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Learning Preferences in Elementary Education

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Learning Preferences in Elementary Education

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Introduction

There has been and continues to be considerable debate over the idea of learning styles from educators and psychologists. Some argue that learning styles are pointless while others recognize the advantages of them in the classroom. Neuroscientist David Sousa (2011) explains that students have preferences for how they gather information. "Just as most people develop a left- or right-handed preference, they also develop preferences for certain senses as they gather information" (Sousa, 2011, p. 59). This project is founded on the premise that learning preferences are just preferences, and not exclusivities. This project seeks to develop an understanding of the many theories on how children learn, develop a unit plan grounded in research, investigate the research-to-practice bridge in elementary education, and analyze theories of learning and curriculum implementation within the field of elementary education.

Many other terms have been used to describe ideas similar to learning preferences such as multiple intelligences, learning styles, and learning profiles. Learning preferences is being used in this project because it best fits the idea being explored. Learning preferences, in regards to this project, refers to the inclinations a student has toward a particular way of learning. These inclinations could be toward different senses, different intelligences, or different modalities of learning, all of which will be discussed along with their respective theory.

There have been many theorists that have defined the way in which we learn as humans. Gardner defined intelligence as "the ability to create an effective product or service that is valued in culture, a set of skills that make it possible for a person to solve problems in life, and/or the potential for finding or creating solutions for problems, which involves gathering new knowledge" (Anderson, n.d., para 3). Sternberg identified three forms of human intelligence, which are analytical, creative, and practical (Sternberg, 1997). Dunn (1990) formed a learning

styles model, which argues that five key stimuli are responsible for student learning. In addition, Moreno and Mayer with many others have contributed to the idea of multimodal learning environments, environments that call for verbal and non-verbal forms of presentation within the lesson. Schnotz (2005) explains that multimedia, or multimodal, learning indicates "the use of multiple senses such as the eye and the ear" (p. 49).

While many of these theories were not created for the purpose of education, they have been modified to fit classroom needs and assist teachers in better understanding their students. Carl Jung who studied personality types, decision-making, and interactions created the first learning-style theory in the early 1930s. His work was later applied to the Myers-Briggs Type indicator, and formed the foundation for desire to understand human learning (Silver, Strong, & Perini, 1997). Although they weren't intended for use in the classroom, many of these theories and ideas are currently being used by teachers to enhance their students' learning. If done correctly, this can be beneficial. An example of using learning preferences to the benefit of the students is choice boards. Choice boards allow students to choose one or more ways to complete a task, whether it be to learn more about a topic, apply learning, or assess learning (Gregory & Hammerman, 2008). Choice boards are developed around learning preferences and give students the chance to take an active role in their learning. Some choice boards require students to choose from a set of activities within multiple categories while others have students choose one from the entire board. Working with the research based learning theories, educators and researchers developed this idea that benefits students.

Before the 1970s there was very little communication between educators, cognitive researchers, and scientists like Jung. The fields were far removed from one another. Today, cognitive researchers are working with teachers to test their theories and hypotheses "in real

classrooms where they can see how different settings and classroom interactions influence applications of their theories" (Bransford, Brown, & Cocking, 1999, p. 3). Combining fields has offered many benefits to the way in which teachers teach. Gardner's multiple intelligences theory has been studied in the classroom and one of the findings was that "teachers learned to appreciate a wide variety of student strengths" (Harper, Mettetal, & Jordan, 1997, p. 122).

Although there are many who praise the application of these theories in the classroom, some do not feel that they should be used for that purpose. Many educators, principals, and researchers are against the use of these theories in part because they are worried they will not be applied correctly to the classroom. Some of the research in these theories was not created for classrooms and thus educators do not always trust themselves in knowing how to correctly implement them. If the learning preferences are seen as exclusivities and teachers are teaching certain students using only visual tools for instance, the theories are not being put to good use; however, when used correctly they can be helpful for student achievement.

Each of the four theories described in this project have a research background of evidence that shows they can be used effectively in the classroom if done in an appropriate manner. Gardner first developed his theory of multiple intelligences in 1983. Since then he has tweaked his theories and added onto them. This continual revision is evidence of his ongoing research. Key Elementary School in Indianapolis, Indiana, is based off of Gardner's MI theory (Gardner, 1993). Sternberg's theory has been tested in the classroom and has shown positive results (Sternberg & Grigorenko, 2001). Dunn and Dunn proposed one of the most widely used approaches to learning styles in the classroom in the 1970s (Burke & Dunn, 2003). Multimodal learning environments, primarily researched by Moreno and Mayer (2007), are not a necessarily new idea, but have seen more focus over the last few decades.

In a research program on multimodal learning tested by Roxana Moreno and Richard Mayer (2007), they found that the interactive multimodal environment involving a project called *Design-A-Plant* was much more effective than the direct instruction environment in which the same project was done. The interactive multimodal environment resulted in students who had "far higher problem solving transfer scores and perceived the learning experience as more interesting than those who learned with direct instruction" (Moreno & Mayer, 2007, p. 316). This is one of many environments that have been tested in classrooms showing the success of the theory. Sternberg's theory was tested amongst high school students in the Yale Summer Psychology Program. The researchers tested the hypothesis that students "learn and perform better when they are taught in a way that at least partially matches their own strengths," and found it to be true (Sternberg, 1997, p. 21).

