

THE EFFECTS OF COOPERATIVE LEARNING ON NATIVE AMERICAN
STUDENTS' UNDERSTANDING OF ENVIRONMENTAL SCIENCE

by

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STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to others under the specified rules of the MSSE Program.

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July 2014

DEDICATION

This capstone project is dedicated to all the students I have taught using cooperative learning.

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ABSTRACT

This study investigated the effects of cooperative learning instruction on seven students' understanding of environmental science concepts. The students used in-class discussion, groups working together to perform lab activities, and students delivering the daily lesson. Various data collection instruments used included treatment and nontreatment testing, survey questions, and instructor observations, as well as motivation and attitude of the teacher. Results were mixed, as not all students agreed with its effectiveness on certain issues.

INTRODUCTION AND BACKGROUND

My project topic is cooperative learning. Cooperative learning has been used for centuries in Asia. Nguyen, Elliott, Terlouw, and Pilot (2009) noted Lao Tzu (Confucius) touted group collaboration 26 centuries ago. Nguyen et al. also credit Kurt Lewin with information concerning recent collective behaviors. Kurt Lewin was involved in group dynamics at MIT in the 1940's.

Cooperative learning is a popular teaching strategy. Nine hundred research studies have shown that cooperative learning is effective over competitive and individualistic efforts (Johnson, Johnson, & Stanne, 2000). In my completion of my Montana Teaching License, I took several courses in this area. I graduated in 2000 from MSU-Northern with a strong understanding of cooperative learning. I used this strategy extensively in my public school teaching in Montana and South Dakota.

The purpose of this project was to use action research to determine whether or not increased student participation in classroom activities will result in positive outcomes in the classroom. I chose this topic because it was part of my college curriculum at MSU-Northern. I wanted to see if the benefits with my students were as other studies have shown. I wanted to see if it has better outcomes than that of teacher lecture and students working individually with my Native American students.

The need for this project was to observe whether working in groups with cooperative learning as a teaching strategy would raise students understanding of science, whether this strategy would raise higher-order thinking skills, and whether students will be motivated in the classroom.

I have 13 years of science teaching experience with nine years as a public school teacher. I have taught one year at Fort Belknap Community College and three years at Fort Peck Community College. This past year I taught at Brockton School District on the Fort Peck Sioux and Assiniboine Reservation. Of over 100 students enrolled in K-12, the majority are Native American. Males outnumber females by a two to one margin. I taught chemistry, biology, life science, physical science, and environmental science. The focus of this study is the environmental science class.

The environmental science class sample is three females and four males of ages 16 to 18. These students were motivated by the need to pass the required courses to gain entry to a college career. Their attitude was generally pleasant, focused, and committed. Two environmental science students were in Special Education assistance support.

The mission statement of the high school where I teach takes into account the importance to prepare students to be citizens and to prepare them for college. Many students may struggle with certain courses. Pre-entrance testing to college may indicate this. Some reservation high schools are underperforming by Montana Office of Public Instruction (OPI) standards. Various social ills including teen pregnancy, youth suicides, and drug use remain. As a result, Montana OPI data show graduation rates of reservation area high schools are lower than surrounding off-reservation schools. While the Montana state high school graduation rate is at nearly 84%, high schools on Native American reservations with a majority of Native American students are at a 60% high school graduation rate or above. Montana OPI websites have five reasons for this disparity.

They include: classes are not interesting, inability to make up missed classes, negative social influences, too much freedom in the classroom, and failing grades (Miller, (2011).

To improve students' classroom performances in the face of the above issues, I turned to cooperative learning in my search for a way to assist these students to understand science and further their chance to graduate from high school. Our school had student support with a counselor to further help students to graduate. At least one-half of the school staff, including teachers, aides, secretaries, and support staff, were Native American. This study may be of interest to those staffers, as well as key administration at Brockton School District.

The focus question of my project was: What are the effects of cooperative learning on high school students understanding of environmental science concepts? My project subquestions were as follows: what are the effects of cooperative learning on higher order thinking; and what are the effects of cooperative learning on students' attitude and motivation? Johnson, Johnson, and Houlbec (1986) define cooperative learning as "students working together to attain group goals that cannot be obtained by working alone or competitively." Concern about the effects of cooperative learning on students' understanding of environmental science concepts led me to this choice of project. Further subquestions included, what are the effects of cooperative learning on higher-order thinking skills and what are the effects of cooperative learning on students' motivation and attitude?

The members of my MSSE Capstone Committee provided critical feedback throughout the research and writing process. My committee chair was Dr. Peggy Taylor,

Montana State University Masters of Science in Science Education (MSSE) Program Director. Dr. Jewel Reuter, of Montana State University served as my MSSE core and capstone advisor. Also, Lisa Brown of Montana State University served as the project reader on my committee.

