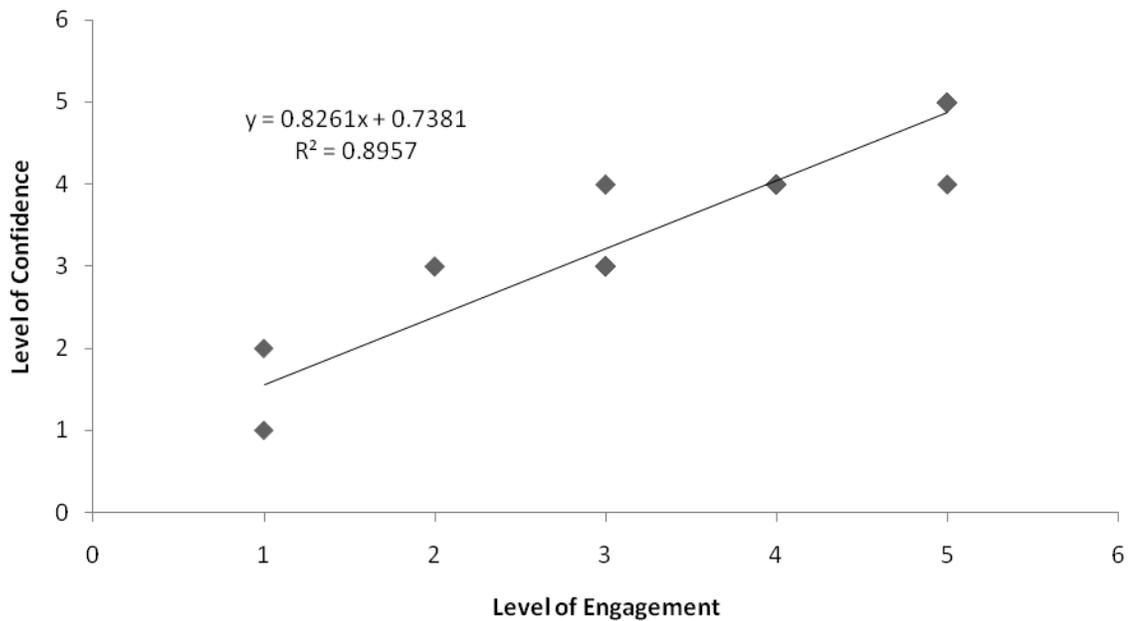


Figure 6. Correlation between the level of engagement students felt during the lessons and the level of confidence they had in their understanding of the material.

Regarding the three methods of differentiation, seventy-one percent of students felt that the way the information was presented helped them. Sixty-six percent of students stated that the appropriate level of difficulty helped them. Sixty-three percent of students felt that the connections they were able to make to the material, as well as their interest in the material, helped them.

Discussion

The research speculates differentiated instruction may increase student understanding of presented material, and may increase student engagement during lessons, but very little actual data exists to support these claims. The purpose of this study is to collect data on differentiated instruction and evaluate if it indeed affects understanding and engagement. The results indicate that differentiated instruction is beneficial to the students in both the areas. Completion of the study also enables the evaluation of one the perceived barriers to differentiation, the ability to address the standards through differentiated instruction.

Effect on Understanding

There is a noteworthy difference in the students' assessment scores between the differentiated and non-differentiated units (see Figure 2). Likewise, the students' post assessment scores from the differentiated unit show a significant improvement from the pre assessment (see Figure 1). This demonstrates that students not only excel during differentiated instruction, but perform better during differentiated lessons than non-differentiated lessons. These results agree with the findings from a similar study by Grimes and Stevens in which student understanding was measured and found to have increased with differentiated instruction (2009). These results also correspond with the

theorized benefits that differentiation increases understanding by enabling teachers to know their students' strengths and needs, which allows them to create effective lessons that promote success (Levy, 2008; Tomlinson, 1999b).

