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Cognitive Styles Impact on Student Self-Efficacy

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Ashten Graham

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Abstract

This study will examine the impact the use differentiated instruction, based on cognitive styles, has on students' self-efficacy. In order to accomplish this, students will be asked to explore what cognitive styles they ascribe to. Then after varied lessons attributing to different learning styles, students will complete a survey to gauge their level of self-efficacy. The goal of this sequence is to determine whether there is a relationship between cognitive styles and self-efficacy. It will also provide insight on how to create the best learning environment to promote academic success through the use of cognitive styles and attention to self-efficacy of every student in the classroom.

Introduction

As a future teacher, it is important take time to consider what type of classroom environment and instructional strategies will allow students the highest chance of academic success. As one prepares for leading a class, is essential that one becomes very aware of what factors best promote academic success for students. Two main factors of academic success are cognitive styles and self-efficacy (Sankar 2011). With the intention of creating the best learning environment for students, I will need to understand the major factors that impact student learning.

The idea of cognitive styles was created on the basis of the statement "people do not all think the same way." The use of cognitive styles has become popular in educational settings for that same reason; if students do not all think the same way how can they be expected to all learn the same way? Through the use of differentiated instruction, based on cognitive styles, all students are given the opportunity to explore topics and concepts through their own cognitive styles. The use of multiple cognitive styles in classrooms also allows for all students to be engaged and active in their learning. It is vital teachers understand how to incorporate student

cognitive styles in the classroom in order to create a positive learning environment.

Belief in one's ability to succeed at a task is known as self-efficacy. This a major factor for student academic success. If a student feels they cannot succeed in a lesson their motivation for trying and their ability to focus decreases. That is why attention to self-efficacy is important in education. It is crucial teachers understand how to promote positive self-efficacy for students in all subjects and concepts.

As a future teacher, one needs to take the time to understand how these two major factors of student success connect. This study will examine the impact the use differentiated instruction, based on cognitive styles, has on students' self-efficacy. In order to accomplish this, students will be asked to look into what cognitive styles they ascribe to. Then after varied lessons attributing to different learning styles, students will complete a survey to decipher their level of self-efficacy. The goal of this sequence is to determine whether there is a relationship between cognitive styles and self-efficacy. It will also provide insight on how to create the best learning environment to promote academic success through the use of cognitive styles and attention to self-efficacy of every student in the classroom.

Literature Review

Cognitive styles and self-efficacy are key factors in determining student success. They are factors that determine how much a student is benefiting from the instruction and assessment provided to them in and out of the classroom. These factors have been studied and research by numerous groups worldwide in hope of understanding how they work in order to increase the odds of student achievement.

Cognitive styles are the psychological differences between how people obtain information. They are defined as the indicators of how students perceive, interact with, and respond to different learning environments (Sankar 2011). It is important for individuals to

understand how they learn. Cognitive styles are biologically imposed (Dunn 1990). By understanding which cognitive styles an individual ascribes to he or she can better prepare studying and learning methods to help them obtain the greatest amount of information. While each cognitive style is different, no one is better than any other (Sternberg, 2005). People all learn differently and understanding how each individual learns best will give that individual the best chance of success. The importance of understanding cognitive styles impacting academic success is a large reason why it is studied so often.

Cognitive styles can be categorized in numerous ways. The educational world often looks at Howard Gardner's theory of multiple intelligences (Dunn 1990). Howard Gardner classified cognitive styles into eight different categories: logical-mathematical, linguistic, musical, visual-spatial, bodily kinesthetic, naturalist, interpersonal, and intrapersonal (Morgan, 1996). Logical-mathematical intelligence is "Sensitivity to, and capacity to discern, logical or numerical patterns; ability to handle long chains of reasoning." Linguistic intelligence is "Sensitivity to the sounds, rhythms, and meanings of words; sensitivity to the different functions of language." Musical intelligence is "Abilities to produce and appreciate rhythm, pitch, and timbre; appreciation of the forms of musical expressiveness." Visual-spatial intelligence is "Capacities to perceive the visual-spatial world accurately and to perform transformations on one's initial perceptions." Bodily-kinesthetic intelligence is "Abilities to control one's body movements and to handle objects skillfully." Naturalist intelligence is "Sensitivity to features of the natural world." Interpersonal intelligence is "Capacities to discern and respond appropriately to the moods, temperaments, motivations, and desires of other people." Intrapersonal intelligence is "Access to one's own feelings and the ability to discriminate among them and draw upon them to guide behavior; knowledge of one's own strengths, weaknesses, desires, and intelligences." Gardner's theory of multiple intelligences was a breaking ground for pushing schools to

differentiate material for all students to be capable of learning.

