THE EFFECTS OF INCORPORATING STUDENT-MADE VISUALS DAILY IN THE JUNIOR HIGH SCIENCE CLASSROOM

by

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ABSTRACT

This project implemented student-made visuals daily in the life science classroom. Students used Play-Doh, white boards, and concept maps to create visuals that reinforced the science concepts. The use of student-made visuals increased understanding and retention for most students, and equally as important, caused students to have a positive attitude toward science.

INTRODUCTION AND BACKGROUND

Over the past three years of teaching, I have observed that junior high students are more engaged when they have the opportunity to do hands-on activities in science, and they can recall information from these activities very well. Aside from structured lab activities, students enjoy showing their understanding of science concepts by drawing on personal white boards or molding Play-Doh. They have informally expressed that they would like to do these activities more often. Additionally, I have observed that my students have a difficult time correctly relating content from one unit with content in past units. As a result of my observations and informal student feedback, I decided to see how daily incorporation of three different types of student-made visuals affected student understanding and retention of science concepts. The three student-made visuals were free hand drawings, Play-Doh models, and concept maps. A concept map is a graphical way to link concepts and show how students understand the relationships between concepts.

I implemented the student-made visuals in one seventh-grade life science class at Southwest Junior High in Forest Lake, MN. Forest Lake is considered a northern suburb of the twin cities and Southwest Junior High serves predominately middle- to upper-class families. The school serves 750 students in grades 7, 8, and 9.

My project posed a great benefit to my students and the school by implementing new teaching strategies with the aim of increasing student learning and retention, which ultimately could improve standardized test scores in science. Science and math scores have been a national focus in recent years under the Obama administration (The Obama-Biden Plan, 2009). Students need a good background in science, technology, engineering, and math in order to competently function, compete, and thrive in society and in the work place. I thought that the use of more student-made visual aids would benefit my students and increase their understanding of science.

Literature suggested that incorporating visual aids, such as animations and graphics, into life science courses increased student long-term retention and attitudes (O'Day, 2007). With this in mind, my project focus question was, *What are the effects of incorporating student-made visuals daily on junior high students' understanding of life science concepts?* My project subquestions were as follows: *What are the effects of incorporating student-made visuals daily on students' long-term memory of life science concepts; What are the effects of incorporating student-made visuals daily on student interest and attitude; and What are the effects of incorporating student-made visuals daily on my teaching and attitude?*

CONCEPTUAL FRAMEWORK

In 1967, Jacobus Henricus van't Hoff introduced the idea that experience in the arts reinforces scientific skills and improves scientific understanding. As history has shown, many Nobel Prize winners in science including Albert Einstein had strong backgrounds in art (Root-Bernstein & Root-Bernstein, 2013). Sixteen years after van't Hoff's proposal, Howard Gardner introduced the theory of multiple intelligences. This theory states that an individual has a unique combination of intelligences they use to solve problems. These intelligences include linguistic, musical, spatial, mathematical, and bodily-kinesthetic intelligence (Garner & Thatch, 1990). Thus, incorporating art into the science classroom may be a way to tap into students' multiple intelligences to improve their overall scientific understanding and skill set.

According to Kingir, Tas, Gok, and Vural (2013), the constructivist theory of learning is based on the idea that students actively form their own understanding of the world through their personal experiences. In a constructivist classroom, the students create their own understandings by exchanging ideas and information with other students and the teacher. Teachers function as facilitators who guide student learning by providing authentic learning opportunities. The constructivist theory also takes into consideration that environmental factors may influence students' learning and motivation. Artistic visuals are a way for students to construct and express their own understanding of the scientific content.

Kinesthetic learning activities have been developed for many areas of science. In a study conducted by Richards (2012), one population of undergraduate students was taught Ptolemaic and Copernican Retrograde Motion with a kinesthetic activity in which students moved around to represent the orbits of planets. A second population of students was taught the same information without the kinesthetic activity. Results indicated that the students who participated in the kinesthetic activity scored significantly higher on the subsequent exam than students who were taught the concepts without the activity. This suggests that kinesthetic activities may improve student understanding and test performance at the undergraduate level.

In addition to full-body kinesthetic activities, incorporating kinesthetic activities in which students create models or graphs may affect student understanding (Breckler & Yu, 2011). Their research showed that comprehension of science concepts increased when hands-on kinesthetic activities involving models were incorporated into the class. Additionally, their study of university physiology students indicated that students only hearing the lecture averaged 51.5% on the test. The same students averaged 90.6% on the test after hearing the lecture *and* completing a short hands-on activity in which they created a model of the oxygen carrying capacity of blood. Way (1982) also discovered that having junior high students create Play-Doh models of cells helped students easily conceptualize and correctly understand that a cell and its organelles are three-dimensional despite the two-dimensional appearance under a microscope. Similarly, research conducted by Stern, Aprea, and Ebner (2003) indicated that university students who actively created graphs or diagrams, based on a given text, had a deeper understanding of the text than university students who passively encountered a generated graph. Subsequently, the process of drawing graphs helped the students to answer questions regarding the text more accurately. Kinesthetic activities such as moving one's entire body, creating a model, or drawing a graph can impact how well students understand science concepts.

The incorporation of hands-on activities, such as creating diagrams and models, may have a significant effect on student achievement and long-term memory due to the link between visual stimuli and memory. According to psychologists, memory has two specific components that store information, one of which is the "visuospatial sketchpad" responsible for taking into account any information in the visual or spatial form (St. Clair-Thompson & Botton, 2009, p.141). As visual capacities in the brain improve from creating diagrams and models, a student's memory score may improve as well. Studies have shown that participating in drawing and painting classes can improve visual imaging and memory test scores, and also result in significant increases in science, math, and standardized test scores in college engineering students (Root-Bernstein & Root-

Bernstein, 2013). Incorporating student-made visual aids through hands-on activities may affect memory and test scores.

Breckler and Yu (2011) suggested that university physiology students' long-term retention 10-12 days after covering the material was much higher when a hands-on activity was included in the lecture compared to retention when no hands-on activity was included in lecture. In their study students averaged a score of 81.1% on test questions answered 10-12 days after a lecture with hands-on activity, versus scoring 51.1% after the lecture without the hands-on activity. The hands-on activity positively impacted retention.

Additionally, Rinne, Gregory, Yarmolinskaya, and Hardiman (2011) stated that long-term memory is greatly influenced by repetition and prolonged attention. The more time spent on a concept, the more likely it is to be retained. Research has shown that artistic activities can lead to sustained attention in young children, resulting in a higher likelihood that these activities and their corresponding concepts will be remembered (Posner & Patoine, 2009). Time spent learning concepts via artistic activities can aid students in retaining the concepts.

Constructivist classrooms enhance student interest and lead to a more positive attitude toward science (Kingir et al., 2013; Breckler & Yu, 2011). In a study of 802 eighth-grade students in Turkey, Kingir et al. (2013) found that students are more likely to enjoy science class and show an interest when they think they can relate the content with their lives, communicate easily with peers and the teacher, and take responsibility for their learning. Research by Areepattamannil (2012) concerning adolescent science students in Qatar and research by Milner, Templin, and Czerniak (2011) concerning four fifth- grade constructivist classrooms in the Midwestern United States found that student motivation increased in constructivist classrooms. Incorporating the use of visual aids in the constructivist science classroom may also impact student attitude toward science. San Francisco State University students reported a high level of engagement and motivation when asked to create a model of oxygen in the blood with tubing and beads during a physiology lecture (Breckler & Yu, 2011). In order to enhance student motivation and interest, these studies all recommended that teachers incorporate constructivist-based activities into the classroom. The creation of student-made visual aids fits well into those constructivist activities by allowing students to reflect on their understanding and build on it, ultimately impacting their attitudes toward science.