While the results support the hypothesis of the study, there are notable limitations within the study. The significant differences between the pre and post assessments scores could be attributed to an increase in knowledge gained from learning about a topic. It is possible that the students would have shown increases in post assessment scores regardless of the method of instruction utilized. In the future, this study could be repeated with a control group that received non-differentiated instruction to allow these issues to be compared. Additionally, the higher post assessment scores during the differentiated unit could be attributed to other limitations of the study such as preference for the material being covered or the incorporation of more hands-on activities that allow students to be active participants in their learning.

Effect on Engagement

While the majority of students report high levels of engagement, many also describe feeling more engaged by the differentiated activities than the non-differentiated activities. These findings indicate that the differentiated lessons have a positive effect on student engagement. In the literature review it is noted that differentiation has a positive effect on engagement and motivation as it targets students' individual needs and preferences. As stated in the research, differentiated instruction also appropriately challenges students, which can increase their engagement (Kapusnick & Hauslien, 2001; Tomlinson, 2001). The results from this study also support claims made by Grimes and

Stevens who found a twenty-five percent increase in motivation and engagement through the use of differentiated instruction (2009).

It is possible that the results could be attributed to a preference for the material being covered, rather than for the way the material is differentiated. Student engagement was not measured prior to beginning the differentiated lessons or measured during any non-differentiated lessons for comparison. The feedback that supported the claim that differentiated instruction is more engaging than non-differentiated instruction comes from student commentary during and after the differentiated lessons.

An unexpected result is the positive relationship between a student's level of engagement and a student's confidence in his or her understanding of the material (see Figure 6); students who report high levels of engagement also report high levels of confidence. This confidence does not appear to be misplaced, as students performed better on the post assessment for the differentiated unit. The correlation between engagement and confidence is very strong which makes sense when reviewing the theorized benefits of differentiation; as students feel more engaged they are less likely to feel bored or overwhelmed and more likely to respond positively to learning (Dobesh, 2008; Kapusnick & Hauslien, 2001). Grimes and Stevens found a connection between these areas; they found a twenty-five percent increase in confidence when lessons were differentiated (2009).

Most Beneficial Method

When comparing the three levels of differentiation to one another, the largest number of students reported that learning profile is helpful to their learning. It seems reasonable to expect the way students learn best would be deemed beneficial in their

education. However, students also feel that readiness and interest are beneficial to their learning. A limitation of this study is that all three methods are utilized in conjunction during the lessons, and the results rely on students being able to recognize the three methods independently.

The strongest correlation of a differentiated method is found between factors attributed to learning profile. The relationship is not as strong as the relationship between engagement and confidence in understanding mentioned earlier; however, it demonstrates a fairly strong positive relationship (see Figure 3). This makes sense given the topics that are considered; if students like the format of the lessons, they will want more lessons structured in that manner. It is worth noting that the graph shows only three data points as students who want more differentiated lessons, always like the format of the differentiated lessons.

The other two correlations deal with the readiness and interest methods of differentiation. While both exhibit positive relationships, they are not as strong as the other correlations. This makes sense because although students may be interested in the material, they may still struggle to form connections on their own without insight from educators or their peers. Since the differentiated lessons often necessitate individual, partner or small group activities, some connections that would be shared with the entire class are shared only with a few individuals.

The positive correlation between the students perception of how difficult the material is and how challenged they feel makes sense; as students feel the difficulty level is appropriate, they would also likely feel challenged. However, many students did not feel challenged, even when they had selected the “just right” difficulty rating. Perhaps

some students need to feel as though the material is more difficult in order to feel challenged. According to the reviewed literature students do best when an activity pushes them past their comfort and readiness levels (Kapusnick & Hauslein 2001; Tomlinson, 2001). This data supports the notion; although some students may feel that the difficulty is just right for them, it may not be enough to push them past their comfort levels to feel challenged.