Research has shown that the use of cognitive styles in the classroom has a strong, positive correlation with academic success outside of the classroom. G. Hwang, H. Sung, C. Hung, C., I. Huang, and C. Tsai (2012) created a role-playing online game that was adapted to students' cognitive styles of the individuals in the experimental group. The results of the experiment concluded that students' being taught with their personal cognitive style has a direct correlation with learning achievements, for students who played the personalized version of the game demonstrated higher levels of achievement than the students who played the standard version of the game. R. Dunn (1990) found in her research that students whom understood their cognitive styles found higher academic success. This is why cognitive styles are so important to use in all settings.

The education world greatly benefits from the use of cognitive styles in schools. R. Dunn (1990) found that when a student is properly diagnosed and instructed on how to use their cognitive style to study and learn there is a significant increase in academic achievement, attitudes towards school, and retention while there is a decrease in school tension. The use of cognitive styles in the classroom has a positive impact on all parts of the school. The biggest impact can be seen on students' achievement in the classroom. R. J. Sternberg and Z. Li-fang (2005), through their observations of one hundred and twenty-four students between the ages of twelve and sixteen distributed among four schools, concluded that students achieved higher levels of academic success when their cognitive style matched their teacher's instructional style. This study determines in order for students to gain the most benefit from instruction or assessment, part of the instruction or assessment must match their cognitive style. The use of cognitive styles in schools has been shown to increase academic success and positive school environments.

Self-efficacy is also a major factor in student success. Self-efficacy can be defined as “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances” (Schunk, 1991). Self-efficacy is based on a person’s perceived ability, the difficulty of the task, amount of effort expended, amount of external assistance received, number and pattern and successes and failures. It can be increased when a student receiving positive feedback on work they completed and positive past experiences. Students’ abilities to believe in themselves have a strong correlation to student finding success and motivation to complete work. Self-efficacy is a student’s belief in their capability to achieve a particular outcome by setting goals and making plans to reach that outcome (Sankar 2011). Through attention to self-efficacy the probability of student success can be greatly increased.

Student academic success can largely be attributed to the use of cognitive styles and attentions to self-efficacy. They often are found to have a strong, positive correlation between each other. Arslan (2013) observed nine hundred and eighty-four secondary students with various ages and abilities. In his surveys of the students and research on their academic achievement, he found that majority of students’ self-efficacy benefited from the use of their cognitive style in the classroom. C.S. Sanker and P. K. Raju (2011) also found that students’ self-efficacy was higher when the instructional style aligned with their personal cognitive style. Educational environments should keep cognitive styles and self-efficacy in mind when creating the best learning environment to promote academic success.

Methodology

The study that was conducted is constructed in attempt to determine the relationship between cognitive styles and self-efficacy. Participants in this study were comprised of one fourth grade class containing twenty students. All of the students were exposed to the same experiences during the four week period the study took place.

In order to determine the relationship between cognitive styles and self-efficacy, students in the class taught by the researcher were first completed a cognitive styles quiz, The Connell Multiple Intelligences Questionnaire for Children. The quiz is has eight sections, each are comprised of seven questions. Each section corresponds to one of Gardner's Multiple Intelligence cognitive styles. Each question is a situation which the students must determine if they agree or disagree. The styles the quiz determines what cognitive style(s) each student ascribes to by keeping track of how many statements the students agrees with in regards to each cognitive style. If a student agrees with six or seven of the statements the cognitive style section the researcher listed that section as a cognitive style they ascribe to. The cognitive style(s) each student ascribed to and are recorded and kept for future reference.

With the data from the cognitive styles quiz in mind, the cooperating teacher and researcher incorporated eight different activities into numerous lessons on different concepts in each core subject area. Each of the activities associates with one of Gardner's eight multiple intelligences. The researcher included an activity for each multiple intelligence since all eight cognitive styles had at least four students ascribe to it. During this time frame students were learning about fractions in Math, the Underground Railroad in Social Studies, adjectives in Language Arts, and landforms in Science. For musical intelligence the researcher incorporated chants and songs for students to learn relating to the content being taught in order for students to connect the course material to music. For visual-spatial intelligence the researcher incorporated visual models—maps, pictures, drawings—for students to observe and create during the coursework in order to visualize the content. In order to incorporate linguistic intelligence the researcher had students read about the content being taught in order to use words to expose them to course material. For Naturalist intelligence the researcher incorporates real-world features of the content by showing videos in order to connect content with real-world applications. Logical-

mathematical intelligence is incorporated by the researcher having students look for and use patterns and formulas in the coursework for students to see logical progression of content. For bodily kinesthetic intelligences the researcher incorporated experiments and hands-on activities for the students to use to learn about the content. In order to incorporate interpersonal intelligence the researcher included group work into the lessons in order to help students learn through peer collaboration. For intrapersonal intelligence the researcher had the students work independently on some course work in order to allow for self-reflection on knowledge of the content.