CONCEPTUAL FRAMEWORK

Social constructivism is the conceptual framework of cooperative learning. Social constructivism involves multicultural curricula. Banks (1999) cites four approaches to multicultural curriculum reform. These include cultural contributions, cultural literature, diverse ethnic perspectives, and social involvement of students in ethnic issues. Suriel and Atwater (2012) used extensive interviews and curriculum units utilizing Bank's four approaches to determine teachers' integration of multicultural curricula in science curriculum units as well as how personal experiences influenced content integration of science curricula. Results of this study varied between no integration to transformation. Study limitations prevented definitive answers to some observed outcomes. Bryan and Atwater (2002) believe qualitative methodologies such as case studies, ethnography, autobiographies, and life histories may be a better way to determine beliefs and approaches by teachers to multicultural curriculum implementation.

The following studies revolve around cooperative learning in the classroom to motivate students by working in groups. General findings and themes that I have uncovered in my research show generally positive results to the use of cooperative learning. Roehrig and Garrow (2007) found positive student achievement in high school chemistry with cooperative learning. Test scores are higher when cooperative learning is

employed. As to the acquisition of higher order thinking skills which involve the ability to apply knowledge, most studies were positive in this area. Thurston et al. (2009) observed gains in science understanding of over 600 students as they advanced from 24 primary schools to 16 high schools. Tsaparlis and Papaphotis (2009) employed active and cooperative learning strategies with 12th-grade students, which are consistent with Vygotsky's zone of proximal development. This method involved students filling out a questionnaire and also giving interviews. Students answered questions concerning chemistry atom orbital theory. Results were mixed, with the authors suggesting traditional teacher presentation would not be superior to the cooperative learning strategies. Further, they state a constructivist pedagogy that employs cooperative learning holds the promise of overcoming misconceptions and misunderstandings.

Hein (2012) cites the use of a student-centered learning technique called process oriented, guided inquiry learning (POGIL) as a means to develop higher-order thinking skills and to help foster positive interactions between organic chemistry students. POGIL facilitates collaborative and cooperative learning in the classroom.

Findings from 25 different studies (Slavin, 1980) show that cooperative learning strategies are more effective than traditional strategies for student achievement. The studies show that cooperative learning increases lower level learning outcomes, and that higher level learning outcomes are also improved by the components of self-regulation and group decision-making.

Cooperative learning in the science classroom resulted in a higher level of student satisfaction and motivation due to a heightened social interaction. In the journal study by

Oortwijn, Boekaerts, Vedder, and Fortuin (2008) of 94 elementary students aged 10 to 12, it was shown that cooperative learning increased popularity and boosted participation of previously noncooperating students.

Overall, Roehig and Garrow (2007) found positive achievement in two high school chemistry groups using cooperative learning. Thurston, et al., (2009) tracked gains in science cooperative learning understanding from primary to high school by implementing cooperative learning. Slavin (1980) found that cooperative learning improved higher level learning outcomes. Oortwijn et al. (2008) used cooperative learning in elementary schools to determine whether multiethnic students and noncooperative students could achieve higher social interaction in the classroom and more cooperation in performing assignments if cooperative learning strategies were instituted.

Veenman, van Benthun, Bootsma, van Dieren, and van der Kemp (2002) conducted a course at two different teacher education colleges in The Netherlands. Based on pre and postcourse observations, there was an increase in teacher positive interdependence, face-to-face interaction, social skills, and group processing. The majority of the student teachers used cooperative learning to achieve both academic and social goals and also showed a readiness to use cooperative learning methods in their future lessons. The students taught by student teachers with the treatment also showed positive attitudes towards working in groups and rated the benefits of working in groups relative to working alone quite positively. I have since employed several strategies involving cooperative learning that were included in the literature. These include

designating a team leader, leading group discussions, selecting cooperative learning groups, and promoting more social contact involving the lesson plan discussion. There are several other essential elements for administering cooperative learning. These elements include positive interdependence, face-to-face interaction, social skills, and group processing. Veenman, van Benthun, Bootsma, van Dieren, and van der Kemp (2002).

Johnson and Johnson (1994) outlined five elements of cooperative learning. These include a clearly perceived positive interdependence, considerable face-to-face interaction, clearly perceived individual accountability, frequent use of small groups with frequent and regular group processing of current functioning to improve the group's future effectiveness. Implementing these elements requires the teacher to identify issues that may be negative to the desired outcome. These include student social strata, ability of individuals within the group, type of material in the lesson, gender, and cultural background. I have noticed that some chapters in the environmental science course are math intensive, and therefore not easily understood, even in a group setting. In these instances, the teacher must be close by, monitoring the group, and willing to answer questions from the group members.

The studies that I have read were quite helpful to me to institute a more student-centered classroom. The literature reflection has been particularly helpful as it allowed me to remember my past use of cooperative learning.

METHODOLOGY

Project Treatment

Treatment and nontreatment units will be utilized to allow for comparison. A nontreatment unit included having the teacher present the lesson plan with a request for students to take notes as the lecture is presented. A treatment unit involved cooperative learning with the students in groups discussing the lesson plan as it was presented. The project timeline is included in Figure 1.

