THE EFFECT ON STUDENT ENGAGEMENT THROUGH THE USE OF CASE STUDIES IN THE EARTH SCIENCE CURRICULUM

by

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ABSTRACT

Engaging students in meaningful learning experiences is an important component in science education. Research suggests that when students find the material relevant and are engaged in the learning process, their motivation to learn increases, which leads to deeper understanding. The purpose of this study was to compare student engagement when using traditional teaching methods versus case studies in the Earth Science classroom. Over the course of the study, students participated in three learning cycles that included case studies, lab activities, lectures, and research tasks in each. During the cycles, data were collected over student engagement, motivation to learn, and perceived relevance of the content. Pre- and Post-Treatment Surveys were used to identify changes over time. Classroom Observations, Student Exit Tickets, and Student Interviews were conducted throughout each cycle. The results showed a correlation between the use of case studies and increased student engagement and motivation. Student responses also suggested that case studies may help make Earth Science content feel more relevant. These findings support the use of case studies into the Earth Science classroom to better engage students with the content and encourage them to take an active role in their learning.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

Context of the Study

Clinton High School is a 9th through 12th grade semi-urban public school located in Clinton, Iowa with a Title I designation. According to the National Center for Educational Statistics (2024), 49.2% (*N*=981) qualified for free or reduced lunch during the 2023-2024 school year. The student body is composed of 54% male and 45% female with a racial distribution is 71% White, 11% Hispanic, 8% Black, and 9% identifying as more than one race (National Center for Education Statistics, 2024). Clinton High School exhibits a diverse population with a considerable proportion of students from low socioeconomic status, creating a complex educational setting that requires a variety of instructional strategies to meet varied student needs.

The performance indicators provided by the state of Iowa have identified Clinton High School as underperforming in several key areas. According to the Iowa Department of Education (2024), students perform below average in mathematics, reading, and science on the Iowa Assessments with proficiency at 56.5% (*n*=693), 57.7% (*n*=696), and 51.4% (*n*=230) respectively. Clinton High School fell below the state average with 88.7% (*N*=981) daily attendance and a four-year graduation rate of 79.6% (*n*=235) during the 2023-2024 school year (Iowa Department of Education, 2024). The school and district administration have identified the building goals for the school year to improve attendance and level of student engagement.

The Earth Science course I teach is a one-semester graduation requirement composed of students with various educational backgrounds in science. The course follows the Next Generation Science Standards (NGSS) adopted by the Iowa Core with an emphasis on the NGSS Science and Engineering Practices. Students in the class study various areas covering astronomy, geology, meteorology, and climatology throughout the semester. Students may take Earth Science during any semester of their sophomore, junior, or senior year or have the option to take the honor level equivalent. The general Earth Science course used in this study contains students with various academic abilities ranging from general education students, English language Learners, and students with individual education plans. The Earth Science course selected required a wide range of educational needs to be considered when implementing case studies and measuring student engagement.

The range of students within the Earth Science classroom presents challenges to effectively engage all students through the current curriculum. Part of the challenge in engaging students is the lack of a strong connection between the content to students' lives. A multidisciplinary approach to teaching Earth Science would aid in making the connection to prior knowledge and experience for students. Case studies were used to implement this approach, and it was chosen to engage students with a multi-perspective view of Earth Science by learning content through a problem-solving approach. This approach helps students take ownership of their learning and encourages them to apply scientific concepts in real-world contexts.

Focus Question

My focus question was, What effect do real-world case studies have on student engagement in the Earth Science classroom?

My sub-questions include the following:

1. Do students perceive case studies as more relevant and applicable compared to traditional teaching methods?
2. How do case studies influence student motivation to learn Earth Science concepts?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Introduction

Case studies are a valuable teaching strategy to increase student engagement. Real-world scenarios in case studies challenge students to think critically and come to solutions (McDonald et al., 2018). This increase of engagement of students stems from relevance and meaningful tasks that can be achieved through the authentic learning found in case studies (Kem et al., 2021). Students are required to bring in prior knowledge and skills to view the case from multiple perspectives. Unlike content-specific tasks, Mård and Hilli (2022) state using case studies requires students to utilize multiple disciplines and perspectives to reach a solution. Research shows that case studies are an effective educational strategy to incorporate authentic learning to increase student engagement.

Effectiveness of Case Studies in Education

Case studies are a non-traditional approach to allow students to engage in real-world problem-solving. Students are required to engage with the material through real-world issues, and by doing so, often have more significant academic outcomes. The value of case studies in education has played a significant role in preparing students for careers and higher levels of education by allowing the opportunity for students to face similar challenges they will see in their careers (McDonald et al., 2018). As an educational tool, case studies have been found effective in increasing academic performance and competency in academic skills.

Academic Performance

Academic performance can be significantly impacted through increased student engagement in case studies. Emblen-Perry (2022) concluded there is an increase in students' motivation to engage in classroom activities if students view it as purposeful and will provide a higher quality of work associated when tasked with relevant case studies. Seshan et al. (2021) credits the elevated level of engagement to the students' ability to apply their knowledge through multiple perspectives in complex scenarios found in case studies. Similarly, Nohria (2021) suggests students are able to recall knowledge and skills from case studies better than information obtained from traditional lectures due to a greater level of engagement. Implementation of case studies into the curriculum can impact student engagement by providing students with an active role in applying knowledge to real-world situations. Greater academic outcomes, such as retention, can be associated with the application of knowledge to real-world case studies compared to traditional approaches to education. The increase in student academic performance highlights the importance of integrating case studies into the curriculum to promote learning experiences that enhance student engagement.