The incorporation of artistic activities not only impacts the students, but also the teacher. A study conducted by McKeen (2010) followed three fifth-grade science teachers who incorporated artistic activities such as drawing, creative writing, and song-writing into their classrooms. The results indicated that all three teachers found it challenging to incorporate new artistic activities due to a lack of time, but when the teachers did incorporate the arts, they became more reflective and self-aware of their teaching. This study also indicated that all of the teachers saw the arts as a way to differentiate methods to measure student understanding of the science content, and as a way to develop stronger communication with their students and other colleagues (McKeen, 2010). Additionally, another student-made visual, the concept map, has been shown to encourage secondary teachers and lead to better communication among colleagues (Conlon, 2009).

Incorporating arts and student-made visuals into the constructivist science classroom can greatly enhance student learning and memory of science content and science skills, as well as impact the teacher's attitude and amount of self-reflection. Constructivist classrooms allow students to have autonomy in developing their own understanding while teachers facilitate learning. Student-made visuals give students another avenue with which to perceive the world, build on their learning, and display their understanding. The teachers can use these same activities as an alternative tool to evaluate student learning. It is important for science teachers to recognize the value of artistic activities and student-made visual aids in science in order to reach multiple intelligences. This project aims to build on the research dedicated to revealing the effects of using student-made visual aids in the science classroom.

METHODOLOGY

This project was conducted over four units in the life science curriculum, one nontreatment unit and three treatment units to allow for comparison. The nontreatment unit was Evolution: Change Over Time of DNA, which lasted two and a half weeks. In this unit students learned about Charles Darwin, his theory of natural selection, and the evidence that exists supporting the theory of evolution. This unit was taught in a typical teacher-centered manner without any special treatment. The three treatment units were the Human Body's Homeostasis and Skin, the Digestive System, and the Cardiovascular System in which students learned about the human body's organs and their interactions. The first two treatment units lasted one and a half weeks, while the third treatment unit lasted two weeks. These three treatment units were taught with the daily incorporation of a student-made visual aid, such as Play-Doh models, student drawings on white boards, or concept maps. The nontreatment unit was used to compare with the treatments units to determine the effects of student-made visuals.

Throughout the nontreatment unit, students learned new material through teacher PowerPoint presentations, class discussions, textbook readings, and Internet activities. Students used science notebooks to organize each lesson and record information. Students worked with peers to complete a hands-on station activity over two days that reinforced classroom concepts regarding evolution. Aside from the station activity, no other experiments or hands-on activities took place in the classroom.

The three treatment units covered the Human Body's Homeostasis and Skin, the Digestive System, and the Cardiovascular System. Each day after using science notebooks to go through the teacher PowerPoint presentation, class discussion, book reading, or online activity, students had time to create visuals according to teacher instructions that reinforced concepts from the lesson. During this time students were asked to make or draw specific items from the day's lesson and connect that model or drawing with the lesson (Figure 1).

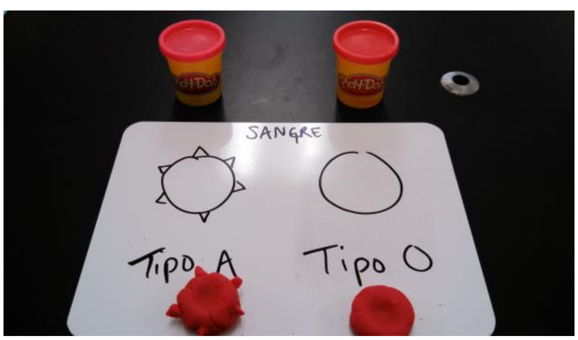

Figure 1. Example of student white board drawings and Play-Doh models of two blood types.

In one lesson during the third treatment unit on the Cardiovascular System, the class started by reading together a few paragraphs from the textbook regarding the composition of blood and the various cells. Following the reading, students were instructed to form a red blood cell, a white blood cell, and a platelet with Play-Doh and then identify the cell whose job it is to transport oxygen. As the students created their models they received informal feedback from classmates, and the teacher walked around giving corrective feedback when necessary. When all students had their models correctly formed, the teacher asked students to identify the correct cell in response to additional questions about the cell's life span, presence of nuclei, and function. This activity reinforced and assessed student learning. Students then set their models aside and read one more paragraph from the textbook regarding blood types. They were then asked to form various types of red blood cells with their Play-Doh such as type AB+, O-, and A-. Class concluded after students correctly identified which of the models was the universal donor and which was the universal recipient.

The students who participated in the treatment were 22 seventh graders in one section of Spanish Immersion Life Science, 9 males and 13 females. This class was taught completely in Spanish. All students in this class attended a Spanish Immersion Elementary School and learned Spanish fluently as their second language.

To answer the focus question and subsequent questions, data were collected in three different ways for each question. This allowed for data triangulation and a thorough comparison of results (Table 1). Data were collected from the students, the teacher, and a colleague to incorporate multiple points of view on the treatment's effects. Additionally, the multiple perspectives allowed for quantitative and qualitative data to be collected to answer the project questions regarding attitude and to minimize bias.

To assess student motivation and attitude toward science, Nonconcept Pretreatment Interview Questions and Nonconcept Posttreatment Interview Questions were used to conduct interviews with the same six students, three girls and three boys (Appendices A & B). The six students included two high achievers, two average achievers, and two low achievers in order to provide multiple perspectives. The interviews provided in-depth information regarding students' attitudes toward science in general and toward the use of specific student-made visuals. The same six students additionally completed the Student Content Interview Questions both pretreatment and posttreatment to provide additional information on how student learning was affected by the incorporation of visual aids (Appendix C). They were asked about which activities help them to learn best, and then they were asked to create a concept map with various scientific terms learned over the course of the treatment units. In all interviews, responses were recorded by the teacher. Interview data was analyzed for common themes and used to support evidence from surveys.

To accompany the student interviews in providing an indication of how student-made visuals affect student interest and attitude, all students completed the Student Attitude Pretreatment and Posttreatment Survey (Appendix D). The frequency of *Strongly Disagree, Disagree, Agree,* and *Strongly Agree* responses for each statement was recorded and trends were identified. Additionally, teacher observations were recorded using the Teacher Observation Prompts pretreatment and posttreatment, and trends were identified to provide supporting evidence to the interview and survey data regarding student attitude (Appendix E).

To assess student learning, preunit and postunit surveys were administered during the three treatment units. All 22 students completed the Student Pretreatment Unit Two Survey before the second treatment unit on the Digestive System and the Student Posttreatment Unit Two Survey after (Appendices F & G). The survey data was analyzed for common themes and used to support evidence from the preunit and postunit assessment scores. Similar preunit responses and postunit survey responses were grouped together, and their frequencies were compared. Students also completed the Student Pretreatment Unit One Survey and the Student Pretreatment Unit Three Survey before those units, as well as the Student Posttreatment Unit One Survey and the Student Posttreatment Unit Three Survey following those units (Appendices H, I, J & K). The survey data was analyzed for common responses and trends. The frequency of responses was then compared between the preunit and postunit surveys.