After all of the units, in which the eight activities were included, were complete, the students completed a standard survey that assesses their self-efficacy about the lesson. Three questions are used in the survey to examine students' self-efficacy: 1. reflection on their ability to remain activity thinking, 2. engaged and motivated, and 3. further their knowledge of the concept during the activity. The students were asked to rate their response for each question on a scale of one to five, with one being the lowest self-efficacy and five being the highest. The students were also asked to explain their response for each question in order to help the researcher understand why the student chose the response they did. The researcher then examined the relationship between cognitive styles and the responses to the post lesson self-efficacy surveys. In order to determine whether there is a positive relationship between cognitive styles and self-efficacy, the students' responses must show the activities the students' respond higher levels of self-efficacy to the questions should align with the lessons that match their recorded cognitive styles.

Data and Analysis

Twenty students took the cognitive styles quiz. There were fifty-six statements the students were asked to state whether they agreed or disagreed. The statements were separated

into eight cognitive style categories each with seven questions. Each student ascribed to at least two cognitive styles as shown in the data table below.

Names	Cognitive Style Quiz Results							
	Musical	Visual	Linguistic	Naturalist	Logical	Bodily	Inter	Intra
Alijah							X	X
Michael		X		X				
Victor					X		X	X
Lauren	X	X		X	X	X	X	
Kiara	X	X	X			X	X	
Bryson			X	X	X	X	X	X
Chaise						X		X
Stacey		X		X	X		X	
Kyre	X					X		
Katie	X		X	X			X	
Shelby		X		X		X	X	
Harrison				X			X	
Evalyn				X			X	
Kelen				X	X	X		
Kendall	X	X						
Devin		X		X				X
Andrew		X			X			
Ainsley	X		X	X			X	
Natalia		X					X	
Sarah					X		X	

These results show that each student ascribed to at least two to six different cognitive styles. The majority of the students ascribed to the visual, naturalist, and interpersonal cognitive styles. The data shows that the students have and desire to visualize what they are learning about. The data also shows that students like to see connections between the content they are learning as well as the real-world, with naturalist intelligence. This data shows that many of the students are extremely social beings, with interpersonal intelligence.

After students took the cognitive survey, the students then participated in four weeks of instruction in which eight activities, each representing a different cognitive style, were incorporated. At the end of this instructional time, the students were asked to respond on a one to

five scale to three questions—reflecting on their ability: remain actively focused, engaged and motivated, and further their knowledge of the concept during the activity. The results of the students’ surveys are displayed in the table below:

Name	Musical			Visual-Spatial			Lingustic			Naturalist		
	Music			Models			Reading			Videos		
	Focused	Engaged	Learned	Focused	Engaged	Learned	Focused	Engaged	Learned	Focused	Engaged	Learned
Alijah	1	2	1	3	3	3	4	3	3	5	4	3
Michael	4	1	1	5	5	5	5	5	5	4	4	4
Victor	3	5	5	5	4	5	5	4	5	4	4	3
Lauren	5	5	5	5	5	5	5	5	5	5	5	5
Kiara	5	5	5	5	5	5	5	5	5	5	5	5
Bryson	1	1	1	2	3	3	3	5	3	5	5	3
Chaise	2	3	5	3	5	5	2	3	5	2	5	5
Stacey	5	5	5	5	5	5	5	4	4	5	5	5
Kyre	1	4	1	5	3	3	2	1	4	4	3	5
Katie	5	5	5	5	4	5	5	5	4	5	5	5
Shelby	5	3	5	5	4	3	5	5	4	4	5	3
Harrison	4	4	4	5	5	5	5	5	5	5	5	5
Evalyn	5	4	3	4	4	4	5	4	3	4	4	4
Kelen	1	1	1	3	3	3	4	3	1	5	5	5
Kendall	5	3	3	5	5	5	2	2	3	5	4	5
Devin	5	5	5	5	5	5	3	4	1	5	5	2
Andrew	5	4	5	5	5	5	5	5	5	5	4	4
Ainsley	5	4	3	5	5	5	5	5	4	5	4	5
Natalia	4	4	4	4	4	4	3	2	4	4	2	3
Sarah	4	5	4	5	4	5	3	3	4	3	5	5

Logical-Mathematical			Bodily Kinesthetic			Interpersonal			Intrapersonal		
Formulas/Patterns			Experiments			Partner Work			Independent Work		
Focused	Engaged	Learned	Focused	Engaged	Learned	Focused	Engaged	Learned	Focused	Engaged	Learned
3	3	3	5	5	5	1	1	1	4	4	4
1	1	1	4	5	5	3	3	2	5	5	5
5	5	4	3	4	5	3	3	2	5	4	5
5	5	5	5	5	5	4	5	5	5	5	5
5	5	5	5	5	5	2	3	4	5	5	5
3	3	4	3	3	3	2	1	1	1	3	2
1	1	1	3	2	5	4	2	1	3	4	5
5	5	5	5	5	5	5	5	5	5	5	5
5	4	5	3	3	5	5	2	5	5	2	5
5	4	4	5	4	5	5	5	5	5	5	5
5	4	4	4	3	5	5	5	5	1	3	2
5	5	5	5	5	5	5	5	5	5	4	5
2	2	3	5	5	4	5	5	4	3	2	2
3	4	4	4	4	4	5	5	4	3	3	3
3	3	4	5	5	5	5	4	3	3	3	3
4	4	5	5	5	5	5	5	5	3	4	3
5	5	4	3	3	3	5	4	5	5	5	5
3	4	4	5	5	5	5	4	5	4	4	3
4	2	3	4	4	4	3	4	4	4	4	4
2	4	5	4	5	4	4	3	4	3	3	3