Student interest and relevance of content are enhanced by presenting concepts within real-world case studies. Nohria (2021) suggests case studies expose students to real-world dilemmas making the concepts more relevant and engaging to students. The relevancy of the content makes it meaningful to the students and intentionally creates an opportunity to engage (Kim et al., 2021). It is also suggested by Seshan et al. (2021) that the integration of theory with real-world situations increases student awareness of the importance of key concepts. Providing students with real-world situations increases students' interest in the curriculum leading to more meaningful engagement. This increased interest in the authentic context of the curriculum

enhances students' ability to understand important concepts being covered. Authentic learning found in case studies improves understanding through increased interest and engagement.

Academic Skills

Increasing engagement through case studies promotes critical thinking and problem-solving skills. Savery (2019) discusses how the use of case studies allows educators to align instructional goals while also requiring students to find solutions based on their knowledge and promotes problem-solving skills. Likewise, Seshan et al. (2021) promote case studies as a way for students to utilize theory to think critically to come to solutions based on real-world situations. A theme found by Seshan et al. (2021) concluded in increase in test taking ability and a greater understanding in content compared to traditional teaching methods. Based on this decision-making process required of case studies, Emblen-Perry (2022) noted that case studies also require students to evaluate their decisions to critically aid in the problem-solving process. Educators who utilize case studies challenge students to think critically and apply knowledge to complex problems. Active engagement in the problem-solving process enhances students' skills through the crucial consideration of knowledge and multiple perspectives.

Student Engagement in Education

To enhance student engagement within the classroom, there is value in understanding the nature of student engagement. Student engagement can take different forms based on the context of the classroom setting and it is important to understand the approaches to reaching a deeper level of engagement in students. The level of engagement of students is correlated to the learner outcomes due to the involvement of students in the learning process. By exploring the type of

engagement and its effects on student understanding, educators can begin to understand and enrich student learning experiences.

Forms of Student Engagement

Student engagement is essential for academic success and is influenced by meaningful learning experiences; however, defining student engagement can vary. Perry (2022) argues that all areas of engagement need to be met and breaks down distinct types of engagement into categories which include (a) affective, (b) behavioral, (c) cognitive, and (d) agentic engagement. This varies from Lei et al. (2018) as they discuss that actively partaking in learning tasks can be considered engagement. Janna et al. (2019) expand on this idea by suggesting student engagement stems from purposeful tasks and collaborative learning. Perry would categorize Lei et al. and Janna et al. definitions of engagement into behavioral and agentic engagement, respectively. Engagement in learning includes multiple dimensions that students in different settings meet. Understanding this multilevel nature of engagement and incorporating effective instructional strategies can create a learning environment conducive to student engagement. Educators can promote meaningful engagement in the classroom by considering various aspects and levels of student engagement.

Effects of Student Engagement

Student engagement at all levels is essential for academic success and is influenced by meaningful learning experiences. Emblen-Perry (2022) indicates when students are motivated to engage in classroom tasks, they are more likely to place greater effort into their work. In their research, students reported an increase in knowledge that Emblen-Perry (2022) connected to the increase in engagement that case studies provide. Aker and Ellis discussed how the level of

engagement can also be tied to students' ability to take ownership of their own learning. Aker and Ellis (2019) continue by noting that student-centered learning increases student engagement. Perry (2022) argues it is important for student engagement that a task requires a great amount of concentration and encourages students to seek new learning opportunities to reach a deeper level of engagement. The evidence highlights the importance of purposeful and complex activities to promote student engagement. Motivated students who have ownership over their learning are more likely to engage with the content and necessary skills to succeed academically.

Authentic Learning in Education

Authentic learning experiences in the classroom incorporate relevance, real-life settings, and complex problem-solving. O'Neill and Short (2023) define authentic learning activities as tasks that integrate curriculum with real-world relevance. Authentic tasks must be geared towards students based on connection to the content and complexity to meet students' academic levels. Nkhoma et al. (2017) underscores the necessity of relevance and real-world settings for authentic learning while advocating for students to be valued participants in the learning process by allowing for independent learning. Savery (2019) highlights how case studies as authentic tasks offer intricate problem situations compelling students to analyze evidence and articulate their thinking through problem-based learning. This view is supported by observations by Nkhoma et al. of increased student engagement through the collaborative discussions associated with case studies and other authentic learning strategies. Authentic learning tasks are valued for creating learning experiences that are relevant to the students through real-world context and force students to think critically. The necessity of integrating authentic approaches such as case

studies in the classroom can promote student engagement and facilitate a deeper level of learning.

Authentic activities in education serve to bridge the gap between academic learning and real-world application to foster a multidisciplinary approach to complex challenges. Morley and Jamil (2020) argue that the traditional content-focused approach to teaching is insufficient in preparing students for careers and higher education while promoting the importance of balancing academic rigor and content with work-related skills. An interdisciplinary approach to teaching through authentic learning can equip students with the skills essential for the multifaceted challenges of the real-world (Kanmaz, 2022). Case studies are an effective tool for scaffolding students' application of knowledge to real-world challenges that require multiple perspectives, argues Savery (2019). The value of integrating authentic learning experiences into the classroom is to prepare students with the skills and knowledge necessary to succeed in and beyond the classroom. Connecting authentic learning experiences to the classroom benefits students academically and promotes student growth.

The multidisciplinary approach found in authentic learning tasks promotes growth in collaboration, creativity, and inquiry leading to increased engagement. Hardy (2021) suggests greater collaboration among learners occurs due to the necessity for multiple perspectives to think creatively when solving real-world inquiries in authentic tasks. The importance of engaging students through both science content and skills necessary for interdisciplinary careers can occur through the authenticity of real-world problem-solving (Hadzigeorgiou, 2019). Authentic learning that requires a multidisciplinary approach to learning can aid in balancing academic rigor and work-related competencies which Morely and Jamil (2020) have identified as

necessary for students. Multiple disciplinary approaches to education aid in increasing interpersonal skills while increasing engagement through real-world relevance. Learning found in authentic learning environments can lead to improved academic growth while increasing the engagement of students in the learning process to support student success.