Additional Benefits

There are additional benefits that stem from the intent to increase engagement and understanding through differentiation. During the differentiated lessons students work more independently. This enables the teachers to effectively meet and work with students individually or in small groups. The classroom also becomes very student centered, which allows the students to recognize their own needs and take charge of their learning. While it is possible that these factors come about because of the classroom setting, there is research on differentiation that supports the creation of such environments. Tomlinson has stated that differentiated methods empower teachers to create student-aware environments (2008) that motivate students to push themselves (2006).

Addressing the Standards

The literature review exposed a common fear among educators that differentiating lessons would take away from the time and resources needed to meet state requirements and address the standards (Tomlinson, 1999b). However, in completing this study the teachers found that they are not only able to align their differentiated lessons to the standards, but they feel that they more thoroughly encompass the standards through their

differentiation. This finding supports earlier results from McTighe and Brown who supported an alliance between differentiated instruction and the standards (2005).

Conclusion

As educators continue to face growing diversity within the classroom they need to recognize the benefit of utilizing strategies that enable them to reach and challenge each student. Differentiated instruction appears to be successful at increasing student engagement and understanding in the seventh grade science classroom. Students report feeling highly engaged in the differentiated lessons, and comparisons of assessments reveal significant increases in understanding after differentiation is implemented. Additional benefits, including a student centered classroom and independence, are also achieved.

Despite the apparent success of the study there appear to be at least two alterations that could be put into place to produce better results and more data on the effectiveness of differentiation. In the future it would be beneficial to repeat the study with a control group that did not receive differentiated instruction. To achieve the best results the experimental and control groups should be made up of a similar mix of students learning about the same topics. Secondly, the three methods of differentiation could be utilized separately to gather more feedback on their individual benefits in order to determine which method is most effective at increasing understanding and/or engagement.

References

- Anderson, K. M. (2007). Differentiating instruction to include all students. *Preventing School Failure, 51*(3), 49-54.
- Cooper, C. R. (2007). Boredom in school? Differentiated instruction can alleviate it. *Parenting for High Potential, 14-15*.
- Dobush, K. (n.d.). *Differentiated instruction*. Retrieved October 10, 2009, from http://webhost.bridgew.edu/kdobush/strategies%20for%20teaching%20reading/handbook/diff_inst/differentiated%20instruction.htm
- Edwards, C. J., Carr, S., & Siegel, W. (2006). Influences of experiences and training on effective teaching practices to meet the needs of diverse learners in schools. *Education, 126*(3), 580-592.
- George, P. S. (2005). A rationale for differentiating instruction in the regular classroom. *Theory into Practice, 44*(3), 185-193.
- Grimes, K. J., & Stevens, D. D. (2009). Glass, bug, mud. *Phi Delta Kappan, 90*(9), 677-680.
- Hall, B. (2009). Differentiated instruction: Reaching all students. *Pearson's Research into Practice*. Retrieved October 11, 2009, from https://www.wilsonsd.org/77032081816511420/lib/77032081816511420/DI_Reaching_All_Students.pdf
- Hall, T. (2002). Differentiated instruction. *National Center on Accessing the General Curriculum*.
- Kapusnick, R. A., & Hauslien, C. M. (2001). The 'silver cup' of differentiated instruction. *Kappa Delta Pi Record, 37*(4), 156-159.

- Levy, H. M. (2008). Meeting the needs of all students through differentiated instruction: Helping every child reach and exceed standards. *The Clearing House*, 81(4), 161-164.
- Loeser, J. W. (2008). Differentiated instruction. [PDF document]. Retrieved October 10, 2009, from <http://search.ebscohost.com/>
- McTighe, J., & Brown, L. (2005). Differentiated instruction and educational standards: Is détente possible? *Theory into Practice*, 44(3), 234-244.
- Moon, T. R. (2005). The role of assessment in differentiation. *Theory into Practice*, 44(3), 226-233.
- Multiple intelligences survey*. (n.d.). Retrieved November 29, 2009, from <http://www.teacherspayteachers.com/Product/Multiple-Intelligences-Student-Survey>
- New York State Education Department (2008). School report card: Henry V. Burger middle school. [PDF document]. Retrieved October 10, 2009, from <https://www.nystart.gov/publicweb-rc/2008/2c/AOR-2008-261701060015.pdf>
- Tomlinson, C. A. (1999a). Leadership for differentiated classrooms. *School Administrator*, 56(9), 6-11.
- Tomlinson, C. A. (1999b). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Tomlinson, C. A. (2000a). Differentiation of instruction in the elementary grades. *ERIC Clearinghouse on Early and Elementary Childhood Education*. Champaign, IL.