Gardner's Multiple Intelligence Theory

Gardner first published his research on Multiple Intelligences in 1983 in *Frames of Mind*. His theory was designed to delve into the mind of the human being and challenge the way in which people were deemed intelligent. In fact in his opening chapter of *Frames of Mind*, Gardner describes multiple examples of an intelligent person, though they are all intelligent in different ways. One young man was a master sailor at the age of 12, one memorized the entire Koran in preparation to become a religious leader, and one learned to program a computer. These are all very different skills, yet all reflect intelligence (Gardner, 1983). Gardner defies the idea that intelligence is singular and "offers a pluralistic view of the human mind" (Gregory & Hammerman, 2008, p. 32).

According to Gardner (1983), human intellectual competence must entail problem solving skills involving responding to, resolving, and possibly creating a product, as well as the

potential for "finding or creating problems" resulting in the beginning of new knowledge (Gardner, 1983, p. 64-65). Gardner first named seven intelligences: Linguistic, Logical-Mathematical, Bodily- Kinesthetic, Visual/Spatial, Musical, Interpersonal, and Intrapersonal. In 1999 Gardner added an eighth intelligence: the Naturalist intelligence, explained in his book *Intelligence Reframed* (Gardner, 1999). In his book *Multiple Intelligences: New Horizons in Theory and Practice*, he begins to discuss the possibility of a ninth intelligence, the Existential intelligence. Ultimately he decided that it does not fit all criteria laid out to be an official intelligence at the moment. His reasoning being that "it has not yet been determined whether a specific part of the brain specializes in this faculty" (McCoog, 2010).

There are many who do not believe Gardener's MI theory should be used in the classroom for a variety of reasons. Gardner even recognizes many of these issues and works to respond to them and explain how his theory can be used incorrectly, which very often it is. Gardner (1999) describes a situation in Australia where a school aligned intelligences with racial groups. This is not the way he intended his theory to be used and he commented on it saying there should not be any testing going on regarding a student's level of intelligences unless it is to determine whether or not "a child has a cognitive impairment that inhibits a certain kind of learning" (Gardner, 1999, p. 81). Gardner also acknowledges that teachers are misunderstanding his theory by using the intelligences as learning styles. He describes it in this way: while a person may be gifted with music they may not be in a domain that requires mathematical thinking. In the same way, a person who may be good at writing in her native language may not be as successful in public speaking, which are both characteristics of linguistic intelligence. "Perhaps the decision about how to use one's favored intelligences reflects one's preferred style" (Gardner, 1999, p. 85). He uses the example that extroverted people may be more inclined to

public speaking and talk shows, while an introverted person may be drawn to crossword puzzles and poetry.

While Gardner's theory may not be the most popular with researchers in terms of classroom use, it is used quite often. There is even an entire school founded on the theory: The Key Learning Community in Indianapolis, Indiana. It began as Key Elementary School in 1987 as a K-6 program with 150 students at Indianapolis Public School #97. They added Grades 7-8 in 1993 and continued 9-12 in 1999, adding one grade per year. The entire Key Learning Community was completed in 2003 with its first graduating class. The curriculum of the Key Learning Community is grounded in Gardner's *Frames of Mind*. The school is now known as the Multiple Intelligences Magnet School 616 (Key Learning Community, 2014). Gardner (1993) explains that there are three main practices of his theory in the school. First are "apprenticeship-like pods" where students work with a variety of ages to master a craft of interest like gardening, making money, or cooking. Second are the strong ties the school has to the community. Outside specialists are invited to speak to students regarding a craft or occupation. Finally students are involved in three 10-week projects related to the three themes the school decides on for the year. These projects offer a visual record of each child's progress (Gardner, 1993).

Each of the Gardner's 8 intelligences are extensive, and the table below lists a few examples of how they are used in the classroom, some of which are credited to the menus created by Linda Campbell (1997) and Gregory and Hammerman (2008).

Intelligence	**Classroom Examples**
Linguistic	Storytelling, use debate, interview professionals and peers, write poems, compose letters
Logical-Mathematical	Experiment, find patterns, use analogies,

	probability in natural contexts, make graphs and tables
Bodily-Kinesthetic	Dance/movements, hands-on materials, field trip, participate in community involvement, puppet shows
Visual	Movie, creating artwork, board game, make three-dimensional models, use tools of technology
Musical	Song creation, instrument use, express thought through music, investigate the nature of sound
Interpersonal	Service project, teaching someone else, using social skills intentionally, cooperative learning, role playing
Intrapersonal	Journal, set goals, grade your own work, design plans for meeting goals, reflect on processes
Naturalist	Observation notebooks, photograph natural objects, care for wildlife, make models, investigate outdoors

It is important to realize that Gardner's MI theory was not specifically created for use in the classroom, but can be used if thoroughly researched to understand how to use it correctly in order to create a more effective learning environment. Intelligences are not styles and they are not meant to be used to teach based on each intelligence. "MI theory is in no way an educational prescription" (Gardner, 1999, p. 89). He cautions teachers to be careful in their attempt to teach all subjects using all of the intelligences. He also explains that we should not be "labeling people in terms of 'their' intelligence" because it could make people believe that they are only able to learn in a certain way, which is untrue (Gardner, 1999, p. 90). Teachers may use Gardner's MI theory as a means of informally observing student behavior to classify learning preferences in order to plan instruction in a more meaningful way for the students (Gregory & Hammerman,

2008). Making note of these behaviors and classifying students can be done without student knowledge and will not create a label they feel they need to abide by.