The benefit found in authentic learning does not come without challenges in creation and implementation. Alfiani and Wijayati (2022) discuss that educators are not well equipped with the possible challenges when incorporating authentic learning due to the lack of knowledge in the education theory. They suggest that teachers need to have deeper understanding of the student learning process through teacher preparation for more accurate evaluation of student progress. Similarly, Aziz et al. (2020) concluded that teacher preparation is deficient in preparing educators to implement thorough authentic learning opportunities in the classroom. Aziz et al. continues to identify time constraints as a challenge for educators for full implementation. Without proper time to create and evaluate tasks, educators struggle to fully carry out meaningful authentic learning in the classroom (Hidayati et al., 2017). Educators may be discouraged with authentic learning tasks due to lack of experience and in increase workload required compared to traditional learning.

Conclusion

Case studies in education have a significant impact on academic achievement by increasing student engagement. The authentic learning and the multidisciplinary approach provided by case studies serve as a catalyst for students to engage in tasks that have real-world relevance and motivate students to take an active role in the learning process. By increasing relevance in the classroom, students are likely to engage at a higher level in learning tasks which

have been demonstrated to increase achievement in the classroom and beyond. Academic achievement is increased by the meaningful authentic learning experiences found in case studies that promote academic skills of critical thinking and problem-solving, allowing students to engage at all levels. Utilizing a multidisciplinary approach grounded in case studies can provide learning opportunities that positively affect learner outcomes through an increase in student engagement.

CHAPTER THREE

METHODOLOGY

Demographics

My action research utilized a mixed method design to identify how multidisciplinary use of case studies affects student engagement in the Earth Science Classroom. Students participated in a variety of traditional classroom learning methods along with case studies to compare the relationship between student level of engagement, motivation to learn, and relevancy in the content across the teaching methods. By increasing my understanding of the factors that may influence student engagement with the curriculum, I was able to improve my teaching by creating relevancy for my students. The research methodology for this action research has been reviewed and received an exemption (Appendix A) by the Montana State University Institutional Review Board and compliance for working with human subjects has approved the research methodology.

Clinton High School has placed student engagement as a focus of professional development and a part of the school goals for the 2024-2025 school year. Educators have been looking monthly at strategies to use in the classroom that can increase student engagement to increase attendance based on a change in state law. Within the Science department, we set the goal of increasing our state assessment scores through the increase of science reading in the classroom. The purpose of the study was to grow student engagement in the Earth Science curriculum through a multidisciplinary approach geared towards real-world application. The research question was, what effect do real-world case studies have on student engagement in the

Earth Science classroom? The research sub-questions were, do students perceive case studies as more relevant and applicable compared to traditional teaching methods and how do case studies influence student motivation to learn Earth Science concepts? Through the implementation of case studies into my Earth Science classes, I wish to use my action research to meet the needs of the school and the science department.

Earth Science is a one semester graduation requirement that is offered during a student's sophomore, junior, or senior year. Students may also meet the graduation requirement through an honors level Earth Science class that is offered during the fall semester. The research was implemented during the spring semester. Three Earth Science classes were used in the study for a combined 44 students. Twenty-nine percent (n=13) of students participating were on an Individual Education Plan. Forty-three percent (n=19) of the students identified as male and 57% n=25) identify as female. The majority of Earth Science students are sophomores at 65.6% followed by juniors, seniors, and freshmen at 22.9%, 8.3%, and 4.2%, respectively. Students in this course cover a wide range of topics in Earth Science within Astronomy, Geology, and Atmospheric Sciences.

Treatment

This study utilized a combination of observational and correlation research design to collect data and analyze student engagement. Educational research can benefit through observational research design by collecting qualitative data through the students in the natural context of the classroom to view participants holistically to study their perspectives. In my role as a participant observer, I remained actively involved in classroom activities throughout the research process to closely engage with participants and their experiences. The correlational

design aimed to explore the relationship between the use of case studies and student engagement. While this approach allowed for identifying patterns and relationships, it did not establish causation, as other factors in the curriculum can affect engagement such as assorted topics that may pique student interest. Student engagement was measured based on the students ability to participate in the task and students motivation to extend their learning beyond the minimum requirements.

Data collection began with a Pre-Treatment Survey (Appendix B), administered during the second week of the semester, to gather baseline information on students' perceived levels of engagement with various learning techniques. Over the next two weeks, I conducted three Student Observations (Appendix C) to assess engagement during distinct activities: a lecture, a lab exercise, and a research task. During each activity, students completed Exit Tickets (Appendix D) to provide additional insights into their perceptions of engagement. After completing the initial data collection, I introduced the concept of case studies to the students with a shortened example that we worked through as a full class. The first independent case study followed this introduction, during which I observed student engagement and administered the Exit Ticket once again. Additionally, I conducted Student Interviews (Appendix E) with a small group of five students to obtain a deeper understanding of their experiences. This cycle of Student Observations, Exit Tickets, and Student Interviews was repeated for two subsequent case studies to ensure comprehensive data collection.

At the conclusion of the study, students completed a Post-Treatment Survey to evaluate their perceptions of engagement after participating in the case study activities. By integrating Pre- and Post-Treatment Surveys, Student Observations, Exit Tickets, and Student Interviews,

this approach provided a multifaceted understanding of student engagement and the potential influence of case studies on their learning experience.

Data Collection and Analysis Strategies

Qualitative and quantitative data were collected through the four data collection tools. The data collection tools were chosen for the purpose of data triangulation to aid in answering the corresponding focus questions in Table 1. Pre- and Post-Treatment Surveys collected data from students to show changes in their perceived level of engagement, motivation, and relevance in the coursework from before and after the treatment. During the course of the research, students were interviewed and asked to complete an Exit Ticket at the conclusion of traditional learning methods and case studies to allow for the comparison between the treatment and traditional learning.

Table 1. Data Triangulation Matrix.