The final method of collecting data on how student-made visuals affect student understanding was the Human Body Assessment given pretreatment and posttreatment to all 22 students (Appendix L). This assessment covered information from all three treatment units with open-ended questions, fill-in-the-blank questions, and true/false questions. The assessment provided quantitative data concerning student understanding of concepts. The mean and median scores were calculated. A Test of Significance for Unknown Means and Unknown Variables was used to determine if posttreatment scores differed from pretreatment scores. Regression testing was used to look for correlations. The students were then given the same Human Body Assessment 14 days after the treatment ended to quantify what the students remembered, thus addressing the long-term retention of the content learned. This assessment allowed for a second quantitative comparison of posttreatment scores and scores 14 days later, again utilizing the Test of Significance for Unknown Means and Unknown Variables and regression testing, along with a comparison of mean and median scores.

Along with the delayed Human Body Assessment, two other data collection tools were used to determine the effects of incorporating student-made visuals on students' long-term memory of life science concepts. They included the Student Content Posttreatment and Delayed Interview Questions (Appendix M), as well as the Student Content Posttreatment and Delayed Survey (Appendix N). The interviews and surveys provided qualitative data and detailed information on the types of information retained 14 days after the treatment ended. The qualitative data was coded and analyzed for themes to support evidence from the delayed Human Body Assessment.

To assess the effects of incorporating daily student-made visuals on the teacher's attitude and teaching, the teacher completed a weekly reflection journal with prompts along with the Teacher Pretreatment and Posttreament Attitude Survey (Appendices O and P). The weekly reflections were analyzed for themes, and the frequency of the survey responses, *Strongly Disagree*, *Disagree*, *Agree*, and *Strongly Agree*, was recorded. Additionally, a colleague observed the teacher during both the nontreatment and treatment units to provide an unbiased perspective on how the teacher was affected by the incorporation of student-made visuals. The colleague recorded general observations and also used the Nontreatment and Treatment Colleague Observation Prompts to record aspects of the teacher's attitude and teaching (Appendix Q).

This project began in January of 2015 and was completed by the middle of March, 2015. The Project Timeline lays out the duration of these four units (Appendix R). The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix S).

Table 1
Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3
Primary Question: 1. What are the effects of incorporating student-made visuals (student drawings, concept maps, Play-Doh models) daily on junior high students' understanding of life science concepts?	Human Body Assessment	Student Content Interview Questions	Student pretreatment and posttreatment unit surveys
Secondary Question: 2. What are the effects of incorporating student-made visuals daily on students' long-term memory of life science concepts?	Human Body Assessment	Student Content Posttreatment and Delayed Interview Questions	Student Content Posttreatment and Delayed Survey
3. What are the effects of incorporating student-made visuals daily on student interest and attitude?	Student Attitude Pretreatment and Posttreatment Survey	Nonconcept Pretreatment and Posttreatment Interview Questions	Teacher Observations Prompts
4. What are the effects of incorporating student-made visuals daily on the teacher's teaching and attitude?	Nontreatment and Treatment Colleague Observation Prompts	Teacher Weekly Reflection Journal Prompts	Teacher Pretreatment and Posttreatment Attitude Survey

DATA AND ANALYSIS

The results of the pretreatment and posttreatment Human Body Assessment indicated that the incorporation of Play-Doh, white boards, or concept maps every day positively impacted student understanding. There were 15 points possible on the Human Body Assessment, and the average score on the posttreatment Human Body Assessment was over double the average score on the pretreatment Human Body Assessment (N=22). The average score on the posttreatment assessment was 13.14 (87.6%) while the average score on the pretreatment assessment was 6.18 (41.2%). The median and mode for the pretreatment assessment were both seven, while the median and mode doubled on the posttreatment assessment to 14 (Figure 2).

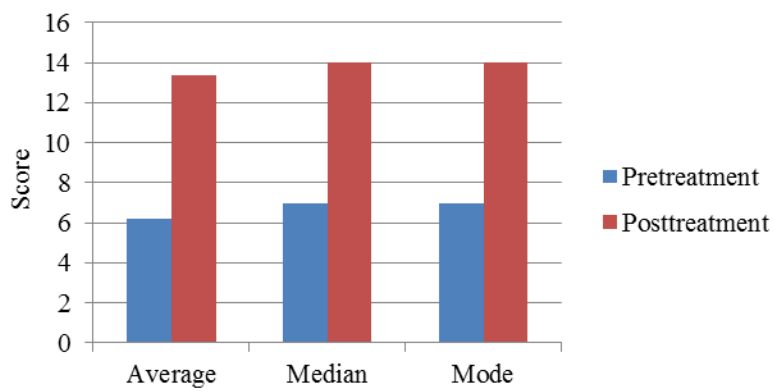

Figure 2. Statistical analyses of pretreatment and posttreatment human body assessment scores, (*N*=22).

The interviews also indicated an improvement in student understanding over the course of the treatment. The six interviewed students created posttreatment concept maps that correctly incorporated more terms than were incorporated on the pretreatment concept maps. Five of the six students created pretreatment concept maps that correctly included six (50%) or less of the 12 given words. Posttreatment, though, all six students were able to increase the number of terms they correctly used on the concept map, with an average of 10 (83.3%) words correctly linked. An example of the increased understanding can be seen in the two concept maps of the average-achieving male. On the pretreatment concept map this student correctly linked seven of the twelve given words in a concept map (Figure 3). On the posttreatment concept map this same student correctly linked all twelve of the given words (Figure 4).

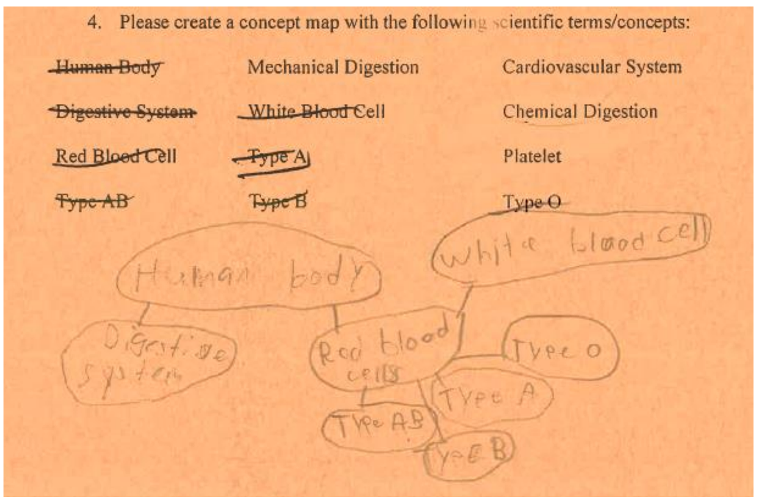

Figure 3. Pretreatment interview concept map by average-achieving male student.