From the results I can see my students have a rather positive self-efficacy with a maority

cognitive styles and any particular area of self-efficacy—focus, engaged and motivated, and learning. First the researcher compared the students’ cognitive styles, shown by bold and centered number, and the students’ self-efficacy in particular to staying focused, shown by the number level the student chose and corresponding color.

Name	Students Self-Efficacy for Staying Focused							
	Musical	Visual	Linguistic	Naturalist	Logical	Bodily	Inter	Intra
Alijah	1	3	4	5	3	5	1	4
Michael	4	5	5	4	1	4	3	5
Victor	3	5	5	4	5	3	3	5
Lauren	5	5	5	5	5	5	4	5
Kiara	5	5	5	5	5	5	2	5
Bryson	1	2	3	5	3	3	2	1
Chaise	2	3	2	2	1	3	4	3
Stacey	5	5	5	5	5	5	5	5
Kyre	1	5	2	4	5	3	5	5
Katie	5	5	5	5	5	5	5	5
Shelby	5	5	5	4	5	4	5	1
Harrison	4	5	5	5	5	5	5	5
Evalyn	5	4	5	4	2	5	5	3
Kelen	1	3	4	5	3	4	5	3
Kendall	5	5	2	5	3	5	5	3
Devin	5	5	3	5	4	5	5	3
Andrew	5	5	5	5	5	3	5	5
Ainsley	5	5	5	5	3	5	5	4
Natalia	4	4	3	4	4	4	3	4
Sarah	4	5	3	3	2	4	4	3

The data shows that the students’ self-efficacy levels in particular to staying focused in each activity greatly varies against their cognitive styles. The students’ self-efficacy levels range from 1-5 in their particular cognitive styles. Majority of the students ranked their self-efficacy higher in a cognitive style area than one or more of their personal cognitive styles. The rest of the students gave the same ranking to their cognitive styles and the other cognitive styles areas. Some students do tend to focus well in their cognitive style area(s), while others lack focus the most in their cognitive style area(s).

Next the researcher compared the students’ self-efficacy in particular to staying engaged and motivated to their cognitive style in each activity. The table below shows to results of the data with the students’ cognitive styles, shown by bold and centered number, and the students’ self-efficacy in particular to staying engaged and motivated, shown by the number levels the student chose and corresponding color.

Student's Self-Efficacy for Staying Engaged and Motivated								
Name	Musical	Visual	Linguistic	Naturalist	Logical	Bodily	Inter	Intra
Alijah	2	3	3	4	3	5	1	4
Michael	1	5	5	4	1	5	3	5
Victor	5	4	4	4	5	4	3	4
Lauren	5	5	5	5	5	5	5	5
Kiara	5	5	5	5	5	5	3	5
Bryson	1	3	5	5	3	3	1	3
Chaise	3	5	3	5	1	2	2	4
Stacey	5	5	4	5	5	5	5	5
Kyre	4	3	1	3	4	3	2	2
Katie	5	4	5	5	4	4	5	5
Shelby	3	4	5	5	4	3	5	3
Harrison	4	5	5	5	5	5	5	4
Evalyn	4	4	4	4	2	5	5	2
Kelen	1	3	3	5	4	4	5	3
Kendall	3	5	2	4	3	5	4	3
Devin	5	5	4	5	4	5	5	4
Andrew	4	5	5	4	5	3	4	5
Ainsley	4	5	5	4	4	5	4	4
Natalia	4	4	2	2	2	4	4	4
Sarah	5	4	3	5	4	5	3	3

In particular to staying motivated and engaged in an activity and their cognitive style, the results of this data also show a wide variety of comparisons between the students’ self-efficacy.

Fourteen of the twenty students did not have their highest self-efficacy in one of their cognitive style areas. The other six students gave their highest rating to all of their cognitive styles areas, but also had other cognitive style areas they gave equally high ratings to.

Lastly, the researcher compared the students’ self-efficacy specifically to staying learning

to their cognitive style in each activity. The table below shows to results of the data with the students’ cognitive styles, shown by the bold and centered number, and the students’ self- efficacy in particular to learning, shown by the number levels the student chose and corresponding color.