	Focus Questions		
Data Collection Instruments	What effect do real-world case studies have on student engagement in the Earth Science classroom?	Do students perceive case studies as more relevant and applicable compared to traditional teaching methods?	How do case studies influence student motivation to learn Earth Science concepts?
Pre- and Post-Treatment Survey	X	X	X
Student Exit Ticket	X	X	X
Observations	X		
Student Interviews	X	X	X

Pre-and Post-Treatment Survey

A Pre- and Post-Treatment Survey (Appendix B) was conducted prior to the implementation of the treatment and once the treatment period had been completed. The survey included a mix of Likert style and open-ended response questions to collect data regarding student attitudes, motivation, and engagement through different teaching methods. By incorporating the survey twice, I was able to analyze the change in students' throughout the treatment period.

Combining Likert-style and open-ended questions in a Pre- and Post-Treatment Survey provides comprehensive data on student engagement perspectives. The Likert-style questions provided quantifiable data that aids in identifying trends through comparative analysis before and after implementing case studies into the curriculum. The use of Likert-style questions was selected for the ability to standardize responses to increase the reliability and validity of the data (Hampson, 2014). By complementing the Likert-style questions with open-ended responses, students were able to elaborate on their responses allowing me to gather in-depth insights that go beyond the standardized data (Peterson, 2000). Open-ended responses were categorized into themes using thematic analysis to identify patterns in student engagement, motivation, and interest in the content. The quantitative data from the Likert-style questions and the qualitative insights of open-ended responses create a fuller picture and add depth to the research.

Student Observations

Observations took place during class periods in which case studies were implemented and in selected class periods that contained traditional lectures and labs using the Student Observation form (Appendix C). Observational data was collected by tallying the number of

students a) on task, b) asking questions, c) discussing topics, d) completing additional research, and f) completing the task. The types of questions being asked were also tallied to help in identifying the depth of engagement. The tallies and the documentation of specific questions provided a mix of quantitative and qualitative data. The use of observations for data collection helped to identify distinct types and levels of engagement found in the classroom during different teaching methods. Through data analysis of the observation data, I strived to identify changes in student engagement.

Classroom observations are a valuable method of data collection in educational research by noting student behaviors, engagement, and interactions with the content. Real-time data collection enabled immediate documentation limiting errors in recall that can take place in interviews and surveys (Burton & Bartlett, 2005). These observations enabled me to see changes over a longer period for several types of activities compared to the effect of case studies in the classroom. By identifying the frequency of distinct types of engagement, I was able to analyze the change in engagement through traditional methods versus case studies. Direct observations of student engagement helped collaborate findings of qualitative and quantitative data found from analysis of surveys and interviews.

Student Exit Tickets

During the research period, Student Exit Tickets (Appendix D) were utilized at the end of the class sessions featuring various educational activities. Qualitative and quantitative data were collected regarding student experiences and engagement. An analysis of the data was utilized to identify the level at which students find the activity relevant. Implementing the student Exit Ticket over the course of multiple types of activities offered the ability to analyze the change

across modes of learning to see if there is a correlation between student engagement and case studies when compared to traditional methods. Quantitative data was collected and analyzed through thematic analysis of open-ended responses to identify themes associated with what students find engaging in the activities and motivations to extend learning.

The choice of Exit Tickets was for the continued collection of data throughout the research period unlike the Pre- and Post-Treatment Survey which occurred only twice or the interviews which took place after the implementation of case studies. Exit Tickets offered me the opportunity to analyze changes throughout the entire research period for a more complete view of the student perspective (Exit Tickets, 2024). The longitudinal research approach through the use of Exit Tickets can help identify key factors that affect students' engagement and relevance to the activities.

Student Interviews

Students Interviews (Appendix E) were conducted as a semi-structured survey at the end of the treatment period. The purpose of the interview was to collect qualitative data on students' perspectives on the use of case studies and how it affected their motivation and engagement. The semi-structured format allowed for follow-up questions to student answers. This provided a more comprehensive view of their thinking than surveys alone can contribute. The comprehensive view is provided by the structure of questions regarding motivation and relevance that cannot be provided by observations or quantitative data alone. The collection of student responses enabled thematic analysis to provide patterns in student motivation and perception that occur through the implementation of case studies.

Interviews provided an opportunity for participants to reflect on their experiences. According to Altheide (1996), analysis of interview data can provide themes on the perspectives and opinions of students to better understand their experiences. Peterson (2000) discusses the importance of using open-ended questions that can limit bias in response by not requiring predetermined answers. Unlike surveys, open-ended questions provided during the interviews give students the opportunity to voice their thinking, which can make students feel part of the research process leading to greater articulation in their responses compared to standardized questions to provide greater context (Jain, 2021). Student interviews may significantly impact on the research by providing participant insights regarding their engagement, perceived relevance, and motivation to learn Earth Science through case studies.

Analysis Strategies

Qualitative data was analyzed using thematic analysis. Thematic analysis is a technique used to identify, analyze, and communicate patterns found in qualitative data. The purpose of thematic analysis is to discover underlying themes of participants' experiences and perceptions (Altheide, 1996). There are multiple steps in thematic analysis that involve familiarizing oneself with the data, coding data into common trends, and generating and refining themes. The use of thematic analysis was chosen as the interview data needed to be compiled into themes to identify a clearer pattern in the student responses. The specific themes identified in this research arose through patterns found within student responses and were not pre-selected to better align with students natural responses. Themes in student responses provide insight into how motivation and engagement are representative of the entire sample size.

One strategy utilized in analyzing quantitative data is normalized gains. Normalized gains are a valuable data analysis technique in correlation research design where researchers aim to assess the effectiveness of interventions or teaching methods. By analyzing these correlations, researchers can identify relationships between the effectiveness of an intervention and various predictors (Bowen & Bartley, 2014). Utilizing normalized gains in correlation research helps in controlling initial differences among participants, making it easier to draw meaningful conclusions about the impact of specific variables. Normalized gains were used to show changes in levels of engagement and student motivation to learn throughout the treatment.