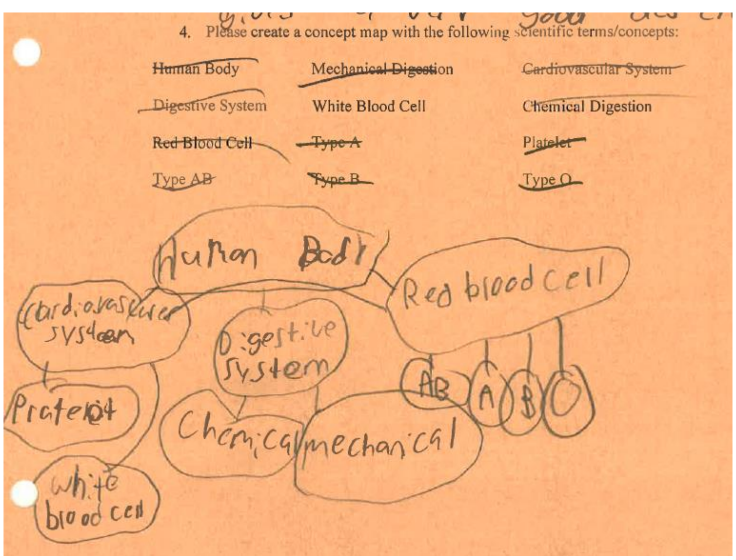

Figure 4. Posttreatment interview concept map by average-achieving male student.

The pretreatment and posttreatment unit surveys provided a third form of data regarding student understanding. In the first unit, students ranked their own understanding of the human body's skin and homeostasis much higher on the posttreatment survey than on the pretreatment survey. Using a scale from one to five, the class had an average ranking of two on the pretreatment survey, while on the posttreatment survey this average increased to 3.77. This trend continued for the second and third treatment units. The third unit saw the lowest increase while the first unit had the greatest increase (Table 2).

Table 2
Average Student Pretreatment and Posttreatment Unit Survey Rankings For The Question, "On a scale of 1 to 5, how would you rank your understanding…"

	Pretreatment	Posttreatment	Change
Unit 1	2.0	3.77	+1.77
Unit 2	2.8	4.0	+1.2
Unit 3	2.7	3.5	+0.8

Note. 1= You don't know what it is, 5= You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else. (*N*=22).

Not only was student understanding impacted by the treatment, but student attitude was impacted as well. Student surveys and interviews indicated that students looked forward to science class more when they knew they were using Play-Doh or white boards in the lesson. The Student Attitude Posttreatment Survey results showed that students enjoyed science more when using Play-Doh, white boards, and concept maps, however students preferred using Play-Doh or white boards over creating concept maps (Figure 5).

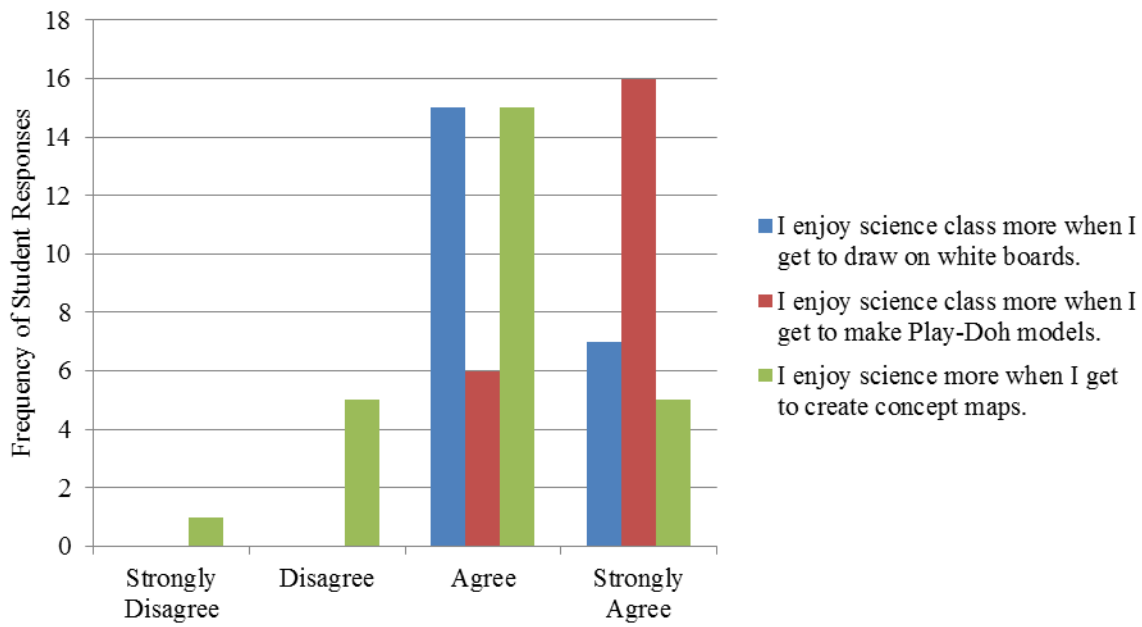

Figure 5. Frequency of student responses on student attitude posttreatment survey, (*N*=22).

In nonconcept posttreatment interviews, all six students indicated that using Play-Doh and white boards in science class was fun and helped them to learn better than if we hadn't used them: "I enjoy it because we get to physically show that we know something just by molding it. I enjoy white boards because it makes me feel like we are playing a game." One student also indicated that using these items boosted his self-esteem because he was better at these activities than reading the textbook or doing worksheets: "Using Play-Doh made me feel really good about myself. Using white boards helps me as well and I feel good about myself."

Although students really enjoyed using Play-Doh and white boards, they were not as excited or positive about concept maps. Some of the comments in the nonconcept posttreatment interviews included: "I don't like using concept maps very much. It makes me bored," "I like science class the same whether we use concept maps or not. Concept maps aren't boring but they aren't fun," and, "I feel like they don't help me as much as white boards."

The Teacher Observations also corroborate these attitude trends. During the third unit on the cardiovascular system the teacher noted that 100% of students were engaged during the last five minutes of class and, "Everyone is making models with Play-Doh, working well with partners to identify the blood type of their friend's model, and participating when I ask questions." On another day when the students were asked to use whiteboards to describe the pathway that food takes through the digestive system, the teacher noted that the class was completely silent because they were all focused on thinking of the organs of the digestive system and correctly writing them on their boards. Regarding student attitude toward concept maps, the teacher noted, "Most students enjoyed the challenge of linking up the words in ways that made sense, but did not describe it as a 'fun' activity like using Play-Doh."

This study also looked at the treatment's effect on students' long-term memory of life science concepts. Data from the posttreatment and delayed assessment indicated that student scores did not change much on average from the posttreatment assessment to the delayed assessment. On the posttreatment Human Body Assessment the class had an average score of 13.14 (87.6%) and when given two weeks later the average score was 13.64 (90.9%). Additionally, a slight increase was also seen in the median scores. The median score on the posttreatment assessment was 13.5 and on the delayed assessment 14.0. Students scored slightly better on the delayed assessment than on the same assessment given immediately posttreatment.