Student's Self-Efficacy for Learning								
Name	Musical	Visual	Linguistic	Naturalist	Logical	Bodily	Inter	Intra
Alijah	1	3	3	3	3	5	1	4
Michael	1	5	5	4	1	5	2	5
Victor	5	5	5	3	4	5	2	5
Lauren	5	5	5	5	5	5	5	5
Kiara	5	5	5	5	5	5	4	5
Bryson	1	3	3	3	4	3	1	2
Chaise	5	5	5	5	1	5	1	5
Stacey	5	5	4	5	5	5	5	5
Kyre	1	3	4	5	5	5	5	5
Katie	5	5	4	5	4	5	5	5
Shelby	5	3	4	3	4	5	5	2
Harrison	4	5	5	5	5	5	5	5
Evalyn	3	4	3	4	3	4	4	2
Kelen	1	3	1	5	4	4	4	3
Kendall	3	5	3	5	4	5	3	3
Devin	5	5	1	2	5	5	5	3
Andrew	5	5	5	4	4	3	5	5
Ainsley	3	5	4	5	4	5	5	3
Natalia	4	4	4	3	3	4	4	4
Sarah	4	5	4	5	5	4	4	3

The trend continued with varied results of comparison of students’ self-efficacy as related to learning with their cognitive styles. Fifteen students did not have their highest self-efficacy in one of their cognitive style areas. The other five students gave their highest rating to all of their cognitive styles areas, but also had other cognitive style areas they gave equally high ratings to.

Conclusion

In conclusion, the students’ cognitive styles and their self-efficacy did not have a definitive relationship. The data did not show any definitive impact on their students’ self-

efficacy when using activities representing their preferred cognitive style. The data found on this study rejects the original hypothesis that students' self-efficacy will increase when learning in their preferred cognitive style. The students' seem to have varied levels' of self-efficacy across the board and benefit from numerous sources of differentiated activities despite it corresponding to their preferred cognitive style or not. Certain activities increased the self-efficacy of majority of the students. This data shows that this class of students would greatly benefit from the use of numerous form of differentiated instruction across in all of their content areas regardless of which cognitive style it represents.

There are many factors of this study that could have impacted the results of the data and could be studied further. This study however, is only comprised of twenty students between the ages of nine and ten years old. The size of the class is small and in an age range where students are constantly changing. Future studies would benefit from a larger group of students in order to have more data to analyze. Future studies may also benefit from older age groups, for they may be more mature to handle to survey and explanation process. During this study, the students in the class were not often exposed to differentiated instruction by the cooperating teacher. The researcher had to introduce this new way of learning to the students. This can impact the students' results for new activities such as experiments, creating models, and watching videos could impact students' feelings about the unfamiliar, exciting activities. The novelty of the new activities could explain the high self-efficacy results for the use of videos and models. In future studies it should be ensured the students are familiar with differentiated instruction long before the research is conducted. Another factor that impacted the data were the activities themselves. It is nearly impossible to find an educational activity that solely represents one cognitive style. There was some overlap in the activities and the cognitive styles, which could have skewed the data because students may not have ascribed to the other cognitive styles that were also

important to use in the activity. The final major factor that may have skewed the data is the level of wording on cognitive styles quiz and self-efficacy surveys. On the cognitive styles quiz, the students struggled to understand what it meant to have a statement that describes them. Often the researcher had to correct students whom believed they should check any statement that “sounded cool.” The reading level of the self-efficacy surveys was also beyond the vocabulary of the fourth grade students; the researcher then had to orally put each of the questions in understandable terms for the students to attempt to comprehend. Any further research should include changes made to some of these factors that could have impacted the data.

Throughout this research process it has become clear that it is imperative that teachers take the time to complete Action Research with their students in order to ensure they are using the most effective teaching practices for the students they have. Though there may be a great deal of research to support a hypothesis, a teacher should still conduct Action Research, for the students in a particular class may or may not fit the same mold as those whom participated in previous studies. This experience supports the notion that teachers should look into what teaching styles would be the most effective for each class of students. In the future, this researcher will continue to use surveys, observations, and assessments in order to create lessons that are geared towards the specific students within the class being taught in order to provide them the most effective instruction for each students they encounter. While different types of instructional activities can increase the self-efficacy of a group of students, it is the teacher’s duty to figure out what those activities are.

References

ARSLAN, A. (2013). Investigation of Relationship between Sources of Self-efficacy Beliefs of Secondary School Students and Some Variables Beliefs of Secondary School Students and Some Variables. *Educational Sciences: Theory & Practice*, 13(4), 1983-1993.
doi:10.12738/estp.2013.4.1753

Self-efficacy is also an important component to student achievement and there appears to be a correlation between it and cognitive styles. Arslan attempted to look at this correlation between self-efficacy and cognitive styles. Self-efficacy is a students' belief that they can control their performance in achieving the goals they set for themselves. Cognitive styles are the different ways in which students think when learning about a subject—musical, bodily-kinesthetic, interpersonal, verbal-linguistics, logical-mathematical, intrapersonal, and visual spatial. Arslan observed 984 secondary students with various ages and abilities. In his surveys of the students and research on their academic achievement, he found that majority of students' self-efficacy benefited from the use of their cognitive style in the classroom.