CHAPTER FOUR

DATA ANALYSIS: CLAIMS AND EVIDENCE

Results

At the conclusion of the treatment period, both quantitative and qualitative data were analyzed to triangulate the findings from the research. The analysis was used to identify patterns of student experience following the implementation of case studies in the Earth Science curriculum. Statistical analysis was supported by thematic analysis of open-ended responses to provide a deeper understanding of the impact on student relevance, motivation, and engagement.

Student Relevance

Case studies increased students' perceived relevance of Earth Science topics. Data on student-perceived relevance and engagement were collected through exit tickets after completing case studies, lectures, lab activities, and research opportunities. Seventy-three percent (*n*=32) of respondents agreed or strongly agreed that the case studies related to their life or interests as seen in Figure 1.

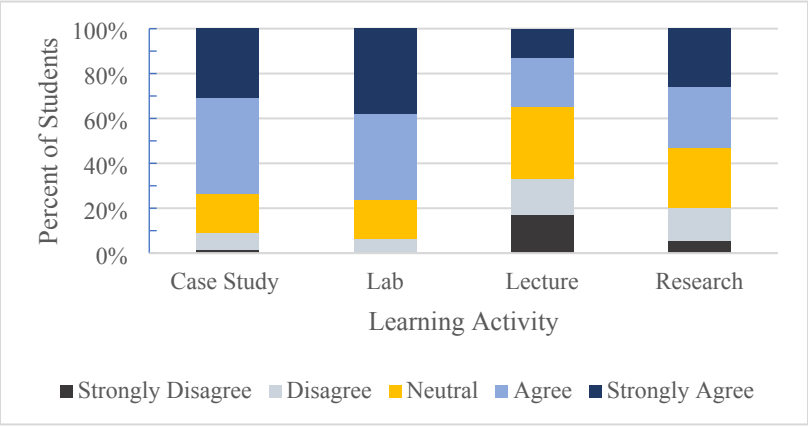

Figure 1. Exit ticket data collected over whether students find learning activity relevant, (*N*=44).

One student commented on the relevance of a case study, stating, “I don’t like most reading homework, but learning about solar winds and other space weather made it feel real since it can affect us by messing with our satellites.” This student highlights how implementation of real-world topics can make the content more relevant to students. Among the four learning activities, students only identified labs as slightly more relevant than case studies.

Student interviews suggested that case studies were perceived as more relevant due to the real-world application and problem-solving components. Following the implementation of case studies, select students were interviewed about their experiences. When asked about the relevance of case studies compared to other learning activities, 67.7% (*n*=8) expressed that case studies were more relevant, with several students discussing the real-world aspect. Twenty-five percent of the students interviewed mentioned the problem-solving component of case studies as contributing to their relevance, while 41.7% felt learning about real-world challenges played a role in increased relevance.

Students’ perceived relevance did not show a statistically significant change following treatment based on Pre- and Post-Treatment Survey data. Students completed a Likert-style survey evaluating their perceived relevance to Earth Science content. Table 2 shows a shift in perceived relevance between the Pre- and Post-Treatment Surveys.

Table 2. Pre- and Post-Treatment Survey data if content in Earth Science is relevant to the student, (*N*=44).

	Pre-Treatment	Post-Treatment
Strongly Agree	0.00%	0.00%
Agree	11.36%	20.45%
Neutral	45.45%	63.64%
Disagree	38.64%	15.91%
Strongly Disagree	4.55%	0.00%

However, a Chi-Squared test returned a p-value of 0.071, which is above the 0.05 threshold for statistical significance. In response to questions regarding the relevance, one student noted, “I like the class a lot. The activities we do can be cool, but I don’t know when I would ever use it.” This response suggests that enjoyment in the classroom does not necessarily indicate a perceived relevance to the content.

Student Motivation

Student motivation to learn Earth Science increased significantly following the use of case studies. The Pre-Treatment to Post-Treatment Survey showed a noticeable shift toward "agree" or "strongly agree," as shown in Figure 2. Specifically, 66% (*n*=29) of students reported being motivated to learn Earth Science after the treatment, compared to only 20.5% who felt the same in the pre-treatment survey.

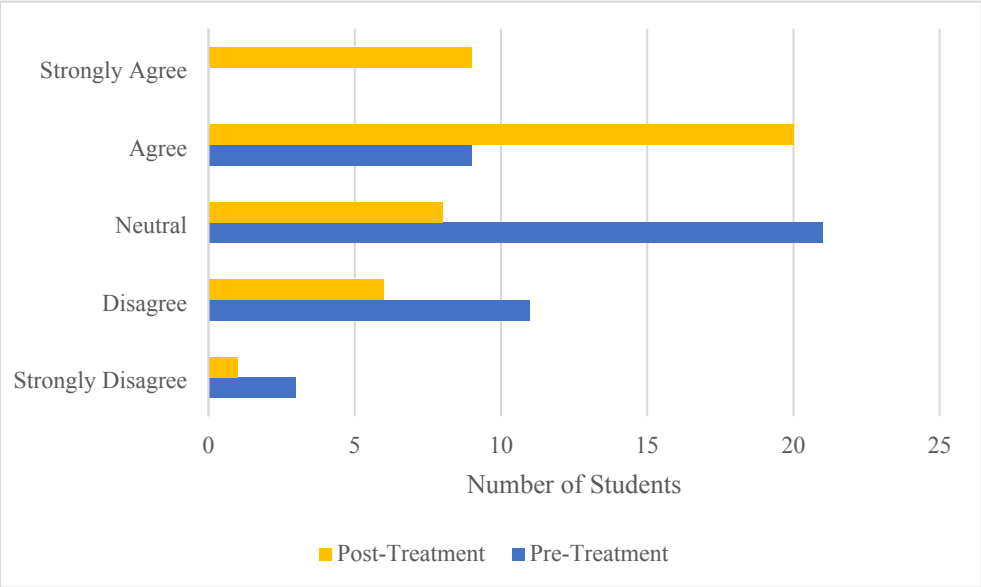

Figure 2. Pre- and Post-Treatment Survey data on the number of students who are motivated to learn Earth Science, (*N*=44).