The posttreatment and delayed content interviews also showed that students did not forget much in the two weeks since the treatment ended. Four of the six students interviewed correctly answered all seven content questions during both interviews. Both students who did not correctly answer all questions during the posttreatment interview increased the number they correctly answered during their delayed interview by one question. The low-achieving female answered five questions correctly posttreatment and six questions correctly during the delayed interview. The average-achieving male answered six questions correctly posttreatment and all seven questions correctly during the delayed interview. There were no commonalities in the questions these two students incorrectly answered.

The concept maps created during the posttreatment interview were identical to those created during the delayed interview for four of the six students. The low-achieving female, however, was not able to accurately link the blood types to differences on the surfaces of red blood cells in the delayed interview. Rather, she indicated that the blood types were connected to the platelets. The high-achieving female also wrote on her delayed concept map that she did not know what a platelet was aside from it being a part of the blood (Figure 6).

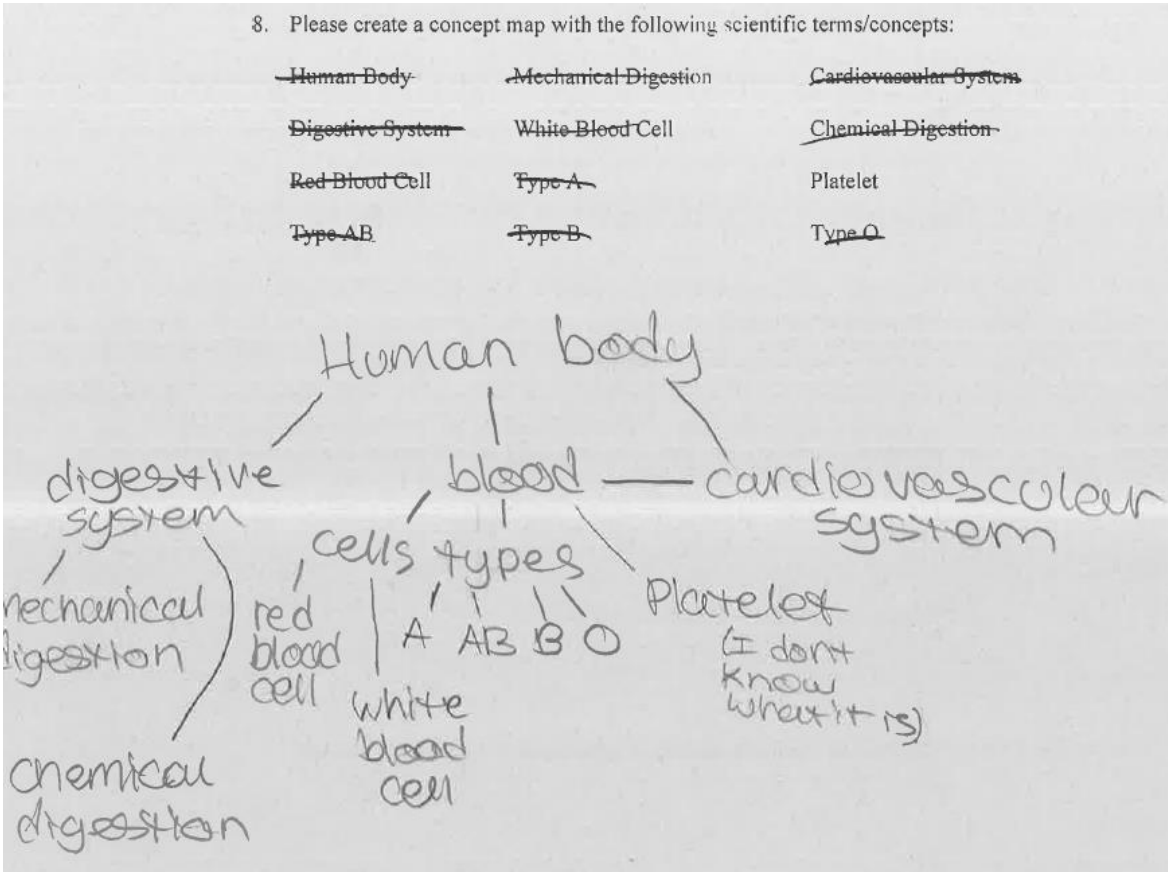

Figure 6. Delayed treatment interview concept map by high-achieving female.

The results from Student Content Posttreatment and Delayed Survey indicated that students thought they remembered just as much two weeks later. The question that saw the highest frequency of *Disagree* responses was, “I can describe the chambers of the heart using their correct names.” On the posttreatment survey eight students disagreed and on the delayed survey five students disagreed. Overall, more students chose *Strongly Agree* on the delayed survey than on the posttreatment survey, and fewer students chose *Disagree* on the delayed survey than on the posttreatment survey (Table 3). Students did not think their capabilities waned over two weeks.

Table 3

Frequency of Student Responses on Student Content Posttreatment and Delayed Survey

	Strongly Disagree-Post	Strongly Disagree-Delayed	Disagree-Post	Disagree-Delayed	Agree-Post	Agree-Delayed	Strongly Agree-Post	Strongly Agree-Delayed
I remember a science concept better when I draw or create a Play-Doh model.	0	0	0	1	15	12	7	9
I can describe the chambers of the heart using their correct names.	0	0	8	5	14	12	0	5
I can name all of the possible blood types.	0	1	1	0	11	6	10	15
I can describe differences between veins and arteries.	0	0	4	0	12	13	6	9
I can name type(s) of digestion that occur in the stomach.	0	1	1	0	15	7	6	14
I can name the two types of digestion that occur in the digestive system.	0	1	2	0	8	7	12	14
I can easily describe what homeostasis is.	0	1	3	0	10	7	9	14

Note. (*N*=22).

Data from the colleague observations, teacher weekly reflections, and teacher attitude surveys were analyzed to answer the question, “What are the effects of incorporating student-made visuals daily on the teacher’s teaching and attitude?” Results indicated that teacher attitude was affected both positively and negatively by incorporating the treatment. One weekly reflection stated, “I enjoyed seeing students so excited about using the Play-Doh to make models, but I also felt more stressed because lessons took longer to prepare and carry out. It wasn’t as easy as I thought it was going to be, and at times my room was a mess with white board markers all over the place.” One challenge the teacher noted on both the weekly reflections and the attitude survey was the challenge of coming up with thing for students to create with Play-Doh or draw on whiteboards. “Not all lessons have material that’s easy to draw or model.”

The results of the Teacher Pretreatment and Posttreatment Attitude survey support the dual effect on teacher attitude. For the statement, “Incorporating student-made visuals in lessons creates more work for me than when they are not incorporated,” the teacher changed her response from *Agree* during the pretreatment phase to *Strongly Agree* during the posttreatment phase. Despite the indication that it is more work, she also agreed in both phases that her attitude was positive 90% of the time.

The colleague observations provide more evidence that the teacher came across as having a positive attitude while teaching during both the pretreatment and treatment phases. “The attitude was positive…While using white boards, Ms. Heyer was smiling and interacting with students as she briefly evaluated what they had recorded through four different responses/drawings.” There is no indication that the teacher appeared to have a negative attitude while being observed during the nontreatment period or during the treatment period, but rather, that she came across as “positive and to-the-point.”