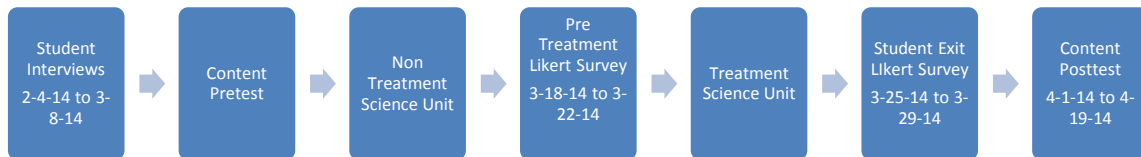


Figure 1. Project Timeline.

Initiating the project involved administering student interviews regarding their feelings toward science, Appendix A. Cooperative learning was used as a treatment to engage students in science and environmental science in particular. Cooperative learning is difficult to effectively measure with quantitative measuring. The same sample of seven students was used throughout the project to determine the effects of cooperative learning compared to a nontreatment unit with a traditional teaching approach. Student responses to survey questions with their written reflections and interpreted by an astute teacher observing was an effective way to gauge the effects of cooperative learning. Student written reflections allow the teacher to gain insights into how students perceived the

project. Since students interacted in cooperative learning, observing their sharing of insightful responses was an important aspect of this project.

The second assessment included environmental science preunit testing, Appendix B. The test was designed to give a baseline of the student knowledge. The nontreatment science unit involved the teacher presentation of the lesson plan through lecture and fielding questions from students concerning the subject material with main issues written out on the whiteboard, followed by assignment of end-of-chapter questions, quizzes and exams. Presenting the lesson also included the use of PowerPoint, computer investigation and or calculation.

The pretreatment Likert Survey was a set of question which gauged students' affinity and liking for science, Appendix C. Using cooperative learning treatment as a teaching strategy for environmental science in the treatment science unit, students would form groups to discuss a topic, such as biomes, to include region, climate, and the plants and animals associated with the various biomes. I may present the lesson plan in terms students may not easily understand. Cooperative learning was used to facilitate understanding by allowing a discourse between students.

Laboratory experiments were conducted to illustrate and enhance learning about specific issues in the lesson plan. Laboratory experiments were aided by calculators and hand-held computers, which are able to read data from several different probes. These devices may graph the solutions as well. Laboratory exercises are usually done with a partner. Thus, cooperative learning was integrated into most science curriculum through at the very least, the laboratory experiments.

The Student Exit Likert survey was administered as a posttreatment data source regarding students' feelings about cooperative learning, Appendix D.

A final postunit assessment was issued to gauge students' scores after the cooperative learning strategy was used, see Appendix E. Individual accountability is another issue with cooperative learning. Johnson and Johnson (1994) state that to maintain each student's fair share of the lesson and the group size should be small. Testing was on an individual basis. Individual students were called upon to give an oral response to what the group studied. I observed the group interaction and recorded the frequency of each member's contributions. This also included having students teach what they have learned to one another.

A chapter in environmental science involving biomes provided a good example. For the nontreatment unit, I gave the lecture based on the lesson. Next, I gave a handout for students to complete. Then we left the classroom for a nature walk to study our local biome. I then gave out a final handout, which we graded. For the treatment, students worked together to solve the questions they had missed. Their initial scores were in the 80% range, while after working to correct the problems together, their scores rose to 100%. Usually the student work was teacher-directed but for this chapter I allowed the students to work together.

Data Collection Instruments

As previously noted, the students involved in this project were attending a Native American high school on a Native American reservation in northeast Montana. The small Native American community consists of 255 people according to the 2010 census.

This community has a laundry and convenience store for its business district. The economy is agriculture which includes farming and ranching. Parents are also employed by the Fort Peck Tribal government in various capacities. Brockton School District had 18 students in the high school. This environmental science class had a range of abilities, from perceptive to a student who rarely turns in work due to a learning disability. The class was the last period of an eight-period day. Six students have Native American lineage. The sample is composed of seven students, four males and three females. Sophomores, juniors, and seniors are in the class. Participation in this research was voluntary and could in no way affect a student's grade for this course. This disclaimer was required for MSU-Bozeman IRB Review Board approval of MSU-MSSE Capstone projects.

In this class, of the seven students in the sample, three males were higher achievers, but only two exhibited intellectual curiosity and motivation in pretreatment. Two females were normal achievers who also exhibited intellectual curiosity and motivation. One female was a capable underachiever with a lack of curiosity and motivation, while one male was a developmentally disabled low-achiever who became motivated through cooperative learning.

Several data collection instruments were employed with this class. The most important collection instrument is the Student Interview Questionnaire, Appendix A, regarding project questions and subquestions. Pre and posttreatment testing Appendix B and Appendix E, was also done. Initially, students were introduced to new material by the teacher through textbook reading and answering of text questions. Hands-on learning

involved demonstrations suggested by the text to enhance previous learning. This was followed by further discussion in a cooperative learning setting with postunit assessment occurring. I also asked students working on a lab assignment to explain and to assist students in the lab. Keeping a watchful eye while remaining available for questions, I realized that cooperative learning was effective in a Native American setting. I also implemented Peer-Assisted Learning (PALS) and Student as Teacher in the classroom. Students were enthusiastic about these approaches in the cooperative learning class. Having students present the lesson-plan allowed them to gain an understanding they did not previously have into the material.