This result yielded a p-value of 0.014, which is below the 0.05 threshold, indicating a statistically significant relationship. One student commented in the Post-Treatment Survey, “I like that we not only learn about the Earth and space but also have to apply what we know. It makes the topics more interesting, even though I don’t really like science.”

Students reported greater curiosity about Earth Science topics after case studies compared to traditional learning activities. At the conclusion of each learning activity cycle, students were given the opportunity to express areas or topics they would like to explore further. Students indicated a greater interest in learning more about Earth Science topics after completing case studies compared to the other three learning activities (Figure 3).

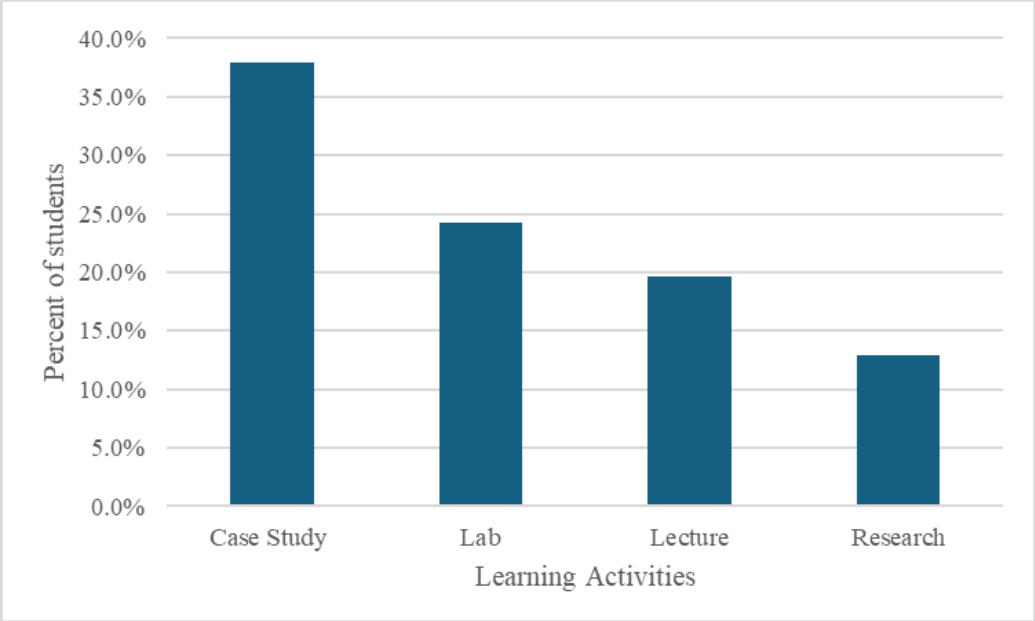

Figure 3. The percentage of students who expressed additional curiosity or interest in additional learning after each learning activity, (*N*=44).

While the specific topics covered in each activity may have influenced this, a correlation exists between case studies and increased student motivation to extend their learning.

Student Engagement

Implementation of case studies led to a higher observed level of engagement compared to lectures and independent research activities. Student engagement data during learning activities were collected through classroom observations. During the case studies, 80% (*n*=35) of students remained engaged throughout the class period, compared to 61% during lectures and 75% during independent research. Lab activities maintained the highest engagement levels at 85%, as shown in Figure 4.

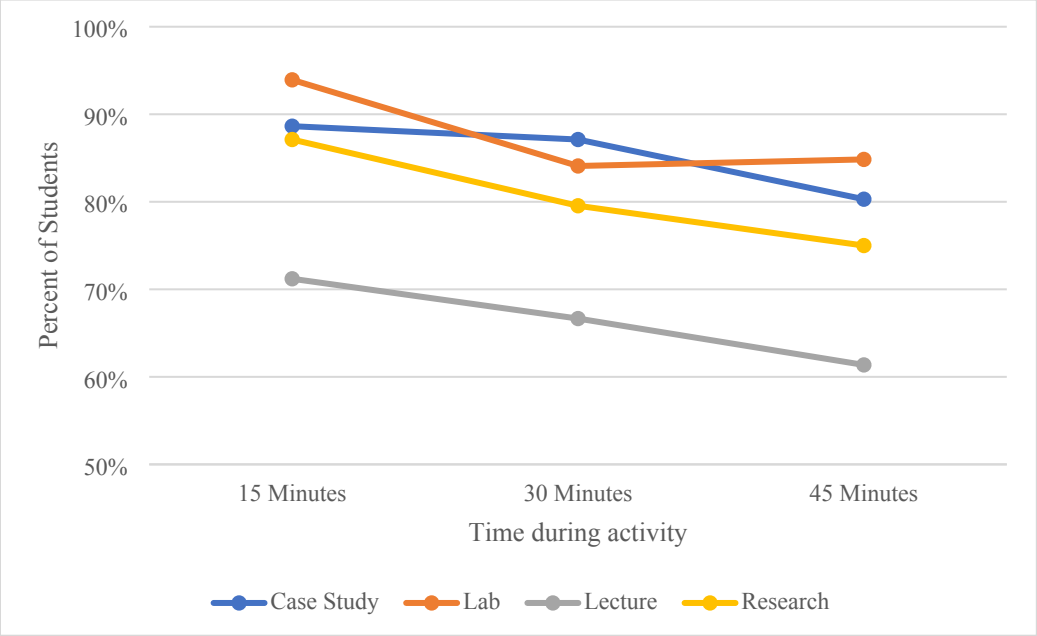

Figure 4. Observation data on the percentage of students engaged over the course of the class period, (*N*=44).