Sternberg's Triarchic Theory of Human Cognition

Sternberg introduced his work on the Triarchic Theory of Human Cognition in 1997. His theory states that teachers should teach their students so that they are using all four abilities: memory, analytical, creative, and practical cognitive skills. It is triarchic because one cannot analyze, think creatively, or apply what one knows without first knowing or recalling the information. In this framework, instruction and assessment are virtually one and the same. Activities can generally be used for either (Sternberg, 1997). It can also be used for any grade and any subject matter (Sternberg & Grigorenko, 2001). It is important to note that educators need to use this theory to teach students in all three ways, not just the way in which they are strong. Students will find one aspect of the activity or assessment to be preferred and other aspects to be challenging. One of the major praises from other researchers of this theory is that it encourages students to "capitalize on their strengths while developing and improving new skills" (Sternberg, 1997, p. 23).

Sternberg and Grigorenko (2001) credit this theory's success to four reasons. First, this instructional technique enables students to encode material in a variety of ways. In doing so they are able to retrieve the information more easily. Secondly, it is not necessary to individualize instruction as much in this curriculum because the individualization is built in within the three modes of learning and assessment. Each student is going to have a preference in analytical, creative, or practical thinking. Third, this triarchic model is "more interesting and thereby motivates students to learn" (Sternberg & Grigorenko, 2001, p. 49). Finally, this theory

encourages teachers to be more enthusiastic about their teaching experience, which motivates them to teach more effectively (Sternberg & Grigorenko, 2001).

This theory has been tested and tried in multiple classrooms and the results are positive. There are few constraints to this model besides the fact that it takes extra time to teach a lesson or do an activity in three different ways. While this may be true, the positive outcomes tend to be worth the effort and extra time spent planning and during the lesson. In 1998, Sternberg, Toroff, and Grigorenko did a study with 3rd graders in low-income Raleigh, North Carolina, and 8th graders in middle to upper-middle classes in Baltimore, Maryland, and Fresno, California, examining the social studies and science learning in their classrooms (Sternberg, 2006). They were split up into three groups: regular course material, emphasis on analytical thinking, and a diverse group, meaning it emphasized analytical, creative, and practical thinking. They assessed students using memory based multiple-choice assessments and analytical, creative, and practical performance assessments. Interestingly, the students in the diverse teaching condition outperformed the other students in both the performance assessments and the multiple-choice assessments. Sternberg and Grigorenko (2006) explain it well, "Even if our goal is just to maximize students' retention of information, teaching for diverse styles of learning still produces superior results" (p. 34).

This table provides examples of ways to teach to the four abilities:

Subject	Memory	Analysis	Creativity	Practicality
Social Studies	Learn why the world needs rules and laws	Make a list of rules and what problems they potentially solve	Direct a skit that shows why rules are needed	Create and discuss a list of rules for the classroom
Language Arts	Learn about characterization	Describe the character and why he/she is	Write a journal entry about what would	Describe a problem the character faced

		important	change if the character had a different personality	and offer an alternative to how you would handle the problem
Mathematics	Remember a mathematical formula	Solve a problem using the formula	Create an acronym for the formula	Find a way to use this formula in the real world
Science	Understand the phases of water	Compare and contrast the phases	Create a board game incorporating the phases of water	Explain how each phase is necessary for life

Educators are able to use this model to teach to the students' strengths while building up their weaknesses. The individualization is built in since every student should be asked to complete a task based on memory, analysis, creativity, and practicality. It facilitates student and teacher involvement and excitement over the curriculum, which leads to better understanding of the material.

The Dunn and Dunn Learning Style Model

Rita and Kenneth Dunn developed The Dunn and Dunn Learning Style Model in the late 1970s. They describe learning styles as "the ways in which 21 different elements affect an individual's ability to master new and difficult academic information and skills" (Burke & Dunn, 2003, p. 103). No one is affected by every one of the elements, but the ones that do affect the individual make up their learning style. Dunn and Dunn identified five key stimuli and the elements that make up a learning style:

Environmental: sound, light, temperature, design

Emotional: motivation, persistence, responsibility, structure

Sociological: self, pair, peers, team, adult, varied

Physiological perceptual, intake, time, mobility

Psychological: global/analytic, hemisphericity, impulsive/reflective (Burke & Dunn, 2003, p. 104)

Dunn and Dunn believe that teachers should identify their students' learning style (Burke & Dunn, 2003). There are four different *Learning Style Inventories* (LSI) for students to take depending on their age: ELSA for ages 7-9, LSCY for ages 10-13, LIVES for ages 14-18, and BE for ages 17 and up. This model has been researched thoroughly in the classroom and it has positive results. When students are taught to their strengths, or preferences, as identified by the LSI, they score higher on standardized tests (Dunn, 1990). Many critics believe that students should not be taught only to their preferences, but should be flexible. Rita Dunn (1990) responds this way: "It is important to note that three-fifths of learning style is biologically imposed" (p. 15). She explains that even if a student were to be taught through a different preference it would be difficult for them to learn due to the biological aspect.

This model has impacted many students through its use in the United States and globally. In 1986 Principal Roland Andrews of Brightwood Elementary School in Greensboro, North Carolina, went to study with Dunn and Dunn in New York. Once he brought the learning styles model back to his school, the *California Achievement Scores* of the school rose from the 30th percentile in 1986 to the 83rd percentile in 1989. The only difference in teaching during that time was the introduction of learning style instruction (Dunn, 1990).