INTERPRETATION AND CONCLUSIONS

The purpose of this action research project was to determine how incorporating student-made visuals daily affected student understanding and retention of life science concepts. I also wanted to know if the incorporation of student-made visuals affected students’ attitudes toward science and the teacher’s attitude toward teaching. Would students have more positive thoughts about science if they knew they would have the opportunity to use Play-Doh, white boards, and concept maps to learn science concepts? Would the teacher have a more positive attitude toward teaching? By incorporating student-made visuals every day in class over three treatment units, I was able to use several data collection methods to determine how the daily treatment impacted student understanding and retention, as well as student and teacher attitude toward science.

During this study I learned valuable information regarding student achievement and the effects of student-made visuals. I recorded and analyzed pretreatment, posttreatment, and delayed treatment assessment scores. The average score of the pretreatment assessment was 6.18 out of a total possible 15 points (41.2%), while the average score more than doubled to 13.36 (89.1%) on the posttreatment assessment (N=22). This indicates that exposure to the new science content through the use of student-made visuals positively impacted assessment scores.

Two weeks after the treatment ended students still retained the information. Students averaged a score of 13.64 (90.9%) on the exact same assessment two weeks after the treatment ended, a slight increase from the average score on the posttreatment assessment. The scores on the delayed assessment were a surprise to me because I predicted that scores on the delayed assessment would be lower than scores on the posttreatment assessment. I did not think the delayed assessment scores would be the same or even slightly higher than the posttreatment assessment scores since the students had not studied or discussed the assessment topics for a two week period. This indicates that the daily incorporation of student-made visuals had a positive impact on retention. Students retained much more material than I had predicted.

An important aspect to consider is the fact that many days the student-made visuals functioned as a way of reviewing the previous days' content. The daily repetition of content alone could have impacted student understanding and retention, even if that repetitive review had not come in the form of student-made visuals. I suspect that the repetition of science concepts and the frequency with which students saw the same assessment questions played a role in the posttreatment and delayed assessment scores. In this study it is not possible to distinguish between the impact of daily review versus the impact of student-made visuals, but it is clear that using student-made visuals as a way to review and reinforce science content had a positive effect on student understanding and retention.

Surveys, interviews, and teacher observations helped capture valuable data regarding student interest and attitude toward science. All three indicate that students enjoyed science class more when creating visuals using Play-Doh or white boards. On the other hand, students were more neutral or negative toward creating concept maps. Six students either disagreed or strongly disagreed to the statement, "I enjoy science more when I get to create concept maps," while no students did so regarding Play-Doh or white boards. The students did not perceive the creation of concept maps to be as fun as using Play-Doh or white boards to learn science concepts.

In addition to collecting data on student attitude, my final question in this project questioned how my attitude and teaching was affected by the incorporation of student-made visuals daily. The colleague observations indicate that I came across as having a positive attitude during both the nontreatment and treatment periods. However, the surveys and teacher weekly reflections indicated a dual effect on my attitude. I enjoyed teaching more when the students were excited about learning science through the use of Play-Doh, white boards, and concept maps, but I found it to be more work to prepare and carry out the lessons. I had to put more forethought into how I would incorporate Play-Doh, white boards, or concepts maps into every lesson than I had anticipated, and some lessons had content that was not easily made into a visual. One other aspect of the treatment that bothered me a little bit was the fact that some days my classroom had white boards, markers, or Play-Doh scattered around when they were not correctly stored under their desks. The poor storage units often required me to spend personal time or class time providing each student with the appropriate materials, again contributing to the feeling that I had more work to do during the treatment.

VALUE

By conducting this study, I found that incorporating student-made visuals daily had a positive impact on student understanding and retention of life science concepts. Student assessment scores greatly improved over the course of the treatment period, from an average of 41.2% to 87.6%, and student retention was high. The average posttreatment assessment score was 87.6% and two weeks later on the delayed assessment the average score showed a slight improvement at 90.9%. Next year my goal will be to incorporate student-made visuals in all of the units, even if it is not daily. It will be valuable to see if understanding and retention in all units increases throughout the year.

Given that this investigation indicated an increase in work for me to incorporate student-made visuals in every lesson, in the future I will incorporate them on some days but not every day. I think this will help to improve my attitude toward incorporating student-made visuals. I enjoy seeing my students excited about science and having fun while learning, so I will continue to incorporate activities with Play-Doh, white boards, and concept maps. I will use time during the summer to review unit lessons that lend themselves more to the use of visuals and adapt these lessons to include either one type of student-made visual. I will also look into a better organization system for our desks so that the necessary materials do not become scattered throughout the classroom.

The data analysis showed that despite creating more work for me, the incorporation of student-made visuals positively impacted students' attitudes toward science. This provides another reason that I would like to incorporate student-made visuals throughout all units. Creating positive attitudes and excitement toward science can increase student engagement and understanding. The positive experiences and excitement my students have at the junior high level could even influence their future science education. If they enjoy science at this level, they may be more likely to enroll in science electives in the future and find something that sparks their interest.

The surveys, interviews, and reflections noted that students enjoyed using Play-Doh and white boards more than creating concept maps. That said, the growth demonstrated through concept maps in this study indicates that concept maps can be an important tool in developing student understanding. Next year I would like to be more intentional about using Play-Doh and white boards as tools to introduce new concepts throughout units and then using concept maps as a way of reviewing those concepts at the end of each unit.

Based on what I learned in this project I would recommend incorporating student-made visuals in all seventh grade life science classes. The data supported the positive impact on students academically and attitudinally. The majority of students indicated that they understood and enjoyed science more when they were able to use Play-Doh, white boards, or concept maps to learn. Modeling, drawing, and connecting concepts are valuable skills for science and can be useful in many other academic and nonacademic settings. Helping students strengthen these skills while gaining a better understanding of science concepts is win-win.

Conducting this action research investigation allowed me to see the importance of student-made visuals in the science classroom as well as the impact of reviewing material daily. The student-made visuals brought excitement to the classroom, and as I saw how excited students were, my interest and excitement toward teaching improved. Since many of the activities in which we used student-made visuals were used to review concepts, I can see how valuable daily review is to learning and retaining the material. I want to continue to incorporate student-made visuals in my classroom to help students understand and retain the content while enjoying themselves.

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APPENDICES

APPENDIX A

NONCONCEPT PRETREATMENT INTERVIEW QUESTIONS

This interview is completely voluntary and will in no way affect your grade or class standing.

1. How do you feel about science at school? Explain.

2. What activities during science class help you to learn the science concepts the best? Explain.

3. If you could change one thing about science class what would it be and why? Explain.

4. Do you think you will be better at science concepts, worse at science concepts or about the same at science concepts if you used Play-Doh in class to model science concepts?

   Better Same Worse

   Why?

5. Do you think you will be better at science concepts, worse at science concepts or about the same at science concepts if you used white boards in class to draw science concepts?

   Better Same Worse

   Why?

6. Do you think you will be better at science concepts, worse at science concepts or about the same at science concepts if you used concept maps in class to connect science concepts?

   Better Same Worse

   Why?

7. Is there anything else you would like to add about science class that you would like me to know?

APPENDIX B

NONCONCEPT POSTTREATMENT INTERVIEW QUESTIONS

Nonconcept Posttreatment Interview Questions

This interview is completely voluntary and will in no way affect your grade or class standing.