The data collection instruments employed are shown in Table 1. Since students interacted in cooperative learning, observing their sharing with insightful responses was also an important parameter of this project. Triangulation of the above data collection instruments provided the teacher with an effective insight into the value of cooperative learning. A Project Poster is located in Appendix G and the Project Timeline is located in Appendix H.

Table 1

Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3
What are the effects of cooperative learning on students' understanding of environmental science concepts?	Preunit and postunit student concept interviews	Pretreatment and posttreatment student surveys on their perception of understanding	Pre and postunit student assessments
What are the effects of cooperative learning on higher-order thinking skills?	Preunit and postunit student concept interviews	Pretreatment and posttreatment student surveys on their perception of	Teacher Observations

		understanding	
What are the effects of cooperative learning on students' motivation and attitude?	Pretreatment and posttreatment student nonconcept interviews	Pretreatment and posttreatment student surveys	Teacher Observations

DATA AND ANALYSIS

Effects on Student Understanding of Environmental Science Concepts

The primary data source was the pretreatment and posttreatment content test score percentile comparisons, which are shown in Figure 2. All students scored higher on posttreatment testing, where the lowest change in scoring was 30 points and the highest change in scores was 50 points.

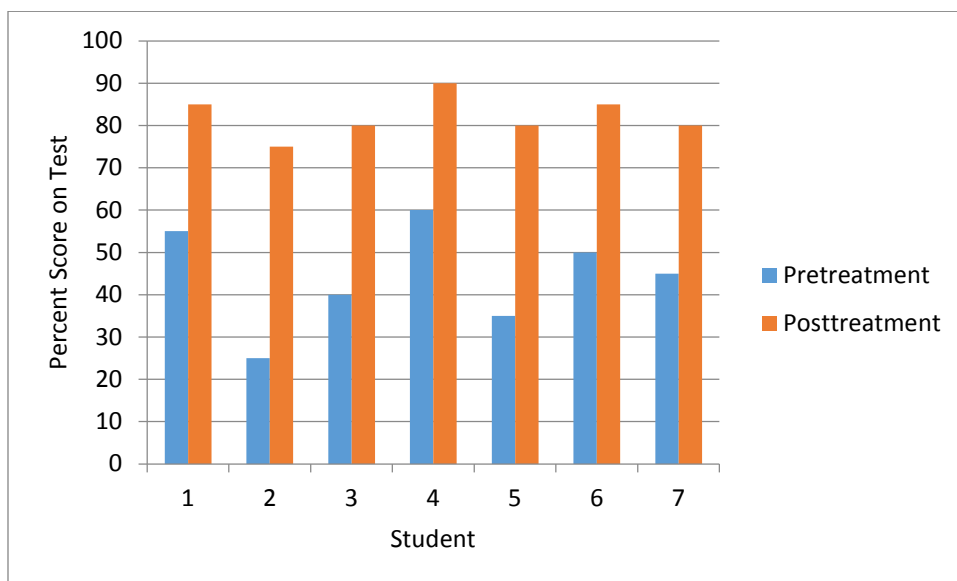


Figure 2. Pretreatment and Posttreatment Cooperative Learning Percentile Test Score Comparison.

Additional data included Student Interview Questionnaire responses of five student responses with two students absent. Positive responses included statements such as: “Students learn and participate more because it’s fun learning,” shows a very positive impact of cooperative learning, which helps to explain why they like cooperative learning. “They can read along with the teacher,” is a comment that helps to explain how they used reading to learn and stay on task. “It’s much easier when you learn a lot and understand environmental science,” shows that students find it easier learn with cooperative learning. “You understand a little more when it comes from your classmates.” shows that students empowered by cooperative learning feel that they learn more. “I don’t know.” was a nonpositive response to the question. Table 2 data provide more supporting responses to the question concerning positive responses to being better prepared for future science courses.

Table 2
Student Posttreatment Exit Survey Percent Responses for the Effects of Cooperative Learning

Cooperative learning...	SA	A	N	D	SD
Motivated me to continue science	2	5			
Stimulated my intellectual curiosity	1	6			
Held my attention and interest	2	3	2		
Better prepared for future science courses I will need.	3	2	1	1	
Increased my confidence in science reasoning skills	2	3	2		

Note. Likert Scale SA = Strongly Agree and SD = Strongly Disagree (Students Individually Responding)

Teacher Observations were the third data collection source for this question. I observed that students gained understanding by explaining concepts to each other. They

expressed to me often that peers explain and translate to their dialect the lesson plan, increasing their understanding.