Tomlinson, C. A. (2000b). Reconcilable differences? Standards-based teaching and differentiation. *Educational Leadership*, 58(1), 6-11.

Tomlinson, C. A. (2001). *How to differentiate instruction in mixed ability classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. A. (2006). *An educator's guide to differentiating instruction* (J. M. Cooper, Ed.). Boston, MA: Houghton Mifflin Company.

Tomlinson, C. A. (2008). The goals of differentiation. *Educational Leadership*, 66(3), 26-30.

Wormeli, R. (2006). Busting myths about differentiated instruction. *Principal Leadership*. Retrieved October 11, 2009, from <http://www.wilmette39.org/DI39/dipdf/BustingMythsaboutDI.pdf>

Appendix A

Multiple Intelligences Survey

Directions: Complete each section by placing a “1” next to each statement you feel accurately describes you. If you do not identify with a statement, leave the space provided blank. Then total the column in each section.

Section 1

- I enjoy categorizing things by common traits
- Ecological issues are important to me
- Hiking and camping are enjoyable activities
- I enjoy working on a garden
- I believe preserving our National Parks is important
- Putting things in hierarchies makes sense to me
- Animals are important in my life
- My home has a recycling system in place
- I enjoy studying biology, botany and/or zoology
- I spend a great deal of time outdoors

Section 2

- I easily pick up on patterns
- I focus in on noise and sounds
- Moving to a beat is easy for me
- I've always been interested in playing an instrument
- The cadence of poetry intrigues me
- I remember things by putting them in a rhyme
- Concentration is difficult while listening to a radio or television
- I enjoy many kinds of music
- Musicals are more interesting than dramatic plays
- Remembering song lyrics is easy for me

Section 3

- I keep my things neat and orderly
- Step-by-step directions are a big help
- Solving problems comes easily to me
- I get easily frustrated with disorganized people
- I can complete calculations quickly in my head
- Puzzles requiring reasoning are fun
- I can't begin an assignment until all my questions are answered
- Structure helps me be successful
- I find working on a computer spreadsheet or database rewarding
- Things have to make sense to me or I am dissatisfied

Section 4

- I learn best interacting with others
- The more the merrier
- Study groups are very productive for me
- I enjoy chat rooms

- _____ Performance art can be very gratifying
- _____ Spreadsheets are great for making charts, graphs and tables
- _____ Three dimensional puzzles bring me much enjoyment
- _____ Music videos are very stimulating
- _____ I can recall things in mental pictures
- _____ I am good at reading maps and blueprints
- _____ Participating in politics is important
- _____ Television and radio talk shows are enjoyable
- _____ I am a “team player”
- _____ I dislike working alone
- _____ Clubs and extracurricular activities are fun
- _____ I pay attention to social issues and causes

Section 5

- _____ I enjoy making things with my hands
- _____ Sitting still for long periods of time is difficult for me
- _____ I enjoy outdoor games and sports
- _____ I value non-verbal communication such as sign language
- _____ A fit body is important for a fit mind
- _____ Arts and crafts are enjoyable pastimes
- _____ Expression through dance is beautiful
- _____ I like working with tools
- _____ I live an active lifestyle
- _____ I learn by doing