Multimodal Learning

Multimodal learning, a theory most researched by Roxana Moreno and Richard Mayer, states that the more ways you learn something, the more likely you are to understand and remember it. Moreno and Mayer (2007) define multimodal learning environments as "learning

environments that use two different modes to represent the content knowledge: verbal and non-verbal" (p. 310). Students are given both a verbal description and visual representations of the content at the same time. "Student understanding can be enhanced by the addition of non-verbal knowledge representations to verbal explanations" (Moreno & Mayer, 2007, p. 310).

Many researchers have been studying the usefulness of this strategy and have found great success in the classroom due to the cognitive processes our brain undergoes during learning. When learning, students subconsciously select important verbal and non-verbal information to process further in their working memory. From there they organize their understanding and link it to prior knowledge they may have about the subject (Moreno & Mayer, 2007). When verbal and non-verbal information is paired together, students are more likely to hold onto more information and thus learn more effectively. One setback to this model is that it can lead to cognitive overload, overloading the capacity of the cognitive system (Moreno & Mayer, 2007). When too much is going on, the brain cannot handle all of it and students shut down. Teachers need to take out the unessential information to ensure this does not happen.

An example of multimodal learning in the elementary classroom is picture books. While reading to students about any content or story, they are more likely to receive and hold on to the information if they are given the chance to look at the pictures. Pictures help describe what is happening in the story and give further explanation about content without overloading the students' cognitive capacities. "Alphabetic print is no longer the only carrier of meaning and representation" (Hassett & Curwood, 2009, p. 273). No matter how students like to learn, as other theories have focused on, multimodal learning theorists (e.g., Low & Sweller, 2005; Moreno & Mayer, 2007; Fletcher & Tobias, 2005) suggest that all students should be taught in many ways to ensure understanding.

Differences and Similarities

Upon examination of the four different theories, many similarities and differences emerge among them. One major difference is whether or not teachers should identify learning preferences, styles, or multiple intelligences in students. Gardner and Sternberg say no, while Dunn and Dunn says teachers should. When identifying a student's learning preferences, it is a possibility that it could cause a student to believe that he/she can only learn in whatever way he/she was told. This is not the case for all students, but could be detrimental for some. As explained throughout this project, students do not only learn in one way. As Moreno and Mayer have explained, students should learn in a variety of ways in order to truly understand and grasp the material being covered. The researchers disagree on the issue of assessing and identifying students learning preferences throughout their work.

A second difference is that some of these theories were created for the classroom and some were not. Whether used as a model for curriculum development or researched in order to further understand the brain and how students think and learn, each theory has something teachers can take away in regards to their students and the ways in which they learn. Three of the four theories described different systems that can be used to categorize student learning. While most had some sort of system, they were all different and grounded on different criteria. (For example, Dunn and Dunn is based on environment, while Gardner focuses solely on intelligences.)

Finally, there is a difference among the theories with respect to active vs. passive learning. Active learning holds students responsible for their own learning. Students are able to lead lab experiments, use debate and role-play, and choose their own assignments. Students are normally more engaged in active learning and there is an increase in motivation when this type

of learning is used. Passive learning is the traditional teaching approach. It encompasses lecture-based class time with little discussion or choice involved (Michel, Cater, & Varela, 2009). In reviewing the four theories discussed in this project, it is interesting to see that many can be used either actively or passively, or even a combination of the two. If students are able to use a choice board to choose their learning activity, they are engaging in active learning. Each of the theories can use a choice board to create an active environment; however, they can also have students engage in passive learning if not used in a beneficial way. If students are just listening to a lecture and looking at a picture in a multimodal classroom without being required to actively participate in discussion or process the information differently, they are experiencing passive learning.

There are quite a few similarities among these four theories as well. The three main similarities are 1) students do indeed have preferences, 2) classroom instruction should be based on students' interest, and 3) teachers should advocate for choice based, varied instruction. The most important factor is that each of these theories calls for learner-centered classrooms in order for their theory to work well in the classroom with students.

Important Information for Teachers

Before implementing these theories, or any curriculum based off of these theories, teachers should critically examine what they are being given. Not everyone who has created lessons, units, or curriculum frameworks founded on these theories and ideas has done so in a correct manner. The main purpose is to help students succeed as learners. If the curriculum is not doing that it is not worth using, no matter what theory it is built on.

Beyond being used correctly, it is important to realize that what may work for one class many not work for the next. Each class is full of new individuals who bring various prior

knowledge and understandings to the classroom. Respecting what students know and how they feel about learning is just as critical as implementing an interactive, preference-based lesson. Foremost, students need to feel important and secure in a classroom before they are able to do any learning. It is also crucial for teachers to get to know their students. Knowing their interests and their hesitancies is vital in planning instruction. Also knowing each student's background, his or her level of motivation, and sense of efficacy is helpful.

This project focuses mainly on using different models of instruction to activate intrinsic motivation, though extrinsic motivation should be considered in the implementation of the plan. Generating interest in a learner-centered classroom is the best way to do this. When the learner is interested in something, processing time is increased (Sousa, 2011). Getting to know the students, determining what they are interested in, finding their learning preferences, and using those interests and preferences to teach the students is how teachers can shape the environment and develop students' intrinsic motivation to encourage learning.