Effects on Higher-Order Thinking Skills

Responses to the student interview questionnaire included five responses with two students absent. Positive responses included comments such as: “the effects are much greater with cooperative learning,” “reading and homework help,” “students like to participate and do different things,” and “students wanted to understand the questions.” These responses describe students’ realization that cooperative learning generated a deeper understanding of assignments that required higher-order thinking skills.

Data in Table 2 also look at the effects of cooperative learning on higher order thinking skills Responses show “cooperative learning stimulated students’ intellectual curiosity, better prepared them for future science courses they will need, and it increased their confidence in science reasoning skills.”

One additional interview question focused on students’ confidence in solving problems. These posttreatment data support the positive survey results.

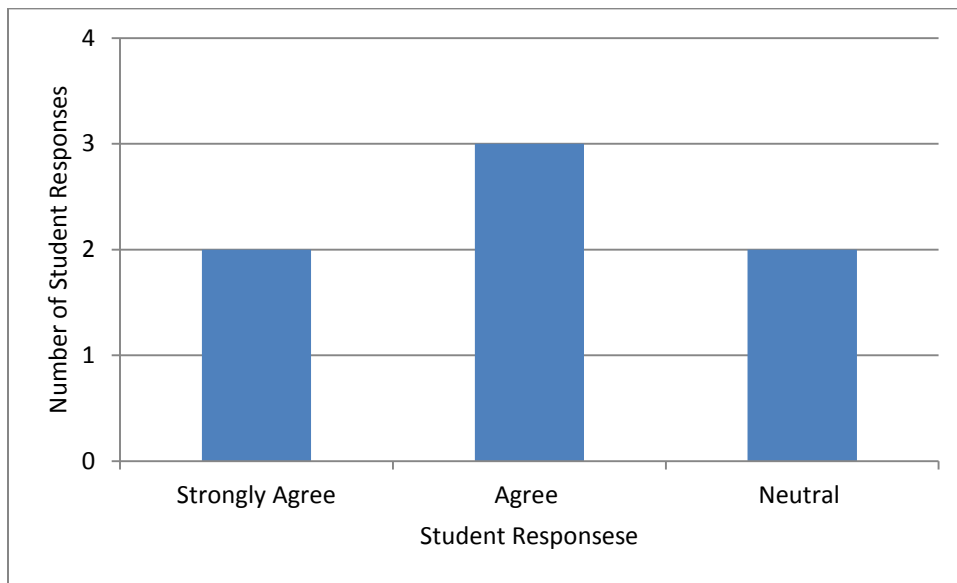


Figure 3. Students' Responses to Interview Question Concerning Their Increase in Confidence to Solve Environmental Science Problems When They Work in a Group. (N=7).

Teacher Observations also focused on the student thinking. I observed that students in environmental science class responded positively to the lesson plan assignments and asked insightful questions regarding the lesson plan.

Effects on Student Motivation and Attitude

The pretreatment Likert Survey was directed at student motivation and attitude. The results are given in Table 3. The majority of students in environmental science class enjoyed science class and hands-on labs. None of the students found science boring. These results showed students' strong interest in actively learning science and they indicated to me that they embrace working together more often to learn science during the treatment unit. Table 2 showed positive posttreatment effects regarding interest and attitude resulting from cooperative learning.

Table 3
Student Pretreatment Concept Interview

Student Concepts	SA	A	N	D	SD
I enjoy Science	5	2			
I am concerned about the environment	2	4	2		
I am qualified to take environmental science	4	2	1		
I like labs and experiments	6	1			
I think science is boring				6	1

Note. Likert Scale SA = Strongly Agree and SD = Strongly Disagree (Students Individually Responding)

The Teacher Journal observations helped determine student attitudes. During labs, students were motivated to help each other with performing experiments. One would set up the experiment, one would acquire the materials, and they would all work together on the procedure. Each student would verify the results. In writing the conclusion, they might collaborate on explaining the observed results. Students had great leadership and were extremely motivated to teach, explain, and assist fellow students in completing assignments and collecting data from labs.

Figure 4 shows students' feelings after participation in environmental science regarding higher-order thinking skills class compared to how they felt before cooperative learning. These data also indicated an overall acceptance of the cooperative learning strategy.

The survey data showed that nearly all the students agreed or strongly agreed on the effects of cooperative learning. However, a few students did not agree on being better prepared for future science courses. The results are shown in Table 3.