Section 6

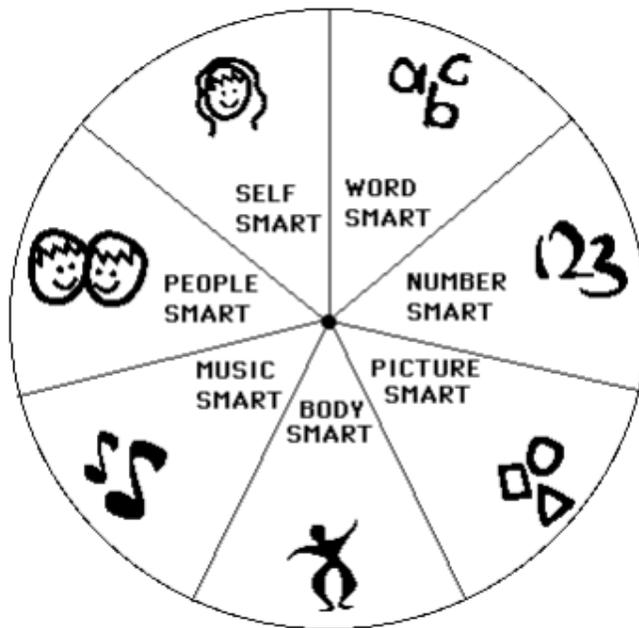
- _____ I enjoy reading all kinds of materials
- _____ Taking notes helps me remember and understand
- _____ I faithfully contact friends through letters and/or e-mail
- _____ It is easy for me to explain my ideas to others
- _____ I keep a journal
- _____ Word puzzles like crosswords and jumbles are fun
- _____ I write for pleasure
- _____ I enjoy playing with words like puns, anagrams and spoonerisms
- _____ Foreign languages interest me
- _____ Debates and public speaking are activities I like to participate in

Section 7

- _____ I am keenly aware of my moral beliefs
- _____ I learn best when I have an emotional attachment to the subject
- _____ Fairness is important to me
- _____ My attitude affects how I learn
- _____ Social justice issues concern me
- _____ Working alone can be just as productive as working in a group
- _____ I need to know why I should do something before I agree to do it
- _____ When I believe in something I will give 100% effort to it
- _____ I like to be involved in causes that help others
- _____ I am willing to protest or sign a petition to right a wrong

Section 8

- _____ I can imagine ideas in my mind
- _____ Rearranging a room is fun for me
- _____ I enjoy creating art using varied media
- _____ I remember well using graphic organizers
- _____ Performance art can be very gratifying
- _____ Spreadsheets are great for making charts, graphs and tables
- _____ Three dimensional puzzles bring me much enjoyment
- _____ Music videos are very stimulating
- _____ I can recall things in mental pictures
- _____ I am good at reading maps and blueprints



- Section 1 – This reflects your *Naturalist* strength.
- Section 2 – This suggests your *Musical* strength.
- Section 3 – This indicates your *Logical* (mathematical) strength.
- Section 4 – This shows your *Interpersonal* strength.
- Section 5 – This tells your *Kinesthetic* (athletic) strength.
- Section 6 – This indicates your *Linguistic* (verbal) strength.
- Section 7 – This reflects your *Intrapersonal* strength.
- Section 8 – This suggests your *Spatial* (visual) strength.

- _____ TOTAL for Section 1
- _____ TOTAL for Section 2
- _____ TOTAL for Section 3
- _____ TOTAL for Section 4

- _____ TOTAL for Section 5
- _____ TOTAL for Section 6
- _____ TOTAL for Section 7
- _____ TOTAL for Section 8

Source: *Multiple intelligences survey*. (n.d.).

Appendix B

Exit Ticket

1. Did you like the format of today's lesson?

Yes

No

2. Would you like to have more lessons structured in this manner?

Yes

No

3. Did you like the material covered in today's lesson?

Yes

No

4. What would you rate the level of difficulty of this lesson?

3
(Too difficult)

2
(Just right)

1
(Too easy)

5. Rate your level of engagement in today's lesson (5 being the highest level).

5
(Very engaged)

4

3

2

1
(Not at all)

6. Rate your current understanding of the material (5 being the highest level).

5
(Very confident in
my understanding)

4

3

2

1
(None at all)

7. What about today's lesson did you find helpful? (circle all that apply)

- The way the information was presented.
- The level of difficulty of the material appropriately challenged me.
- The connection(s) I was able to make to the material.
- Nothing, I didn't like this lesson.
- Nothing, I don't feel that I learned very much from this lesson.