Similar to the classroom observations, students also reported a higher level of engagement during case studies. The use of case studies led to 89.4% of students indicating they were engaged for more than 80% of class time, compared to 74.2% and 76.5% lectures and independent research activities, respectively. One student who did not report being engaged during case studies wrote, "Probably not much, I struggle to learn from reading and would rather just take notes and be told what I need to know." This highlights a potential barrier to engagement with case studies, especially for students who struggle with reading comprehension. However, thematic analysis of exit ticket data revealed that 47.7% of students identified real-world application and problem-solving elements of case studies contributed to increased engagement and 22.3% identified the ability to work collaboratively and played a role in their engagement.

The use of case studies in the classroom resulted in a statistically significant increase in student engagement. The Pre-Treatment Survey data showed that 63.6% of students did not find Earth Science activities engaging, reporting either neutral or not engaging feelings about the material (Figure 5).

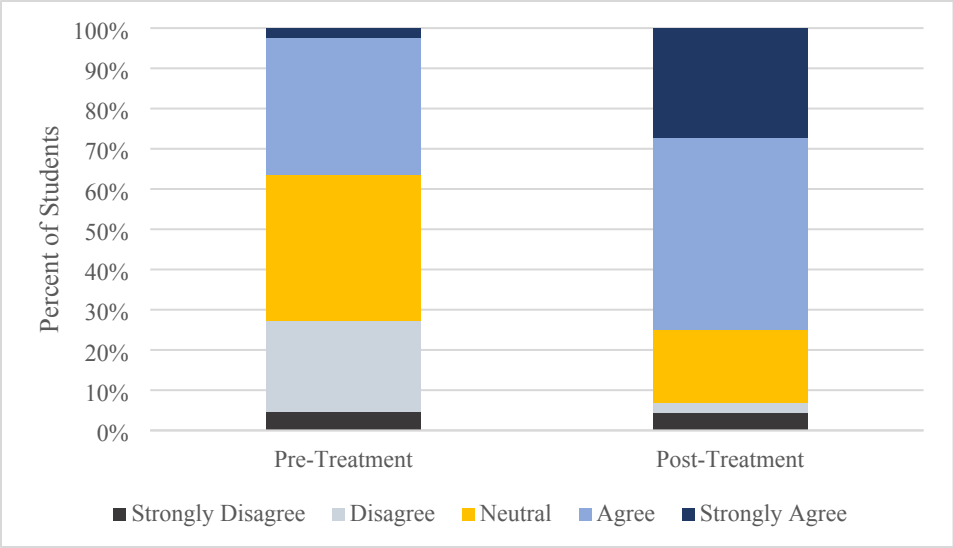

Figure 5. Pre- and Post Treatment Survey data on student reporting if Earth Science is engaging, (*N*=44).

This is contrasted by the post-treatment data which showed 75% of students found the classroom activities engaging. One student wrote, “I think the activities we do in class are interesting. I like how it’s not the same every day and doesn’t feel like busy work.” This shift in student engagement had a p-value of 0.026, indicating a statistically significant change according to the Chi-Squared test.

CHAPTER FIVE

VALUE: REASONING AND REFLECTION

Claims From the Study

The goal of this study was to identify if there was a correlation between the use of case studies and student engagement in the Earth Science classroom. To better understand student engagement in the classroom, I looked at the relevance students found in case studies and student's motivation to learn Earth Science as relevance in tasks increases student engagement (Kem et al., 2021). Understanding what increases students relevance and motivation better helps create engagement in the classroom.

Student Relevance

Students may find relevance in case studies to real-world application benefiting engagement. Exit ticket data shows 73.6% of students found case studies relevant at a comparable level to students preferred lab activities (76.2%) and noticeable higher than traditional learning activities of lecture (34.7%) and research tasks (52.8%). Nohria (2021) discussed the increase of relevance found in case studies stems from the real-world application, which may not be present in the traditional lecture or research task and may explain the higher rate of relevancy found in case studies. While this suggests that students perceived case studies as more relevant than traditional methods, the change in overall perceived relevance of Earth Science topics from pre- to post-treatment was not statistically significant. This leads to this study being inclusive on the relevance case studies bring to the Earth Science classroom. This

study's findings on increasing student perceived relevance through case studies remain inconclusive.

Student Motivation

The implementation of case studies supports increased student motivation to learn Earth Science. Other factors may have played a role during the research period that may affect student motivation such as changes in unit topics; however, case studies stood out among the different learning activities. Case studies lead to 37.9% of students being motivated to explore the topic deeper or had additional curiosities that extend beyond the task compared to the next highest at 24.2% for lab activities. The motivation from case studies stems from their authentic nature that makes students feel valued in the learning process as discussed by Nkhoma et al. (2017) leading to students to be motivated to learn beyond the activity. This is also supported by the results of the Likert-style survey where there was a normalized change of 39.6% toward increased motivation from pre- to post-treatment. These findings suggest case-studies can influence motivation for students to engage with Earth Science topics.

Student Engagement

The implementation of case studies shows a positive correlation with both observed and perceived student engagement. Students remained engaged for 80.3% of the class period during case study lessons, compared to 61.4% during lectures. Perceptions of engagement were also high with 89.4% of students reporting being engaged for nearly the entire period indicating a similarity between perceived and observed engagement. The higher percentage of students remaining on task compared to the more traditional activities may stem from the higher level of concentration necessary for case studies which Perry (2022) has highlighted as necessary to

increase student engagement. Similarly, pre-treatment to post-treatment saw a normalized gain of 43.5% towards greater engagement in the survey data with students reporting the real-application and problem-solving tasks as making case studies engaging. With the implementation of case studies during the treatment period, the case studies created a more student-centered curriculum leading to a higher level of engagement as supported by Aker and Ellis (2019). Although causation cannot be established in this study, the research supports the hypothesis that implementation of case studies can contribute to a more engaging curriculum.