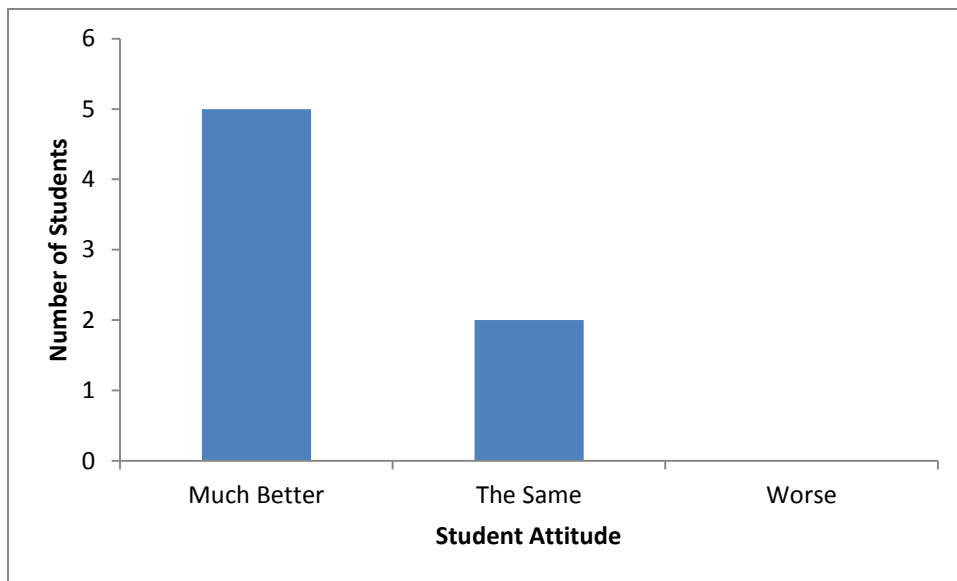


Figure 4. Posttreatment Student Attitude Survey Data, (N=7).

I sometimes observed two negative student behaviors. The first involves social interaction. A few students on occasion did not wish to interact with assigned students of another tribe in their group. Secondly, high-achieving students sometimes took exception to being asked to cooperate on a regular basis because of their perception that lower-achieving students were taking advantage of their natural talent.

INTERPRETATION AND CONCLUSION

Data were analyzed to answer my focus question on the effects of cooperative learning on the understanding of high school environmental science concepts. Data were also analyzed to assist my understanding of the effects of cooperative learning on higher-order thinking and students' attitude and motivation. Evaluation of the data collected from a nontreatment unit and a treatment unit suggests that cooperative learning had the greater increase on concept understanding and students' attitude and motivation.

Additionally, there was a positive increase in students' higher order thinking. There was an average score of 82% on the postunit assessment compared to an average pretest score of 44%. Similarly, there was an increase in students' attitude and motivation as indicated by interview, survey, and observation. Also, interview and survey data show an increase in higher-order thinking.

Cooperative learning is one tool to successfully engage students in science and environmental science in particular. In my capstone project, cooperative learning was difficult to effectively quantitatively measure since students interact in cooperative learning. My interpretation of student responses to survey questions with their written reflections and by my astute observations are an effective way to gauge the effects of my cooperative learning capstone project.

In the future I would do more assessment with the students. More assessment data would assist me in better analyzing the outcome of the treatment. Also, I would have more follow up questions during the interview to get a deeper understanding of the students' understanding of concepts, how they were leaning, how they wish to learn, how they best learn, and if working in random groups with with different tribal members would prove to be a serious distraction. I would help them understand their higher-order thinking and address the various skills required for higher-order thinking during the project to better describe how their higher-order thinking and curiosity changed.

I encountered few negative comments to questions posed by the project. I realize that younger students in lower grades would require more direction, but most students take to it and embrace the higher order thinking skills, the wisdom of their peers, and the

social nature of the strategy very easily. This reality was totally unexpected because I did not expect them to embrace cooperative learning so quickly or easily. My experience showed me that cooperative learning is a very positive strategy that empowers Native American students to discover and experience their latent intellectual potential.

VALUE

The value of cooperative learning in the Native American classroom cannot be overstated. The social nature of Native American culture lends itself well to the concepts of cooperative learning. Having students teach each other is an effective way to reach many Native American students. However, as previously stated, I feel the teacher should exhibit tolerance and understanding while the students are engaged in cooperative learning. This positive outcome for my environmental science class means that I will continue to use student-centered teaching strategies in my classroom.

Part of my evolving strategy was born of necessity. I needed laboratory assistants to aid me in conducting experiments. This was a natural fit for cooperative learning. My students loved cooperative learning. It changed the classroom dynamic to one of their social setting, and made the lab results easier to understand when explained by a peer. I realized I should have been doing more cooperative learning in my science classes long before this. Before initiating this study, I had only been experimenting with cooperative learning labs, and they were effective for students' increased understanding, higher order thinking skills, and higher student interactions.

I am in a new area of teaching for me. I am now empowering the student with their own cultural strengths. Students understand cooperative learning procedures

because of values of Native American culture. Native students are very social. Using cooperative learning taps into this aspect of Native culture. I do not use all the rules cited in the research studies on cooperative learning. However, I try to keep students on task while they are in the classroom, insisting they maintain a science focus. The effects of cooperative learning on students' understanding of environmental science concepts are positive in my Brockton classroom because it empowers the student to share insights. It also allows students to teach each and encourage each other to learn. As a teacher, it is a positive teaching strategy for me.

Since I have started this project focus, I have come to more fully appreciate actual communication with my students, rather than simply being the teacher. The understanding that I have gained from students sharing their insights has given me a level of satisfaction I have not previously had while teaching. It feels good to me to get to know what my students are thinking about their studies. They learn from me but more importantly I have experienced learning from them.