The next three ideas addressed provide a framework for the similarities among the many researchers discussed. They are as follows:

- Students have preferences
- Instruction should be based on interest
- Choice based, varied instruction is key

Students Have Preferences

Among the four theories reviewed, each made it clear that students have preferences. Whether teachers choose to teach to these preferences or not, they are there. Some are biologically imposed while others are developed over time as students experience learning (Dunn, 1990). The question is whether or not to identify students' preferences. There are

arguments for both sides of this debate. While Gardner (1999) made it clear that his theory was not intended to label students, some feel that knowing your students' preferences is helpful as a teacher. Knowing what students prefer in their learning experiences enables teachers to build lessons that are more appropriate for their needs and desires. While lessons should certainly be multimodal in practice, they should also appeal to all students in some way. Whether that is through the content of the lesson, the activities done in the lesson, or the assessment following the completion of each lesson, teachers need to construct their plans in a way that students will enjoy learning and be motivated to do well. While constructing a variety of activities is important, teachers should not assign a student a certain task based on what he or she believes the student would prefer, but rather provide an array of choices for the student. Most learning preference assessments are not scientifically valid enough to decide what a student ultimately would preference. Also, choice is not always appropriate. Teachers sometimes need to guide student understanding through specific assignments that do not provide choice.

In the classroom the best way to identify student preferences is to avoid relying on students to complete a sort of assessment, but rather use learning profile surveys in a class to help students reflect on their learning or to simply begin the conversation about how all students learn differently; however, they should not use those survey results for diagnostic purposes. Ultimately, good teachers will use multiple strategies to get to know their students and seek to discover what preferences the students have. It may not be found on the first day for every student, but by careful examination of the students' work habits and by seeing whether or not they get excited about various activities, teachers will be able to figure out what his/her students enjoy and are interested in. From there, teachers can create a curriculum, lessons, and assessments off of these preferences in order to meet the students needs and desires.

Instruction Based on Interest

Basing instruction on student interest is essential to student success according to the four theories previously discussed. Instruction based on interest generally means that instruction is informed by knowing what students are interested in. This includes the content, process, and product of each lesson. While there is a scope and sequence that must be followed, the information can be taught in an interesting way, and can help motivate the students to learn. Interest leads to intrinsic motivation, and intrinsic motivation leads to learning.

One great way to teach to interest is by creating a menu of items for students to choose from. The key here is that every item should be equally challenging and should meet the same objectives. By allowing a student to take an active part in their learning, they are likely to be more motivated to do the work. Each menu item should be multimodal in that it covers more than just one mode of learning. Including options for multiple intelligences from Gardner, the three abilities from Sternberg, and varying the stimuli described by Dunn and Dunn, the teacher will be following the research base of these theories while teaching engaged students and guiding them to learn the material.

Interest based curriculum can be choice based or not. Knowing the students in the classroom is important. Each student has some interests that relate to the curriculum and some interests that do not. While one student may love the science of simple machines, another may be more interested in the history of the Civil War. Knowing what each student is interested in and what they desire to know more about will help each teacher create powerful, interest based lessons. Contracts are another way to incorporate interest into the curriculum. "Contracts have often been used to allow students some flexibility and choice in their learning" (Gregory & Hammerman, 2008, p. 105). They provide students with their goals and expectations for

learning, choices they may make in order to arrive at that learning, and responsibility for making sure they get there. Gregory and Hammerman (2008) have created a contract template that includes the following: "clear learning goals, a list of concepts to be learned, an action plan describing what the student will do, a timeline for completing the tasks, the resources and materials the student will need to accomplish the tasks, and how learning will be assessed" (p. 105). Giving students the opportunity to create a contract with the teacher shows that they are being trusted to learn the material their own way. Each lesson will not be of interest to each student, but by using choice boards and contracts, students are able to take an active responsibility in their learning.

Choice Based, Varied Instruction

It is not good enough to write a curriculum to fit the majority of the class's interests and learning preferences. While it is inappropriate and impossible to fit each intelligence, style, or preference in each lesson, each should fit in somewhere within the unit. All students should have the opportunity to succeed in the classroom. Every student's brain does not function at the same speed or in the same ways. Individualizing instruction by using choice helps ensure that each student's needs can be addressed. The underlying idea of each of these theories is that creating choice based instruction is key to student success. Gardner describes a variety of ways students can be intelligent, Sternberg lists the three abilities students can prefer, Dunn and Dunn explain different stimuli that affect student learning, and Moreno and Mayer infer that students learn in many ways all at once. While individualization was described in different ways among the many theories, the underlying key idea is there across all of them.

In most classrooms, it would be impractical and ineffective for teachers to have a completely different activity for each student based on their preferences or needs, but teachers

should plan and teach aimed at a variety of preferences and instructional levels throughout the unit. A main goal of using choice based lessons is that teachers can teach to the strengths of their students at some points, while working toward improving weaknesses at others. Just because a student does not prefer to draw does not mean that they should never try it. Elementary students in particular are still learning what they enjoy and how they learn best. Providing a variety of instructional experiences through the use of choice boards and other choice based curriculum helps students learn about who they are while teaching them in a way that is meaningful, powerful, and research-based.

Closing

Since the early 20th century, learning theories have been discussed and created. From the time when Carl Jung developed the first learning-styles theory until now, the world of education and of learning preferences has come a long way. Many theorists have studied and researched how people think, what they prefer, and what determines learning experiences to be beneficial for students. While at the start, many of these theories were not meant to be used in the classroom, teachers and researchers alike started using them to teach children. Although teachers have done so unsuccessfully, others have developed means of merging the brain research and education worlds together effectively. This has allowed teachers to begin to understand the way in which students learn and think.