Dunn, R. (1990). Rita Dunn answers questions on learning styles. *Educational Leadership*, 48(2), 15.

The use of cognitive styles in the classroom can greatly benefit students and teachers alike. Rita Dunn is a consultant and author on cognitive styles. She has found that despite the multiple models of cognitive styles they all have the same root; each individual prefers a different style of learning to help them understand the material. Through research she found that students who are taught in their preferred cognitive styles obtain higher achievement than when they are taught with approaches that do not match their preferences. Dunn found that cognitive styles are biologically imposed, that is why using

them to learn is important for student achievement. There are multiple factors that are a part of learning styles, which is why they must be identified with a reliable and valid diagnosis assessment. Through her research she found that when a student is properly diagnosed and instructed on how to use their cognitive style to study and learn there is a significant increase in academic achievement, attitudes towards school, and retention while there is a decrease in school tension. The use of cognitive styles in the classroom is initially more work on the teacher, but through practice it can actually make learning and teaching more enjoyable for the students and teachers.

Hwang, G., Sung, H., Hung, C., Huang, I., & Tsai, C. (2012). Development of a personalized educational computer game based on students' learning styles. *Educational Technology Research & Development, 60*(4), 623-638. doi:10.1007/s11423-012-9241-x

Cognitive styles are important to consider in all aspects of instruction and assessment.

Hwang, Sung, Hung, Huang, and Tsai found in creating their own educational computer game it was crucial that they take students' cognitive styles into account. The

establishment of personalized learning content in the classroom has been recognized as one of the most important features of educational systems. In order to establish

personalized learning content cognitive styles must be taken into consideration. A

cognitive style not only how a student learns and likes to learn, but is also an instructional strategy updating the cognition, context, and content of learning. With this knowledge

Hwang, Sung, Hung, Huang, and Tsai created an online role-playing game in which the student's cognitive style was stored in their profile. The game then gave them different

tasks based on the learning styles of the student. They piloted this game with a group of forty-six fifth grade students, all of these students were pretested and determined to have

the same amount of prior knowledge of the material. The group was then separated in

which half of them were given the personalized version of the game based on their cognitive styles and half were given one style of the game. The results of the experiment concluded that students' being taught with their personal cognitive style has a direct correlation with learning achievements, for students who played the personalized version of the game demonstrated higher levels of achievement than the students who played the standard version of the game.

Morgan, H. (1996). An analysis of Gardner's theory of multiple intelligence. *Roeper Review*, 18(4), 263.

According to Harry Morgan Gardner's multiple intelligence theory has been widely used in numerous works of literature and research occurring on the subject of intelligence and cognitive styles. Gardner's theory is mainly recognized by schools, for it is an old theory that was revamped for educators attempting to teach students. Cognitive styles can also be described as psychological differentiation; Gardner's multiple intelligences simply are reframing cognitive styles. The basic idea behind cognitive styles is that every individual has preferred ways of organizing all that they experience and think about. Gardner then classified cognitive styles into 7 categories: logical-mathematical, linguistic, musical, visual-spatial, bodily kinesthetic, interpersonal, and intrapersonal. Logical-mathematical intelligence is "Sensitivity to, and capacity to discern, logical or numerical patterns; ability to handle long chains of reasoning." Linguistic intelligence is "Sensitivity to the sounds, rhythms, and meanings of words; sensitivity to the different functions of language." Musical intelligence is "Abilities to produce and appreciate rhythm, pitch, and timbre; appreciation of the forms of musical expressiveness." Visual-spatial intelligence is "Capacities to perceive the visual-spatial world accurately and to perform transformations on one's initial perceptions." Bodily-kinesthetic intelligence is "Abilities

to control one's body movements and to handle objects skillfully.” Interpersonal intelligence is “Capacities to discern and respond appropriately to the moods, temperaments, motivations, and desires of other people.” Intrapersonal intelligence is “Access to one's own feelings and the ability to discriminate among them and draw upon them to guide behavior; knowledge of one's own strengths, weaknesses, desires, and intelligences.” Gardner’s theory of multiple intelligences was a breaking ground for pushing schools to differentiate material for students to all be capable to learning.

Sankar, C. S., & Raju, P. K. (2011). Use of Presage-Pedagogy-Process-Product Model to Assess the Effectiveness of Case Study Methodology in Achieving Learning Outcomes. *Journal Of STEM Education: Innovations & Research*, 12(7), 45-56.