Appendix C

Pre Assessment for Muscular and Skeletal Systems

1. Of the following, which is **not** a function of the skeletal system?
 - a. Protects internal organs.
 - b. Gives shape and support to the body.
 - c. Makes red blood cells.
 - d. Produces vitamin D.
2. Skeletal muscles always work _____.
 - a. alone
 - b. in groups
 - c. in pairs
 - d. none of the above
3. The area where bones meet is called a _____.
 - a. joint
 - b. tendon
 - c. ligament
 - d. muscle
4. What is the skeletal system?
 - a. Only the bones in the body.
 - b. All of the muscles and tendons.
 - c. All of the body's organs – both soft and hard tissues.
 - d. All of the bones in the body and the tissues that connect them.
5. Which of the following statements is **incorrect**?
 - a. Bone is where most blood cells are made.
 - b. Bones serves as a storehouse for various materials.
 - c. Bone is a dry and non-living supporting structure.
 - d. Bone protects and supports the body and its organs.
6. What is the difference between cartilage and bone?
 - a. Bone is rubbery, and cartilage is firm.
 - b. Bone is a more primitive tissue than cartilage.
 - c. Cartilage is rubbery, and bone is firm.
 - d. Bone is inside the body, and cartilage is outside.
7. What are the three types of muscles in our body?
 - a. Cardiac, Skeletal, Flexor
 - b. Skeletal, Smooth, Rough
 - c. Smooth, Rough, Flexor
 - d. Skeletal, Cardiac, Smooth
8. What is the main purpose of your muscles?
 - a. Heals various parts of the human body.
 - b. Absorb fat for digestive system.
 - c. For locomotion.
 - d. Creates a path for your blood vessels.
9. What connects muscle to bone?
 - a. Ligament
 - b. Tendon
 - c. Smooth muscle
 - d. Joint
10. What do ribs protect?
 - a. Lungs
 - b. Brain
 - c. Urinary bladder
 - d. Stomach

Appendix D

Post Assessment for Muscular and Skeletal Systems

1. Of the following, which is a function of the skeletal system?
 - a. Protects internal organs.
 - b. Gives shape and support to the body.
 - c. Produce red blood cells.
 - d. All of the above
2. A joint is:
 - a. where red blood cells are made.
 - b. the area where bones meet.
 - c. what attaches muscles to bones.
 - d. what holds bones together.
3. What makes up the skeletal system?
 - a. Only the bones in the body.
 - b. All of the muscles and tendons.
 - c. All of the body's organs – both soft and hard tissues.
 - d. All of the bones in the body and the tissues that connect them.
4. Skeletal muscles always work _____.

a. in pairs	c. alone
b. in groups	d. none of the above
5. Which of the following statements is **correct**?
 - a. Bone is where most blood cells are made.
 - b. Bones serves as a storehouse for various materials.
 - c. Bone protects and supports the body and its organs.
 - d. All of the above
6. What are the three types of muscles in our body?

a. Cardiac, Skeletal, Flexor	c. Smooth, Rough, Flexor
b. Skeletal, Smooth, Rough	d. Skeletal, Cardiac, Smooth
7. The main purpose of your muscles is _____.

a. to heal parts of the body	c. for locomotion
b. to create a path for blood vessels	d. to absorb fat from digestion
8. What connects muscle to bone?

a. Ligament	c. Smooth muscle
b. Tendon	d. Joint
9. What does the skull protect?

a. Lungs	c. Urinary bladder
b. Brain	d. Stomach
10. What is the difference between cartilage and bone?
 - a. Bone is rubbery, and cartilage is firm.
 - b. Bone is a more primitive tissue than cartilage.
 - c. Cartilage is rubbery, and bone is firm.
 - d. Bone is inside the body, and cartilage is outside.