Despite the different ideas on how to use their theories in the classroom, Gardner, Sternberg, Dunn and Dunn, and Moreno and Mayer do show common features among their research. The three main features discussed in this project are 1) students do have preferences, 2) instruction should be based on interest, and 3) choice based, varied instruction is important in the classroom. Using these three similarities in creating lessons for any grade, students will be

more motivated to learn and consequently will be more likely to retain the information being taught. Teachers using these features in the classroom will provide their students with rich, research-based instruction that will enable them to become better learners.

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Appendix 1: Simple Machines Unit Plan Rationale

This unit plan is based on a research project I did for an honors project at James Madison University entitled Learning Preferences in Elementary Education. My research focused on Gardner's Multiple Intelligence Theory, Sternberg's Triarchic Theory of Human Cognition, The Dunn and Dunn Learning Style Model, and Multimodal Learning. I examined the differences and similarities among the theories and found that they all discussed three important things: (1) Students have learning preferences, (2) Instruction should be based on interest, and (3) Choice-based, varied instruction is key.

In this simple machines unit plan that I have developed, you should see the three similarities throughout. The fact that students have learning preferences is the first similarity and the groundwork for the entire project. Second, I have worked to incorporate a variety of preferences throughout the unit plan. Instruction based on interest gets the students actively engaged in the learning process because they have a desire to learn more or complete the assignment. I have included this in my unit plan through the chances for students to choose an assignment option based on what they prefer and are interested in. Beyond using choice to engage students in their interests, getting to know your students before teaching this unit is necessary. Once you know what your students are interested in, you can tweak the unit based on what you find out. If students really enjoy animals, you can teach inclined planes by discussing how animals may need them. If they like racecars, make the wheel and axle lesson more racecar friendly. This unit plan is not meant to be followed exactly as it is written. Teachers need to determine what will meet their students needs best and will keep them engaged.

Students are given choices in their instruction almost daily. Each science journal page has options for completing it. Some of these options include creating a 3-D visual explanation of

how an inclined plane works, write a letter to someone in the past explaining what a screw is, or just simply write or draw characteristics of pulley. On Wednesday in week 2, students can draw, write, or record answers to their homework questions using different technologies. Their final project is all about choice. They are able to do whatever they would like to create a compound machine that follows the guidelines of the project.

Learning preferences, interest-based instruction, and choice-based instruction are all shown throughout this unit plan. While this unit plan can be taught exactly as written, I suggest teachers get to know their students to determine what interests to incorporate in order to get them more excited about learning about simple machines. If some of the choice options do not work for a teacher's classroom, they are welcome to change them to meet their students' needs. This unit plan is meant to be differentiated based on each classroom's individual needs.

Appendix 2: Simple Machines Unit Plan

Grade Level: 3rd SOL Standard: 3.2 Time Per Lesson: 45 minutes

Unit Learning Objectives

Understand	Know	Do
Students will understand: U1-The function of a simple machine is to make work easier by overcoming forces like friction and gravity. U2-Common, everyday objects use simple machines to make work easier.	Students will know: K1-The lever is a stiff bar that moves about a fixed point (fulcrum). It is a simple machine that is used to push, pull, or lift things. K2-The wedge is wide at one end and pointed at the other to help cut or split other objects. K3-The inclined plane is a flat surface that is raised so one end is higher than the other. The inclined plane helps move heavy objects up or down. K4-The screw is an inclined plane wrapped around a cylinder or cone. A common use of the screw is to hold objects together. K5-The wheel and axle consists of a rod attached to a wheel. A wheel and axle makes it easier to move or turn things. K6-The pulley is a wheel that has a rope wrapped around it. Pulleys can be used to lift heavy objects by changing the direction or amount of the force. K7-A compound machine is a combination of two or more simple machines.	Students will be able to: D1-Identify the six types of simple machines. D2-Differentiate among the six types of simple machines. D3-Investigate the six types of simple machines. D4-Analyze specific items in everyday life to classify them as the correct type of simple machine. D5-Analyze the application of each of the six types of simple machines. D6-Explain the function of each of the six types of simple machines. D7-Identify simple machines that compose a compound machine. D8- Classify simple machines that compose a compound machine. D9-Design an apparatus that contains a simple machine. D10-Construct an apparatus that contains a simple machine.