1. How do you feel about science class at school? Explain.

2. What activities during science class help you learn the science concepts the best? Explain.

3. If you could change one thing about science class what would it be and why? Explain.

4. How has using Play-Doh in science class made you feel about science? Explain.

5. How has using white boards in science class made you feel about science? Explain.

6. How has using concept maps in science class made you feel about science? Explain.

7. After using Play-Doh, white boards, and concept maps in class do you think you are better at science concepts, worse at science concepts, or about the same at science concepts as you were when we didn’t use these things?

   Better Same Worse

   Why?

8. Is there anything else you would like to add about science class that you would like me to know?

APPENDIX C

STUDENT CONTENT INTERVIEW QUESTIONS

Student Content Interview Questions

Date___________________ Circle One: Pretreament Posttreatment

This interview is completely voluntary and will in no way affect your grade or class standing.

1. What activities in science help you best learn the science concepts?

2. How do you think drawings or Play-Doh models affect your learning in science?

3. How do you prefer to study and learn science concepts?

   Why?

4. Please create a concept map with the following scientific terms/concepts:

Human Body	Mechanical Digestion	Cardiovascular System
Digestive System	White Blood Cell	Chemical Digestion
Red Blood Cell	Type A	Platelet
Type AB	Type B	Type O

APPENDIX D

STUDENT ATTITUDE PRETREATMENT AND POSTTREATMENT SURVEY

Student Attitude Pretreatment and Posttreatment Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

Please mark the box that most accurately describes you.

	Strongly Disagree	Disagree	Agree	Strongly Agree
I enjoy science class more when I get to draw on white boards.				
I enjoy science class more when I get to make Play-Doh models.				
I enjoy science more when I get to create concept maps.				
My attitude toward science is more positive when I know we are drawing or using Play-Doh in class.				
I am more interested in science when we are drawing or using Play-Doh in class.				
I look forward to science class more if we are drawing or using Play-Doh than if we're not.				

APPENDIX E

TEACHER OBSERVATION PROMPTS

Teacher Observation Prompts

Date_____________ Circle one: Pretreatment Posttreatment

1. On a scale of 1-5, one being not interested all and five being very interested, what is the interest level of the class as a whole throughout the lesson?_______

Explain:

2. What percentage of students is actively engaged in the lesson half-way through?_____

What do I observe regarding student engagement?

3. What percentage of students is actively engaged in the lesson during the last five minutes?_________

What do I observe?

4. What are students saying during the lesson regarding their attitudes/interest level?

APPENDIX F

STUDENT PRETREATMENT UNIT TWO SURVEY

Student Pretreatment Unit Two Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

1. On a scale of 1 to 5, how would you rank your understanding of the human body's digestive system? ________

   1 = You don't know what it is.
   3 = You have an ok understanding of what it is and how it works.
   5 = You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else.

   Why did you choose that number?

   If you had to describe what the digestive system is and what it does, what would you say?

   Are there any important facts about the digestive system that you know? If so, what are those facts?

2. We are about to begin a unit on the human digestive system including the organs involved and the types of digestion (mechanical and chemical) that take place in each organ. On a scale of 1 to 5, how difficult do you think this unit will be? ______

   1= very easy for 7^{th} grade
   3 = average difficulty for 7^{th} grade; not too hard, not too easy
   5 = very hard for 7^{th} grade

   Why did you choose that number?

3. How would you rank your interest level in learning about the human body, specifically the digestive system? _____

   1= I'm not interested at all. I don't want to learn about it.
   3= I'm kind of interested.
   5= I'm very interested. I can't wait!

   Why did you choose that number?

APPENDIX G

STUDENT POSTTREATMENT UNIT TWO SURVEY

Student Posttreatment Unit Two Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

1. On a scale of 1 to 5, how would you rank your understanding of the human body's digestive system? ________

   1 = You don't know what it is.
   3 = You have an ok understanding of what it is and how it works.
   5 = You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else.

   Why did you choose that number?

   If you had to describe what the digestive system is and what it is to someone else, what would you say?

   Are there any important facts about the digestive system that you know? If so, what are those facts?

2. We just finished a unit on the human digestive system including the organs involved and the types of digestion (mechanical and chemical) that take place in each organ. On a scale of 1 to 5, how difficult did you think this unit was? ______

   1= very easy for 7th grade
   3 = average difficulty for 7th grade; not too hard, not too easy
   5 = very hard for 7th grade

   Why did you choose that number?

3. After learning about the digestive system, how would you rank your interest level in learning more about the human body, specifically the digestive system? _____

   1= I'm not interested at all. I don't want to learn more about it.
   3= I'm kind of interested in learning more.
   5= I'm very interested in learning more. I can't wait!

   Why did you choose that number?

APPENDIX H

STUDENT PRETREATMENT UNIT ONE SURVEY

Student Pretreatment Unit One Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

1. On a scale of 1 to 5, how would you rank your understanding of the human body's skin and ways of keeping homeostasis? ________

   1 = You don't know what it is.
   3 = You have an ok understanding of what it is and how it works.
   5 = You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else.

   Why did you choose that number?

   If you had to describe what the skin is and what it does, what would you say?

   Are there any important facts about the skin that you know? If so, what are those facts?

2. We are about to begin a unit on the human body's skin and ways of keeping homeostasis. On a scale of 1 to 5, how difficult do you think this unit will be? ______

   1= very easy for 7th grade
   3 = average difficulty for 7th grade; not too hard, not too easy
   5 = very hard for 7th grade

   Why did you choose that number?

3. How would you rank your interest level in learning about the human body, specifically the skin? _____

   1= I'm not interested at all. I don't want to learn about it.
   3= I'm kind of interested.
   5= I'm very interested. I can't wait!

   Why did you choose that number?

APPENDIX I

STUDENT PRETREATMENT UNIT THREE SURVEY

Student Pretreatment Unit Three Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

1. On a scale of 1 to 5, how would you rank your understanding of the human body's cardiovascular system? ________

   1 = You don't know what it is.
   3 = You have an ok understanding of what it is and how it works.
   5 = You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else.

   Why did you choose that number?

   If you had to describe what the cardiovascular system is and what it does, what would you say?

   Are there any important facts about the cardiovascular system that you know? If so, what are those facts?

2. We are about to begin a unit on the human cardiovascular system including the organs involved and the possible blood types. On a scale of 1 to 5, how difficult do you think this unit will be? ______

   1= very easy for 7^{th} grade
   3 = average difficulty for 7^{th} grade; not too hard, not too easy
   5 = very hard for 7^{th} grade

   Why did you choose that number?

3. How would you rank your interest level in learning about the human body, specifically the cardiovascular system? _____

   1= I'm not interested at all. I don't want to learn about it.
   3= I'm kind of interested.
   5= I'm very interested. I can't wait!

   Why did you choose that number?

APPENDIX J

STUDENT POSTTREATMENT UNIT ONE SURVEY

Student Posttreatment Unit One Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

1. On a scale of 1 to 5, how would you rank your understanding of the human body's skin and way of keeping homeostasis? ________

   1 = You don't know what it is.
   3 = You have an ok understanding of what it is and how it works.
   5 = You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else.

   Why did you choose that number?

   If you had to describe what the skin is and what it does to someone else, what would you say?

   Are there any important facts about the skin that you know? If so, what are those facts?