I have always known during my tenure as a teacher that cooperative learning is an effective teaching strategy in Native American schools. However, I was not aware of the scope of its importance to Native American students before this research. I plan to continue my robust implementation of cooperative learning strategies in my science classroom. I think a knowledgeable teacher can be successful using cooperative learning in the classroom with caution.

Nine hundred positive studies show that the benefits of cooperative learning are not confined to Native American classrooms. However, cooperative learning teaching strategy may be particularly well suited for the Native American classroom.

Several subunits of cooperative learning such as “student as teacher” and “students working in groups” seem to be particularly effective. Many teachers will not allow students to lead a lesson plan or study together. I think teachers should consider cooperative learning and observe its positive impacts of increased understanding and development of higher-order thinking skills by students.

In preparing for a teaching career, my professors taught this strategy, but I feel the findings I have uncovered of its effectiveness in Native American classrooms should be taught to professionals aspiring to be teachers. Cooperative learning is as natural to the Native Americans as the star quilt and the feathered dancer used in graduation as show in Figure 5.



Figure 5. Native American Drum Wrapped with Quilt and Dancer. (Left) Drum is used at graduation and (right) dancer is a symbol of Native American Culture. Photographs taken by Clinton Whitmer.

The first thing that comes to mind about realizing something new with cooperative learning is the insight into students' thoughts gained by the survey questions and group responses during the writing of this Capstone paper. It was a revelation to me, to have my students share their feelings about teaching strategies. In an educational setting where intellectual interaction is usually confined to a student's understanding of the lesson plan through homework and testing, this sharing by students took me by surprise. About the only other feedback of a similar nature in the science classroom comes from the conclusion of results of science experiments. However, these responses are usually related to the experiment performed, and so do not usually contain insightful information of the nature shared in this Capstone paper. Doing my Capstone Project and writing the paper certainly opened my eyes to the importance of student communication

and student empowering to increase overall student understanding. However, cooperative learning has its place, which means it may not be necessary for all students at all times. I believe my students are now aware that using cooperative learning is a positive learning strategy.

I know that my first years of teaching with cooperative learning strategy were years that I really did not know whether it made a difference in students' understanding, higher-order thinking, or motivation. It was only after I started this study that responses from students provided insight into how they were helped and why they were able to help fellow classmates. I know that I would continue to use this method in the next year. I feel that to have them work together on the lesson plan is an effective method of increasing understanding. Teachers in other disciplines would do well to employ cooperative learning at my school. They would see improvement in all facets of classroom performance.

Responses to the project questions were insightful to say the least. During regular classroom instruction, as a teacher, students rarely gave me any insight into their feelings or understanding. Now that the study is over for me, I plan to survey their feelings in their assignments, as the most compelling component of this study was reading student responses to the survey and interview questions. The full impact of this study is that student responses showed an acceptance of this strategy with a positive outcome for understanding, higher-order thinking skills, and motivation. A final thought is that teachers should be responsible with this strategy, knowing when to employ it and how to use it.

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APPENDICES

APPENDIX A
STUDENT INTERVIEW QUESTIONNAIRE

Interview Questions

Participation in this research is voluntary and can in no way affect a student's grade for this course.

1. How do you feel about environmental science at school? Explain.
2. What activities during class are most helpful?
3. Do you enjoy science? Yes No Explain.
4. If you could change one thing about this class, what would it be and why?
5. After participating in class, do you feel: A) Much better, B) The same, C) Worse?
6. What are the effects of cooperative learning on students' understanding of environmental science?
7. What are the effects of cooperative learning on students' higher-order thinking skills?
8. What are the effects of cooperative learning on students' motivation and attitude?

APPENDIX B
STUDENT PRETEST

Student Pretest

Environmental Science

Name _____

1. Name a threatened species in the world. _____
2. The biodiversity of a tropical biome is a) high, or b) low.
3. T or F A zoo may be used to save a species.
4. Most of the world's water is in the a) ocean, b) lakes.
5. T or F Watering large lawns is a way to conserve water.
6. T or F Factories may cause water pollution.
7. Air pollution may be caused by a) hydroelectric dams, or b) coal-fired generation.
8. T or F Air pollution may affect a person's health.
9. T or F Noise pollution may affect a person's mental health.
10. Acid rain affects the environment by polluting streams and _____ trees.
11. Factors in naming a biome include temperature and _____ .
12. T or F UV radiation from the sun may cause severe sunburn of people.
13. _____ warming may be increasing the surface temperature of the earth.
14. People utilize land for houses and _____ .
15. T or F Reforestation involves replacing forest lands.
16. Plants help prevent soil erosion due to their roots and _____ .
17. T or F Our National Parks help to protect organisms from extinction.
18. T or F Aquaculture is growing fish in pens for consumption by people.
19. T or F Impacts to the environment are due to the increasing human population.
20. T or F Brockton is located in the tall-short grassland.