Week 1

Date	Monday	Tuesday	Wednesday	Thursday	Friday
Lesson Topic	Introduction to simple machines	Introduction to simple machines	Lever – Explanation & application/ function	Wedge – Explanation & application/ function	Inclined Plane – Explanation & application/ function
Objectives	U1, U2 D1, D2, D3	U1, U2 D1, D2, D3	U1, U2 K1 D1, D2, D3, D5, D6	U1, U2 K2 D1, D2, D3, D5, D6	U1, U2 K3 D1, D2, D3, D5, D6
Class Activity	-Assess prior knowledge (Ask: How could I move an elephant from the zoo?) -Read the book "How Do You Lift a Lion?"	-Sorting activity: Give student groups a variety of simple machines to sort into like categories. -Once they are completed, we will discuss the characteristics of each category they came up with and I will give them the name of the simple machine to title their category.	-Look over some lists they made for homework. -Address formative assessment results from Tuesday. Discuss what they wonder about. -Explore the relationship of the fulcrum to load in a penny launching experiment. Pairs of students will be given a ruler and a marker to create a launcher. They are to record on a chart the distance the penny is launched from the fulcrum, moving the fulcrum closer and further away from the load. -Give examples of a lever in everyday life. -Create a lever page in their science notebooks with	-Share some lever pages with the class. -Social Studies lesson on how Native Americans used wedges (antler wedges to split wood to make houses and canoes, arrowheads) and how we use them today (axe, nails, knife, scissors). -Create a wedge page in your science notebooks with characteristics of a wedge. Options for completing the page: Create a song, write a story, show how you use wedges in your life, or create an acronym using the word "wedge."	-Share some wedge pages with the class. -Discuss and experiment with the idea that it takes less effort to move a load the longer the inclined plane. -In small groups, create 2 ramps, one with a yardstick and one with a ruler. Loop a rubber band through the eyehole in a wooden block. Drag the block up each ramp watching the rubber band stretch. The further it stretches, the more force is required to lift it. -Create an inclined plane page in their science notebooks. Options: Compare and contrast a

			characteristics of a lever written or drawn.		wedge and an inclined plane, explain when an inclined plane would be better than a wedge to use through pictures, or create a 3-D visual explaining how an inclined plane works (this will not fit in your science notebook, but the teacher will take a picture of it to glue in later).
Homework	None	Start a list of simple machines you know.	Finish the lever page in your science notebook.	Finish the wedge page in your science notebook.	Finish the inclined plane page in your science notebook.
Assessment	Record answers to the question on an observation chart	Exit slip: "3-2-1" formative assessment – 3-What kind of simple machines are these and why? (Include pictures) 2-Reasons you may use a simple machine 1-Thing you wonder about simple machines	Use an observation chart while observing groups to gather misconceptions and questions students still have to address along the next days of instruction. Build their misconceptions into the lessons.	Look over their wedge page to see if they understand the information. Take note of any misconceptions and address them tomorrow.	Exit Slip: Judge your understanding of why we use simple machines so far using a scale of 1-5. Explain your answer in one sentence.

Week 2

Date	Monday	Tuesday	Wednesday	Thursday	Friday
Lesson Topic	Screw – Explanation & application/ function	Wheel & Axle – Explanation & application/ function	Pulley – Explanation & application/ function	Review of each type & their application/ function	Review of each type & their application/ function
Objectives	U1, U2 K4 D1, D2, D3, D5, D6	U1, U2 K5 D1, D2, D3, D5, D6	U1, U2 K6 D1, D2, D3, D5, D6	U1, U2 K1, K2, K3, K4, K5, K6 D1, D2, D3, D5, D6	U1, U2 K1, K2, K3, K4, K5, K6 D1, D2, D3, D5, D6
Class Activity	-Review some inclined plane pages with the class, addressing any misconceptions. -Read "Twist, Dig, and Drill" by Michael Dahl. -Make your own screw in class in order to see the inclined plane in it. -On your screw page in your science notebook, choose one of the following to show how the inclined plane is part of the screw and what it does: create a rap, draw a picture with labels, or write a letter to someone in the past explaining what it is.	-Review some screw pages with the class. -Complete a KWL chart about wheels and axles. -Push a toy car without wheels down the hallway and measure how far it goes. -Do the same with a car with wheels. -Discuss the results: "Which car went farther? Why?" Explain that the force is lessened with wheels. -Have students do a think, pair, share in which they describe why wheels and axles make it easier for an object to move. -Watch the Wheel & Axle Brain POP Video. -Complete the KWL.	-Discuss think, pair, share results with the class from Tuesday. -Compare lifting a gallon of water with a homemade pulley to lifting it without it. -Explain how pulleys make work easier because they reduce the force required to lift the object. -Create a pulley page in their science notebooks with characteristics of the pulley written or drawn.	-Share some results from homework from Wednesday. -Do the formative assessment listed below and review it with the class, sharing a few. -Work through stations to review each simple machine. Students choose the 3 that they feel most confused about.	-Do the formative assessment listed below and review with the class. -Work through review in groups of 2-3. Choose from one of the following activities: Write and perform a song or dance about simple machines, create a poster, imagine yourself in a different time period and explain how simple machines could be used then, or use humor to show how simple machines could be used incorrectly explaining why it

		-Create a wheel and axle page in their science notebooks with characteristics written or drawn.			wouldn't work.
Homework	Finish the screw page in your science notebook.	Finish the wheel and axle page in your science notebook.	Answer the following questions: How have simple machines changed from when an adult in your life was your age? (Ask an adult in your life about this one!) What simple machine do you see used most often? This may be done through writing, a drawing, or recorded on a recording device like a phone or iPad.	Write down your muddiest point about simple machines. This could be a specific machine, how one works, or anything else you are confused about.	Complete the sorting assignment in your science notebook.
Assessment	Look over their screw page to see if they understand the information. Take note of any misconceptions and address them tomorrow.	Think, Pair, Share results	Homework questions	-Complete the formative assessment "I used to think, but now I know" where students will list a few points they used to think about simple machines and change them based on what they know now (Keeley, p. 121).	-"Odd One Out" in table groups where objects that are simple machines will be listed and students have to figure out which does not fit, explain why, and list the simple machine that fits the rest (Keeley, p. 143).