2. We just finished a unit on the skin and the body's ways of keeping homeostasis. On a scale of 1 to 5, how difficult did you think this unit was? ______

   1= very easy for 7th grade
   3 = average difficulty for 7th grade; not too hard, not too easy
   5 = very hard for 7th grade

   Why did you choose that number?

3. After learning about the skin and the body's homeostasis, how would you rank your interest level in learning more about the human body, specifically the skin? _____

   1= I'm not interested at all. I don't want to learn more about it.
   3= I'm kind of interested in learning more.
   5= I'm very interested in learning more. I can't wait!

   Why did you choose that number?

APPENDIX K

STUDENT POSTTREATMENT UNIT THREE SURVEY

Student Posttreatment Unit Three Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

1. On a scale of 1 to 5, how would you rank your understanding of the human body's cardiovascular system? ________

   1 = You don't know what it is.
   3 = You have an ok understanding of what it is and how it works.
   5 = You have a complete understanding of what organs are involved and how it works; you are able to explain it to someone else.

   Why did you choose that number?

   If you had to describe what the cardiovascular system is and what it is to someone else, what would you say?

   Are there any important facts about the cardiovascular system that you know? If so, what are those facts?

2. We just finished a unit on the human cardiovascular system including the organs involved and the possible blood types. On a scale of 1 to 5, how difficult did you think this unit was? ______

   1= very easy for 7th grade
   3 = average difficulty for 7th grade; not too hard, not too easy
   5 = very hard for 7th grade

   Why did you choose that number?

3. After learning about the cardiovascular system, how would you rank your interest level in learning more about the human body, specifically the cardiovascular system? _____

   1= I'm not interested at all. I don't want to learn more about it.
   3= I'm kind of interested in learning more.
   5= I'm very interested in learning more. I can't wait!

   Why did you choose that number?

APPENDIX L

HUMAN BODY ASSESSMENT

Human Body Assessment

1. What are the two types of digestion that occur in the human body?
   ______________________ ____________________

2. True or False Veins carry blood away from the heart

3. Why is the skin so important to the human body?

4. What is the function of the red blood cell?

5. What type(s) of digestion take place in the mouth?

6. How does the pancreas help in digestion?

7. True or False Peristalsis is the muscular movement that causes food to move through the esophagus to the stomach.

8. Please identify one way in which the human body maintains homeostasis:

9. True or False If a patient with Type AB- blood receives a transfusion of A+ blood, the patient would be just fine.

10. Describe how a burn can affect the layers of the skin:

11. What is the function of valves in the heart and blood vessels?

12. What is the function of white blood cells?

13. How does Type A blood differ from Type O blood?

14. Please write as many of the organs that are involved in digestions that you can:

15. Please put in the following blood vessels in the correct order as blood leaves the heart and travels through them:
    Capillaries
    Veins
    Arteries

    Heart -> ________________ ->_________________-> ___________________-> Heart

APPENDIX M

STUDENT CONTENT POSTTREATMENT AND DELAYED INTERVIEW QUESTIONS

Student Content Posttreatment and Delayed Interview Questions

This interview is completely voluntary and will in no way affect your grade or class standing.

1. What are two types of digestion that occur in the human body?

2. Please give an example of a location in the human body where each type of digestion mentioned above occurs.

3. Please explain what homeostasis is and provide one example of how the body maintains homeostasis.

4. What is the function of skin in the human body?

5. What are the eight different blood types possible for a human to have?

6. What makes those blood types different?

7. What would happen if a person with type A+ blood received type B+ blood at the hospital?

8. Please create a concept map with the following scientific terms/concepts:

Human Body	Mechanical Digestion	Cardiovascular System
Digestive System	White Blood Cell	Chemical Digestion
Red Blood Cell	Type A	Platelet
Type AB	Type B	Type O

APPENDIX N

STUDENT CONTENT POSTTREATMENT AND DELAYED SURVEY

Student Content Posttreatment and Delayed Survey

This survey is completely voluntary and will in no way affect your grade or class standing.

Please mark the box that most accurately describes you.

	Strongly Disagree	Disagree	Agree	Strongly Agree
I remember a science concept better when I draw or create a Play-Doh model of it.				
I can describe the chambers of the heart using their correct names.				
I can name all of the possible blood types.				
I can describe difference between veins and arteries.				
I can name the type(s) of digestion occur in the stomach.				
I can name the two types of digestion that occur in the digestive system.				
I can easily describe what homeostasis is.				

APPENDIX O

TEACHER WEEKLY REFLECTION JOURNAL PROMPTS

Teacher Weekly Reflection Journal Prompts

1. What was my attitude while teaching today?
Explain.

2. Did I enjoy teaching?
Explain.

3. What were my thoughts at the end of the lesson?

4. What went well?

5. What would I change?

APPENDIX P

TEACHER PRETREATMENT AND POSTTREATMENT ATTITUDE SURVEY

Teacher Pretreatment and Posttreament Attitude Survey

Please rate the statements below.

	Strongly Disagree	Disagree	Agree	Strongly Agree
My attitude while teaching is positive 90% of the time.				
I look forward to teaching lessons with student-made visuals.				
Incorporating student-made visuals in lessons creates more work for me than when they are not incorporated.				
I think my teaching is more effective when incorporating student-made visuals.				
I want to create more lessons that incorporate student-made visuals				

1. Challenges I may encounter/have encountered when incorporating student-made visuals:

2. Incorporating student-made visuals impacts my teaching in the following ways:

3. Incorporating student-made visuals impacts my attitude in the following ways:

Any additional comments:

APPENDIX Q

NONTREATMENT AND TREATMENT COLLEAGUE OBSERVATION PROMPTS

Nontreatment and Treatment Colleague Observation Prompts

Please complete the following questions during class, writing down quotes, times, and situations.

Date_______________

1. What was the teacher's apparent attitude while teaching?
Explain.

2. How did the teacher interact with the students?
Explain.

3. Did students participate in a way that showed learning was taking place?
Explain.

4. Did the teacher connect the student-made visuals to students' prior knowledge or current lesson?
Explain.

5. Did the teacher express any frustration or negative sentiments toward incorporating student-made visuals?
   Explain.

6. Did the teacher express any positive sentiments toward incorporating student-made visuals?
   Explain.

Additional Observations:

APPENDIX R

PROJECT TIMELINE

Project Timeline

Start Project Implementation: January 12, 2015
January 14, 2015: Nontreatment Unit with Routine Teaching Strategies, 2.5 weeks – Evolution: Change Over Time
February 10, 2015: Treatment Unit 1 with Intervention, 1.5 weeks- Human Body Homeostasis and Skin
February 24, 2015: Treatment Unit 2 with Intervention, 1.5 weeks- the Digestive System
March 3, 2015:Treatment Unit 3 with Intervention, 2 weeks, the Cardiovascular System
End Project Implementation: March 19, 2015

APPENDIX S

IRB EXEMPTION

IRB Exemption

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects
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MEMORANDUM

TO: Sharon Heyer and John Graves

FROM: Mark Quinn, Chair *Mark Quinn CJ*

DATE: November 10, 2014

RE: *"The Effects of Incorporating Student-Made Visuals Daily in the Junior High Science Classroom"* [SH111014-EX]

The above research, described in your submission of November 10, 2014, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

_X_ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.