Through the correlation between cognitive styles and students’ self-efficacy many strive to find the keys to student success. Sanker and Raju worked to create a 4-P Model of how students learn. One major factor of a student’s learning outcome is their cognitive style. Cognitive styles are indicators of how students perceive, interact with, and respond to different learning environments. Another major factor of a student’s learning outcome is their self-efficacy—belief in their capability to achieve a particular outcome by setting goals and making plans to reach that outcome. Students were tested for their cognitive style using “The Index of Learning Styles.” Self-efficacy was measured by the “Longitudinal Assessment of Engineering Self-Efficacy.” At the end of their study, Sanker and Raju found that students’ self-efficacy was higher when the instructional style aligned with their personal cognitive style.

Schunk, D. H. (1991). Self-Efficacy and Academic Motivation. *Educational Psychologist*, 26(3/4), 207.

Dale H. Schunk defines self-efficacy to be “people’s judgments of their capabilities to

organize and execute courses of action required to attain designated types of performances.” According to Schunk self-efficacy can be used to predict academic achievement, social skills, pain tolerance, athletic performances, career choices, assertiveness, coping with feared events, and much more. Self-efficacy is based on a person’s perceived ability, the difficulty of the task, amount of effort expended, amount of external assistance received, number and pattern and successes and failures. Self-efficacy increases when a student receiving positive feedback on work they completed and positive past experiences. Students’ abilities to believe in themselves have a strong correlation to student finding success and motivation to complete work. According to Schunk’s research, student self-efficacy has been seen to increase with the use of goal setting, high ability with information-processing, observing models, receiving attributional feedback, receiving rewards, and motivation.

Sternberg, R. J., & Li-fang, Z. (2005). Styles of Thinking as a Basis of Differentiated Instruction. *Theory Into Practice*, 44(3), 245-253. doi:10.1207/s15430421tip4403_9

Regarding cognitive styles there seems to be a direct correlation between the use of cognitive styles and student achievement in the classroom. Sternberg and Li-fang researched how cognitive styles impact student achievement. Through their initial research they found that cognitive styles are preferences, not abilities. This is why people can use multiple styles and why no one style is better than another. Through their observations of 124 students between the ages of 12 and 16 distributed among 4 schools, Sternberg and Li-fang concluded that students achieved higher levels of academic success when their cognitive style matched their teacher’s instructional style. This study determines in order for students to gain the most benefit from instruction or assessment, part of the instruction or assessment must match their cognitive style.

APPENDIX A.

COGNITIVE STYLES SURVEY

The Connell Multiple Intelligence Questionnaire for Children

Put a check next to each sentence that describes you.

- Area 1**
- I like to listen to songs on the radio or a CD.
 - I like to watch music videos on TV.
 - I like to go to music concerts and hear live music.
 - I can easily remember tunes, raps, or melodies.
 - I take music lessons, singing lessons, or play a musical instrument.
 - I can learn new songs easily.
 - I like to sing.
- Area 2**
- I like art classes.
 - I like to draw, paint, and make things with clay.
 - I enjoy putting puzzles together.
 - I like to build things using blocks, Legos, and models.
 - It is fun to play video games.
 - I can create a picture in my mind to help me think things through.
 - I notice the different styles of things, such as clothes, cars, and hairstyles.
- Area 3**
- I like to read books, magazines, and comic books.
 - I have a good vocabulary and like to learn new words.
 - I enjoy writing e-mails to my friends.
 - I like to write.
 - It is fun to play word games such as Scrabble and Mad Libs, do crossword puzzles, and acrostics.
 - I think it would be fun to keep a journal of my thoughts and ideas.
 - I like to talk to my friends on the telephone.
- Area 4**
- I like to play with animals and take care of them.
 - I like going to zoos, parks, or aquariums.
 - I like being outside.
 - I like to hike, walk, or run outdoors.
 - I like to observe nature's changes, such as thunderstorms, rain, snow, and sunshine.
 - I help to recycle and take care of our environment.
 - I pay close attention to things in my environment such as trees, rocks, flowers, birds, bugs, and squirrels.

- Area 5**
- I like to do science experiments and go to science museums.
 - I find arithmetic and math problems interesting.
 - It is fun to solve mysteries.
 - Numbers are really interesting to me.
 - I like games like chess or computer games where you have to think a lot.
 - I like TV shows like *ZOOM*, *National Geographic*, and *Now* that talk about science and math.
 - I can do math problems in my head and make good estimates.

- Area 6**
- I like to dance.
 - I like to play sports such as baseball, soccer, hockey, or football.
 - I like to build models or do beading, sewing, macramé, or carpentry.
 - I enjoy acting in plays or skits or playing charades.
 - I like to move when I am thinking about things.
 - I like activities such as the martial arts, tennis, running, jogging, biking, skateboarding, or gymnastics.
 - I can sometimes “feel” the right answer.

- Area 7**
- I like to be with my friends often.
 - I like to help those who need help.
 - I like to read books or see movies about people and their lives.
 - I can usually tell how other people are feeling.
 - It is fun for me to organize activities at home and at school.
 - I would rather spend time with others than spend time alone.
 - I like to talk in class discussions.