Week 3

Date	Monday	Tuesday	Wednesday	Thursday	Friday
Lesson Topic	Compound Machines	Compound Machines	Examples of items we use that are simple/ compound machines	Finding simple/ compound machines around the school & home	Review Simple & Compound Machines
Objectives	U1, U2 K7 D5, D6, D7, D8	U1, U2 K7 D5, D6, D7, D8	U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6	U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6	U1 U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D5, D6, D7, D8
Class Activity	-Review sorting homework from Friday. -Play this online game on compound machines as a class. Compound Machines Game. -Have groups examine the following compound machines to find the simple machines used in each: scissors, can opener, stapler, your mouth, bike, and wheelbarrow.	-Base the class activity off of the questions students had on their exit slips from Monday. -Each group of 2-3 students gets a commonly asked question. Their job is to search for the answer online through pre-chosen websites or to find the answers in a book. -Each group must present their answer to the class using a multimedia presentation.	-Review some compound machines pages with the class. -Book the computer lab for students to play this online game where they find simple machines in everyday life. Online game.	-Take a "field trip" around school to find simple and compound machines. -Have students fill out a chart in small groups listing each type of simple machine. -Complete the formative assessment.	-Review some charts of simple machines found at home. -Summative assessment in which students work independently to create a chart describing the characteristics of each simple machine and provide examples of each.
Homework	Play the game at home. For students without a computer at home, give them a file folder game	Create a page in your science notebook about compound machines. This should include some pictures as well	Play the game at home. For students without a computer at home, give them a file folder game	Complete a chart or draw simple and compound machines found at home.	None

	comparable to this one. Compound Machines Game.	as examples of compound machines. Also include a story about what the world would be like without a compound machine you choose.	comparable to this one. Online game.		
Assessment	Exit Slip: "3-2-1" – 3-Things you will remember. 2-Things you are struggling with. 1-Fact you found interesting.	The presentation of each group.	As students are completing the game, have mini-interviews with students to discuss how they are feeling about the material and what questions they still have.	"Pass the question" formative assessment: Each table should list a question on a large piece of paper. The class will do a gallery walk around the room and try to answer the questions posed by each table by writing on their paper. Once back to their tables, we will review the questions as a class.	Summative assessment of material learned.

Week 4

Date	Monday	Tuesday	Wednesday	Thursday	Friday
Lesson Topic	Introduce simple machine design and construct project	Project work time	Project work time	Project work time	Share projects
Objectives	U1, U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6, D7, D8, D9, D10	U1, U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6, D7, D8, D9, D10	U1, U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6, D7, D8, D9, D10	U1, U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6, D7, D8, D9, D10	U1, U2 K1, K2, K3, K4, K5, K6, K7 D1, D2, D3, D4, D5, D6, D7, D8, D9, D10
Class Activity	-Put students into groups of three. -Show them videos of past/similar projects, like Rupe Goldberg. -Review guidelines for the project: must contain three simple machines, must hit a bell at the end, and groups will write a short paper on how each simple machine is included.	-Give student groups time to review their brainstorms and come up with more ideas -Have students begin to work on their projects by creating a list of materials needed and drawing a sketch of their project.	-Review project requirements at the beginning of class. -Project work time.	-Review project requirements at the beginning of class. -Project work time.	-Allow student groups to present their projects to the class.
Homework	Brainstorm 3 ideas for your project to share with your group tomorrow.	Continual work on the written portion of the project.	Continual work on the written portion of the project.	Continual work on the written portion of the project.	N/A
Assessment	Brainstorm lists	Project progress	Project progress	Project progress	Project final product

Appendix 3: Simple Machines Unit Plan Feedback Reflection

I sent an evaluation to three third grade teachers in Harrisonburg City and Rockingham County Schools in order to get feedback regarding the unit plan on simple machines I designed for a third grade classroom. I included questions concerning choice, interest, differentiation, how realistic it is, and the sequencing of lessons. I also asked the teachers to list any strengths and weaknesses they saw in the unit plan. I received feedback from two teachers, which was very helpful and provided some insight into today's school culture.

Overall, the feedback teachers provided me with was positive. They recognized how the unit plan provides choice for students with a variety of learning preferences as well as how it can be differentiated based on the needs of individual classrooms. Both believe the lessons within the unit plan are realistic and flow well, but one stated that he/she feels the four week science unit may not be feasible due to the increased emphasis on mathematics and reading in third grade. I found it interesting that only one of the teachers stated this as a weakness. Teachers need to feel like they have the ability to make some decisions on their own, but some may not feel this way depending on their principal's priorities and decisions, how long they have been a teacher in the school, or in what city or county they teach in. This unit does provide opportunities for integration of mathematics and literacy, and one teacher even stated they thought it incorporated reading very well. The way in which a teacher is able to teach and make judgment calls regarding instruction depends on the culture of the school. This also shows how research and practice do not always mesh well. The theories discussed in the research portion of this project were not all created for use in the classroom, so there are still teachers that will shy away from these methodologies.

Some other feedback included the need for less homework depending on their homework load in other subjects and to supplement the activities and lessons with some text for students to read in order to help them become more familiar with the terms as well as make sure parents are on the same page if they are helping them with their work. Supplementing activities with text would be very helpful for those reasons, so if I were to teach this unit plan I would include guided notes for students to fill out as we went through the lessons. This would provide some structure to note-taking and consistency with information. Finally, one teacher indicated that the exit slips may stump some students and that they should be more simplified for certain students. This is certainly possible and teachers should always differentiate this and any other unit plan based on the needs of their individual students and classrooms.