Value of the Study and Consideration for Future Research

Student engagement has been the front and center for many educators due to the impact of technology and changes in students and a shift in educational habits post-pandemic. Identifying effective strategies to motivate students and make science content more relevant is important for creating engaging and meaningful learning environments. Case studies have an established presence in higher education, with documented benefits to student outcomes. However, there is limited research on their direct impact on student engagement at the high school level. Exploring how to effectively use case studies in secondary science classrooms may lead to positive shifts in both student interest and learning outcomes.

This study was designed to deepen my understanding of how a multidisciplinary approach to teaching Earth Science can benefit all students in my classroom. I chose case studies as the primary tool as they incorporate reading and social studies components to the science matter, but further research could be focused on continuing implementation and incorporating additional skills such as communication, society impacts, and more emphasis on critical thinking to engage students. Two specific areas of further research interest are “What is the impact on

academic outcomes when Earth Science is taught through a multidisciplinary approach?" and "How does a multidisciplinary approach influence long term retention of Earth Science understanding?" These two research questions are complex and would require substantial time but be valuable by offering additional insight into the effectiveness as an instructional strategy. Expanding the multidisciplinary approach to teaching may help teachers engage students and develop a more thorough understanding of Earth Science topics.

Impact of Action Research on the Author

This action research project has motivated me to be more intentional about gathering feedback from students not just about their learning, but also about my teaching and the classroom environment as a whole. While the Capstone project required more structured and rigorous data collection, I found the semi-structured conversations during student interviews and the timely feedback from exit tickets especially valuable. These interactions provided meaningful insights that will continue to guide how I shape a more engaging and enjoyable learning experience for my students.

Going through the Capstone process has not only boosted my confidence in my current teaching strategies, but also encouraged me to explore and implement new, non-traditional approaches in my classroom. Before this research, I had never used case studies and relied on teaching styles I experienced as a student or learned during my teacher preparation courses. Although my first attempt at implementing case studies was not perfect, I gained a clearer understanding of how different instructional methods can support a variety of learners. One student even noted that the variety of teaching approaches made class more engaging and felt less like busy work highlighting the value of trying new strategies.

The action research process has also pushed me toward a more data-informed mindset when making instructional decisions. By collecting tangible evidence of student engagement rather than relying on my perceptions, I was better able to evaluate the impact of my teaching. This experience has inspired me to continue exploring effective educational strategies and to seek out future opportunities that will help me grow as an Earth Science teacher.

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APPENDICES

APPENDIX A

MONTANA STATE UNIVERSITY INSTITUIONAL REVIEW BOARD EXEMPTION

Hello O'Connell, Bradley,

Your protocol was reviewed by the IRB and has been approved.

PI: O'Connell, Bradley
Approval Date: 12/9/2024
Title: The Effects on Engagement through the use of Case Studies in the Earth Science Curriculum

Protocol #: 224-1780-EXEMPT
Review Type: Exemption
Expiration Date: 12/9/2029

Work described under this protocol may now commence. The PI is responsible for ensuring that the protocol accurately describes research practices being conducted.

APPENDIX B

PRE- AND POST-TREATMENT SURVEY

Please answer the following questions honestly. Your answers will remain anonymous and will not affect your grade in this course. Your participation in the survey is appreciated but is voluntary.

1. **Content in the Earth Science class is relevant to me.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

2. **Explain your answer from number 1, provide examples if appropriate.**

3. **It is important for people to have an understanding of Earth Science.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

4. **Explain your answer to number 3. Provide examples if appropriate.**

5. **I find activities in Earth Science engaging.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

6. **Identify types of activities that you find engaging. Circle all that apply:**
   a. Lecture
   b. Case Studies
   c. Research Projects
   d. Discussions
   e. Labs
   f. None
   g. Other (Please list below)

7. **I am motivated to learn Earth Science.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

8. **Explain your answer from number 7. Provide an example if appropriate.**

APPENDIX C

STUDENT OBSERVATIONS

Activity: _____

Type of Activity: Case Study | Discussion | Lab | Lecture | Research | Other: _____

Date: _____

Time of Day: _____

Number of Students: _____

Table 2. Number of students engaging in task

	0-15 minutes	**15-30 minutes**	**30-45 minutes**
On Task			
Asking Questions			
Discussing Topic			
Additional Research			
Completed Task			

Types of Questions Asked: Tally

Instructional: (Example – What are we supposed to do? How are we supposed to…?)

Knowledge Based: (Example – What does this mean? Can you explain…?)

Extension: (Example – If this happens, then does that mean….? Is this an example of…?)

Other: Write the question below for future analysis.

APPENDIX D

STUDENT EXIT TICKET

1. This activity relates to your life or interests.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

2. How well did you remain on task? (Examples: Completing work, asking questions, discussing assignment, reading, etc.)
    1. On task less than 20% of the time
    2. On task 21-40% of the time
    3. On task 41-60% of the time
    4. On task 61-80% of the time
    5. On task more than 80% of the time (or completed activity)

3. What aspects of this activity contributed to your understanding or engagement?

If anything, what do you wish you knew more about after this activity?

APPENDIX E

STUDENT INTERVIEWS

1. Answers used in this interview are for the purpose of academic research and will not affect your class standing in any way. Your participation is appreciated but completely voluntary and you are not required to answer all questions and may end the interview at any time. Do you understand?

2. Did the use of case studies affect your level of interest in the topic?
   If yes, how so?

   If not, why not?

3. Did you find case studies more relevant compared to other classroom activities?
   If yes, why do you think that is?

   If not, why not?

4. What did you like most about the use of case studies?

5. What did you like the least about the use of case studies?

6. Do you think case studies help you see the connections between Earth Science concepts and everyday life? Why or why not?

7. How motivated do you feel to learn Earth Science concepts when case studies are incorporated into the curriculum?

8. How do you feel your engagement in Earth Science changed when case studies were introduced compared to more traditional methods?

9. Overall, how would you describe your experience with the use of case studies?