APPENDIX C

PRETREATMENT PERCEPTION LIKERT

Pretreatment Perception Likert

Student Pretreatment Perception Likert

1. I enjoy science.	SA	A	N	D	SD
2. I am concerned about the environment.	SA	A	N	D	SD
3. I feel qualified to take environmental science.	SA	A	N	D	SD
4. I like labs and experiments.	SA	A	N	D	SD
5. I think science is boring.	SA	A	N	D	SD

Where SA=Strongly Agree, SD=Strongly Disagree

APPENDIX D
STUDENT EXIT LIKERT SURVEY

Exit survey for Environmental Science

Statement

- | | | | | | | |
|----|---|----|---|---|---|----|
| 1. | Cooperative learning motivated me to continue in science. | SA | A | N | D | SD |
| 2. | Cooperative learning stimulated my intellectual curiosity. | SA | A | N | D | SD |
| 3. | Cooperative learning held my attention and interest. | SA | A | N | D | SD |
| 4. | As a result of cooperative learning, I feel better prepared for future science courses I will need to take. | SA | A | N | D | SD |
| 5. | Cooperative learning increased my confidence in my science reasoning skills. | SA | A | N | D | SD |

SA=Strongly Agree, SD=Strongly Disagree

APPENDIX E
STUDENT CONTENT POSTTEST

Environmental Science Posttest

Name _____

1. T or F Whales are a threatened species.
2. T or F The biodiversity of a tropical biome is low.
3. Animals raised in a _____ may save an endangered species.
4. T or F Most of the world's water is in lakes.
5. Having a small lawn may help to _____ water.
6. One source of water pollution may be _____ .
7. T or F Coal-fired electrical generators may cause air pollution.
8. Shortness of breath may be an illness caused by _____ pollution.
9. Mental health may be an issue related to _____ pollution.
10. Dead trees in a forest may be the result of _____ rain.
11. Temperature and vegetation are factors in naming a _____ .
12. Severe sunburn of people may be the result of _____ radiation from the sun.
13. Global warming may be causing the _____ of the earth to rise.
14. T or F Housing and agriculture are two ways people use land.
15. Replacing forest lands by replanting is called _____ .
16. Roots and leaves of plants help prevent _____ erosion.
17. T or F Our National Parks help protect the environment.
18. Growing fish in pens for human consumption is called _____ .
19. The increasing human population puts pressure on the environment by land use, pollution, and _____ .
20. What biome is Brockton located in? _____ .

APPENDIX F
INSTRUCTOR JOURNAL

Instructor Journal

- Journal Entry, 2/6/2013. Students conduct peer-to-peer lesson discussion.
- Journal Entry, 2/11/2013. Students engage in cooperative learning with lessons.
- Journal Entry, 2/21/2013. Students perform cooperative learning lab with one student designated as scribe.
- Journal Entry, 2/25/2013. Students as teachers present the lesson.
- Journal Entry, 3/11/2013. Students answer interview questions.
- Journal Entry, 4/8/2013. Nontreatment and treatment units performed by students

APPENDIX G

POSTER

Cooperative Learning

Introduction

The purpose of this project is to determine whether cooperative learning facilitates students' environmental science understanding.

Treatment Design

Pre and posttreatment testing was used. Questions were asked of students involving cooperative learning. Teacher observations were also employed.

Data Collection Instruments

Pre and posttreatment tests

Questionnaire

Observation

Description of Students

The students involved in this project included Native American males and females who were sophomores through seniors in high school age.

Conclusion

Employing cooperative learning resulted in positive outcomes for student understanding.

Project Questions

Do you enjoy science?

What are the effects of cooperative learning on students' motivation and attitude?

Do you have more confidence to solve environmental science problems when you work in a group which also helps you get involved in environmental science?

What are the effects of cooperative learning on students' higher-order thinking skills?

After participating in class, how do you feel? A) Much better, B) The Same, C) Worse

What activities during class are most helpful?

If you could change one thing about this class, what would it be and why?

Response Category	Frequency
Strongly Agree	2
Agree	3
Neutral	2
Disagree	0
Strongly Disagree	0

Rate the following statement: Do you have more confidence to solve environmental science problems when you work in a group which also helps you get involved in environmental science class? Circle one below.

Clint Whitmer
Brockton School District
Brockton, Montana
MSU-Bozeman
MSSE Masters Program

Brockton School District
COOPERATIVE LEARNING: THE EFFECTS
OF COOPERATIVE LEARNING ON
STUDENTS' UNDERSTANDING OF
ENVIRONMENTAL SCIENCE CONCEPTS

APPENDIX H
PROJECT TIMELINE

Project Timeline

February 4 – Pretreatment student concept interviews
March 9 – Nontreatment preunit assessment
March 10 – Nontreatment unit instruction
March 18 – Pretreatment Student Concept Survey
March 23 – Treatment unit implementation
March 25 – Posttreatment content survey
April 1 – Postunit assessment
April 19 – End of project