- Area 8**
- I like doing things by myself.
 - I would rather work by myself than with other students.
 - I like to spend time thinking or writing about things that matter to me.
 - I like to play computer games.
 - I usually know what my feelings are.
 - I like to write my thoughts and feelings in a diary or journal.
 - I know what things I am good at, and what things I am not so good at.

Scoring—Count up the number of responses you had for each area. The areas that you check show how you are smart in the different areas.

- | | |
|---|--|
| <input type="checkbox"/> = Area 1 (Music Smart) | <input type="checkbox"/> = Area 5 (Math Smart) |
| <input type="checkbox"/> = Area 2 (Picture Smart) | <input type="checkbox"/> = Area 6 (Body Smart) |
| <input type="checkbox"/> = Area 3 (Word Smart) | <input type="checkbox"/> = Area 7 (People Smart) |
| <input type="checkbox"/> = Area 4 (Nature Smart) | <input type="checkbox"/> = Area 8 (Self Smart) |

A score of 5 or more indicates a very strong area; a score of 3–4 indicates a moderate area; and a score of less than 3 indicates a developing area.

APPENDIX B.
ACTIVITY SURVEY

Reading

Directions: Circle the number you feel accurately explains your feelings about learning through reading (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

1. I am actively thinking during reading.

5 4 3 2 1



Explain:

2. Reading in class is motivating and intellectually engaging.

5 4 3 2 1



Explain:

3. Reading in class furthers my understanding of the lesson.

5 4 3 2 1



Explain:

Videos

Directions: Circle the number you feel accurately explains your feelings about learning through videos (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree, 1 = I disagree strongly). Then explain why you chose that number.

4. I am actively thinking during videos.

5 4 3 2 1



Explain:

5. Watching videos in class is motivating and intellectually engaging.

5 4 3 2 1



Explain:

6. Watching videos in class furthers my understanding of the lesson.

5 4 3 2 1



Explain:

Music

Directions: Circle the number you feel accurately explains your feelings about learning through music(5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

7. **I am actively thinking during songs/chants.**

5 4 3 2 1



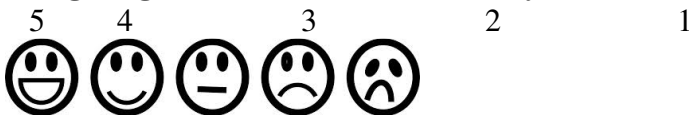
Explain:

8. **Learning songs/chants in class is motivating and intellectually engaging.**



Explain:

9. **Learning songs/chants in class furthers my understanding of the lesson.**



Explain:

Experiments

Directions: Circle the number you feel accurately explains your feelings about learning through experiments (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

10. I am actively thinking during experiments.

5 4 3 2 1



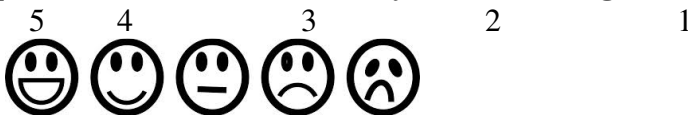
Explain:

11. Experiments in class are motivating and intellectually engaging.



Explain:

12. Experiments in class furthers my understanding of the lesson.



Explain:

Working with Partners

Directions: Circle the number you feel accurately explains your feelings about learning through partner work (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

13. I am actively thinking during partner work.

5 4 3 2 1



Explain:

14. Partner work in class is motivating and intellectually engaging.



Explain:

15. Partner work in class furthers my understanding of the lesson.



Explain:

Models

Directions: Circle the number you feel accurately explains your feelings about learning through reading (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

16. I am actively thinking when drawing/making models.

5 4 3 2 1



Explain:

17. Drawing/making models in class is motivating and intellectually engaging.

5 4 3 2 1



Explain:

18. Drawing/making models in class furthers my understanding of the lesson.

5 4 3 2 1



Explain:

Independent Work

Directions: Circle the number you feel accurately explains your feelings about learning through reading (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

19. I am actively thinking during independent work.

5 4 3 2 1



Explain:

20. Independent work in class is motivating and intellectually engaging.

5 4 3 2 1



Explain:

21. Independent work in class furthers my understanding of the lesson.

5 4 3 2 1



Explain:

Formulas and Patterns

Directions: Circle the number you feel accurately explains your feelings about learning through reading (5 = I strongly agree, 4 = I agree, 3 = I feel neutral, 2 = I disagree 1 = I disagree strongly). Then explain why you chose that number.

22. I am actively thinking when using formulas/patterns.

5 4 3 2 1



Explain:

23. Formulas/patterns in class is motivating and intellectually engaging.

5 4 3 2 1



Explain:

24. Formulas/Patterns in class furthers my understanding of the lesson.

5 4 3 2 1



Explain: