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What interactive strategies promote engagement for English Language Learners in a Post-secondary science classroom?

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By:

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Introduction

Chapter Overview

In this chapter, I discuss my personal experiences and interests that relate to the question I want to answer in my capstone project. I also provide a rationale for wanting to explore this topic, and ways in which it will benefit other teachers in the field and myself. I will also provide a summary of the additional chapters in my capstone paper.

Why Interactive Teaching?

There have been many changes in teaching science in a higher education setting over the past years to incorporate a more interactive pedagogy of teaching rather than the traditional 'chalk and talk' lecture format, especially in the college classrooms (Vercellotti, 2017). The original teaching method in college has been teachers going through PowerPoint slide after PowerPoint slide and oftentimes students are either frantically taking down notes or falling asleep. Through observations and my teaching experience over the years, I believe that the traditional teaching model shows less student engagement and retention of material. The author of 'The Change Up in Lectures,' Joan Middendolf (1996) observed a college classroom where she sat in the back and took notes of what a traditional classroom looked like. Her observation of a college classroom resonated with me:

> I sat in the back of the classroom, observing and taking careful notes as usual. The class started at 1:00 o'clock. The student sitting in front of me took copious notes until 1:20. Then he nodded off. The student sat motionless, with eyes shut for about a minute and a

> half, pen still poised. Then he awoke, and continued his rapid note-taking as if he hadn't missed a beat. (p. 1)

Middendolf's observation led me to many questions about the current format of teaching in these college classrooms. I wondered if students really understand the material or if students simply are just writing down anything the teacher is discussing for fear it will be on the test. Could a student get the same information from the textbook and not show up to class? It takes time and effort to make the college classroom a more interactive space for students. I am a higher education instructor and I have noticed college instructors don't have time to create a more interactive classroom because they are involved in research or other duties at the universities. Instructors also do not have available resources to change their lecture formats into a more interactive setting ("The Change-Up in Lectures", n.d.). If teachers were to change their lectures into a more interactive learning environment they would need more professional development workshops to get started. Additionally, I wondered about how this lecture format affects English Language Learners (ELL) that enter post-secondary education.

There are more ELLs attending post-secondary education in the United States (Bergey et al., 2019). The rates of immigration have increased over the years so colleges have expected an increase in enrollment of international students (Bergey et al., 2019). From 1990 to 2014, the enrollment rate of international students nearly doubled on U.S College campuses (Bergey et al., 2019). I wonder what it would be like for students who are still learning the English Language on top of learning a difficult subject like science. There is a large research gap on the performance of English Language Learners in postsecondary education (Bergey et al., 2019). This gap is because there is no state or federal guidance on how to assess how proficient ELLs

are performing in the college classroom like there is for primary and secondary education (Bergey et al., 2019). This led me to my research question: *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?*

Personal Experiences

As a student. I received my bachelor's degree at the University of Minnesota in Cell Biology and throughout my coursework, most instructors had a mountain of PowerPoint slides they went through in a 50 minute course. I found myself writing as fast as I could during lectures because the instructor went too quickly. I would end up printing out the slides and referring to the textbook for more explanation on the diagrams in the slides. In the lectures I experienced as an undergraduate there was little to no student involvement with the content or instructor during class. Often, I would look around the room and students would be on their phones, working on something else on their computers, or simply dozing off. I pondered to myself if learning was really taking place. I would do most of my learning at home on the living room couch while I read the textbook. I wondered if instructors could make the lectures more worthwhile by involving the students more and making them part of the class. The most student involvement I had in a class during my undergraduate years was mostly in lab and research-based classes.

One memorable class in my undergraduate career that involved student engagement was a physics course. The instructor would lecture, but then engage the class by asking questions through a computer response system called Clickers. The instructor would display multiple choice questions and we would have one minute to think about the answer and submit. This allowed students to be paying attention throughout the lecture because the questions were

formulated from the current material being presented. This was the first time I experienced interactive lecturing (Barkley & Major, 2018).

As a teacher. My experiences as a secondary high school teacher and Biology ELL teacher in adult basic education gave me an opportunity to use interactive teaching and these experiences led me to graduate school and this research study. As a high school Biology teacher, I used interactive teaching and learning a great deal, whether it was during a lecture or a lab experiment. During my lectures, I often used a very useful strategy called, Think-Pair-Share, where students had an opportunity to engage with one another. I would also start class every day with a warm-up question from the previous day's lesson. This helped me gage if the students were ready to move on to new material or if we needed to take a step back and review previous material. I also incorporated inquiry based lessons and assignments such as Process- Oriented-Guided-Inquiry Learning (POGIL). Today, I teach at the college level and still use POGIL activities to really enhance the learning experience by having students work together and problem solve. In my high school classroom, there were many opportunities for student engagement. Students were the center of my class where the students were the leaders in discussions and activities and I was the observer. In my career as a teacher, I also had many opportunities to teach ELLs in secondary education and postsecondary.

I gained a lot of experience with how to approach teaching science to students in English as a Second Language (ESL) level 5 (intermediate) as a teacher of an adult basic education program in Minneapolis. According to WIDA standards, ESL students of level 5 have adequate reading and writing skills in academic English (WIDA, 2020). The students in my classroom were adults that moved to the United States and wanted to start in the US education system and

eventually wanted to attend a community college. Through this teaching experience, I gained a lot of ELL teaching strategies that involved lots of hands-on and interactive activities that promote student engagement. Some of the strategies I used were brainstorming techniques, inquiry-based activities, and vocabulary building strategies, which will be discussed further in chapter two.

There are diverse populations of students now attending community colleges, so one of my main focuses is to use interactive lecturing to particularly help the achievement of ELLs in the biology classroom (Bergey et al., 2019). One of my future goals in teaching is to become a college professor in the field of biology focusing on human physiology and anatomy. One challenge of teaching interactively at the college level is the class sizes are much bigger and teachers feel like there is not a lot of time or room to do activities (Benton & Pallett, 2013). I want to try to incorporate interactive lecturing into my classes to increase student engagement and achievement, and break up long lectures. Researching the literature and constructing my website of interactive strategies will help me answer my capstone question, *What interactive strategies promote engagement for English Language Learners in a Post-secondary science classroom?* Future and current college professors may be able to use my website of interactive strategies as a tool for teaching English Language Learners in their classrooms.

Conclusion

In chapter two, I explored the literature for current pedagogies and theories on teaching methods that increase student engagement. One method I spent some time exploring in chapter two is interactive lecturing, which was the main question of my capstone project. I also explored the literature for strategies for interactive teaching and learning with a focus on strategies on

teaching English Language Learners. I explored the literature on how these strategies can increase student engagement in the classroom. In chapter three, I discussed my project plan by explaining how I tried out several of the interactive strategies I found in the literature by incorporating them into my own classroom in a Human Body Systems college course. I then discussed how I gathered the most effective strategies in my classroom with student feedback and created a website of these useful strategies for myself and teachers in the post-secondary science classroom. In chapter four, I provide a reflection of my capstone project and why I included certain interactive strategies into my website. Through researching the literature and completion of my capstone project I answered the question: *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?*

Chapter Two

Literature Review

Chapter Overview

The question I hope to answer throughout my project is, *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?* In this literature review, the first section will explain the current interactive teaching and learning theories in education right now which can be applied to post-secondary science classrooms. The next section will then explain current strategies of interactive teaching and learning that can be applied in a post-secondary setting. The last section will explain specific strategies for English Language Learners (ELL) and how the strategies can promote engagement in the classrooms. With these three major sections, the goal of the literature review is to find engaging interactive strategies for the classroom of ELLs and then try these strategies out in the classroom.

Current Interactive Teaching Theories

Student - centered approaches to teaching and learning have emerged as common approaches in higher education classrooms in the last 20 years (Wasserman, 2017). Interactive teaching methods include those that are not the traditional lecture where the teacher stands in front of the class and recites everything without involving any interaction from the students (Wasserman, 2017). Most of the time students only talk during this format when the teacher asks questions to the student or the student raises his/her hand (Wasserman, 2017). Interactive teaching methods incorporate student centered learning (Wasserman, 2017). One main and very important goal in interactive teaching is to make the students the center of the class (Wasserman 2017). Some interactive teaching methods that have been observed throughout schools and researched in literature include transformative learning, active learning, collaborative learning,

constructivist learning and inquiry-guided learning. All of these methods of teaching can fall into interactive teaching and learning, where student-interaction is being observed, not just the teacher reciting his/her notes on the board.

Below, several aspects of interactive teaching practices will be explored more and how these methods increase student engagement amongst students particularly, English Language Learners. The interactive theories explored in the literature review will be active learning, collaborative learning and interactive teaching and learning. The literature review will then offer deep exploration into interactive teaching strategies that will help develop a plan to answer the question: *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?*

Active Learning. Active learning is beginning to show up in a variety of higher education classrooms because students have the ability to learn by doing rather than by listening (Weimer, 2017). Active learning incorporates a student centered classroom which means students have the ability to take over and lead. The students become the center of a discussion, experiment or activity and the teacher becomes the active observer (Weimer, 2017). Active learning is used for students to apply their knowledge learned in a variety of ways (Barkley & Major, 2018). Teachers can use active learning for many reasons. It may be used to reinforce content and concepts, deepen subject matter, use higher-order thinking skills, increase student engagement, provide motivation and enthusiasm to a topic (Barkley & Major, 2018).

In the 1990s, many college classrooms began to be redesigned in the form of a *studio classroom* that was developed by J.M Wilson. This type of classroom combined lecture, discussion and lab in one space to enhance the active learning experience (Baepler, 2016). These

classrooms have evolved into the Active Learning Classrooms (ALC) where students become the leaders in the classrooms and active participants.

Many Universities have adopted ALC to engage students more in lecture content and classroom activities. The University of Minnesota has started to set up many classrooms in an active learning environment by setting up tables where students are sitting face-face with one another to promote peer discussion and engagement (Baepler, 2016). Figure 1 is an example of an ALC set up at the University of Minnesota:

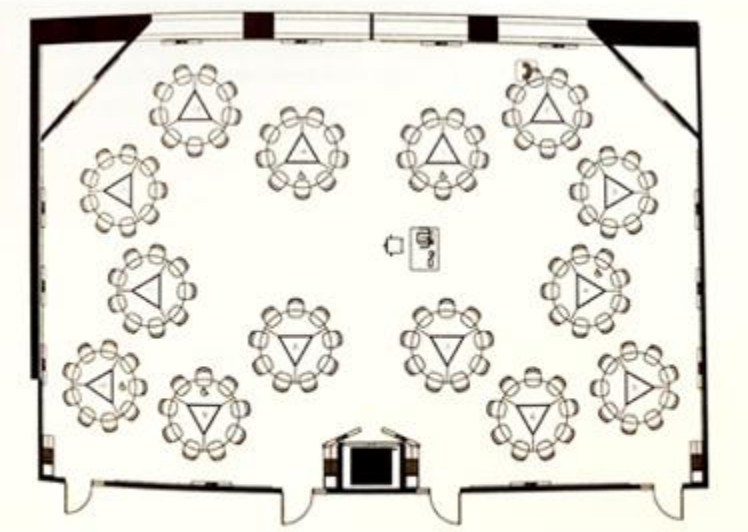


Figure 1: *The floor plan of an Active Learning Classroom (ALC) at the University of Minnesota* (Baepler, 2016)

In an ALC classroom, instructors are able to pause their lectures and allow students to discuss a particular topic that came up in lecture. Also, the instructor can assign problem solving activities throughout the lecture where students have an opportunity to work in groups. Each area by the tables has a whiteboard where students can brainstorm their thoughts on a particular topic in

small groups. The ALC set-ups also encourage peer teaching among students. The instructors can then go around the room to each group and see what they have come up with on their whiteboards. Instructors can use a more inquiry-based approach to teaching where students are able to work on a problem in their small groups and come up with a solution. The instructor is more a facilitator in this type of setting instead of a lecturer. The set up for an ALC is great for interactive lecturing and promoting collaborative learning (Baepler, 2016).

Collaborative Learning. Collaborative Learning is similar to all the other approaches discussed thus far with regard to student engagement because they allow the students to be the center of discussions and activities. Students are usually working in a team of two or more trying to solve a problem or creating a final product for the class (Smith & MacGregor, 1992). In collaborative learning, traditional teaching materials are still used like active listening and note taking, however it combines it with student discussions and active work. Teachers are less the expert in transmitting knowledge and more transmitters of intellectual experiences (Smith & MacGregor, 1992). There are many benefits to collaborative learning such as social, psychological and academic benefits that will be discussed further in this section (Laal, 2012).

The social benefits of collaborative learning develop diversity in the classroom and build a positive relationship among students and teachers. Collaborative Learning is also a diverse learning (Smith & MacGregor, 1992). Students actively work and participate in groups and students offer multiple perspectives to the situations, because they all have different backgrounds, learning styles and experiences. Students are getting different perspectives on the material because all students come with their own ideas to the discussion (Weimer, 2017). Collaborative Learning builds a social support system among students where everyone can learn social skills for the future. Students also learn to be responsible for one another.

The psychological benefits of collaborative learning is creating self-esteem among students, reducing anxiety and maintaining a positive attitude towards teachers. Since students are working in student-centered groups with their peers it also allows for individual students' abilities and contributions to be shown in a group setting (Laal, 2012). This can contribute to a boost of self-esteem within that student. The student may contribute more in a student -centered setting rather than a big group setting. The student may also feel more comfortable speaking and sharing ideas in a smaller setting and this can reduce anxiety for the student (Laal, 2012). Collaborative Learning also has a way of promoting a more positive attitude towards the teacher. Students like the fact they are in charge of their learning and give this to feedback to teachers which promote positive relationships with students and teachers.

Lastly, there are academic benefits to collaborative learning such as promoting critical thinking skills and problem solving skills, using a variety of assessments and making large class sizes more personal (Laal, 2012). In a collaborative learning environment students are developing higher order thinking skills. When working together students are listening to one another, then discussing and asking questions (Laal, 2012). The students are also developing useful problem-solving skills for the future. They are formulating their own ideas when discussing a problem and receiving feedback about their ideas from their peers (Laal, 2012). When assessing students during collaborative learning a variety of assessments can be used instead of using the traditional written test to assess students on the material. Teachers could assess students on the material through a group-project, evaluating a case study, doing stimulation like role playing to simulate the real experience, and even peer teaching (Kadel et al., 1994). Collaborative Learning can also transform the large lecture class into a more valuable

experience. Students get to know other students and can be an active participant in the classroom rather than just a listener.

Interactive Teaching and Learning. Interactive Teaching and Learning incorporates ideas from active learning and collaborative learning. Interactive teaching allows students to be called on and offer ideas to the class. According to Wasserman, 2017, the author of 'The Art of Interactive Teaching' observed an interactive classroom for the first time in graduate school and found that student responses in class were never judged correct or incorrect. Students were able to engage higher level thinking because they felt comfortable in the classroom (Wasserman, 2017). Class discussions are a big part of interactive teaching where students become the center of the class where they are the leaders of discussions and activities rather than just the teacher. In interactive learning students are not passive in the learning process, but have active involvement (Steinert & Snell, 1999). Research has shown that students that are actively involved in the learning process will learn more than students who are passively involved (Steinnert & Snell, 1999). Students are able to receive greater insight into the topic and have a more enriched understanding of the material from being directly involved. It empowers students to become more independent thinkers and engage their higher order skills (Wassermann, 2017).

Inquiry-based Learning. Inquiry based learning is a learning theory that allows students to explore guided investigations that instructors give the students where students are asked questions that are student- centered. Students are given a problem and are allowed to work through the problem while discovering the material. Students move from one level of understanding and proceed to a higher understanding of the material (Justice et al., 2006). Using inquiry based learning in a science class; students can learn the scientific method by dividing the

scientific process into smaller steps (Pedaste et al., 2015). Using a more inquiry- based learning approach relies on the students to be more responsible in their learning and is the first step to using this approach of teaching (Justice et al., 2006). Inquiry-based learning also engages students' interest in science and allows students to learn how to use laboratory equipment and collect data (Abdi, 2014). This could be a useful skill in students' future careers in college or the working world. This type of learning also allows students to solve problems using evidence and formulate scientific explanations based on the evidence (Abdi, 2014). For example, students may solve a complex problem by designing an experiment and collecting data on the outcome of the experiment. Inquiry based learning also allows the students to want to gain further knowledge of the subject and research their own ideas on the particular problem (Abdi, 2014).

Summary. Interactive teaching and learning theories have been discussed in chapter two such as, active learning, collaborative learning, interactive teaching and learning and inquiry-based learning. The main conclusions of this chapter is the students are learning through incorporating their own ideas into the learning process and are not just passive receivers of knowledge. This is very beneficial for students because they are learning the material through doing instead of just listening. English Language Learners can really benefit from this type of learning because working in groups with other students can help ELLs practice the English Language. Any opportunity where ELLs have the ability to practice vocabulary by speaking in groups is promoting a more successful experience for ELLs to learn the material and be engaged in the learning. By discussing the theories, effective interactive teaching strategies can be explored so the overall guiding question of the capstone project can be answered, *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?*

Interactive Teaching and Learning Strategies

There are currently a variety of strategies in the literature for incorporating interactive teaching into the science classroom. In this subsection, current literature on effective strategies for creating interactive teaching in higher education will be reviewed with an emphasis on student engagement in the classroom. Incorporating interactive teaching can become challenging in higher education due to the large class sizes, however there are helpful strategies that could work in the classroom to get students engaged in the material.

Interactive Lecturing Model. One main part of the question I am answering through my project is what interactive lecturing strategies promote engagement of students in college science classrooms. According to Wassermann, "The lecture will always be a primary method of teaching because it embodies the transfer of knowledge from expert to students." (Wasserman, 2017, p.4) However, it can be done more effectively through a process called Interactive Lecturing. Interactive Lecturing is considered the pedagogy of engagement where you are combining an interactive lecture and active learning to create a learning environment where students are the center of the lecture (Barkley & Major, 2018). Interactive Lecturing can involve many strategies that will be covered in a later subsection, but the overall theme is to create student engagement in the classroom. Figure 2 explains the pedagogy model for Interactive Lecturing (Barkley & Major, 2018).

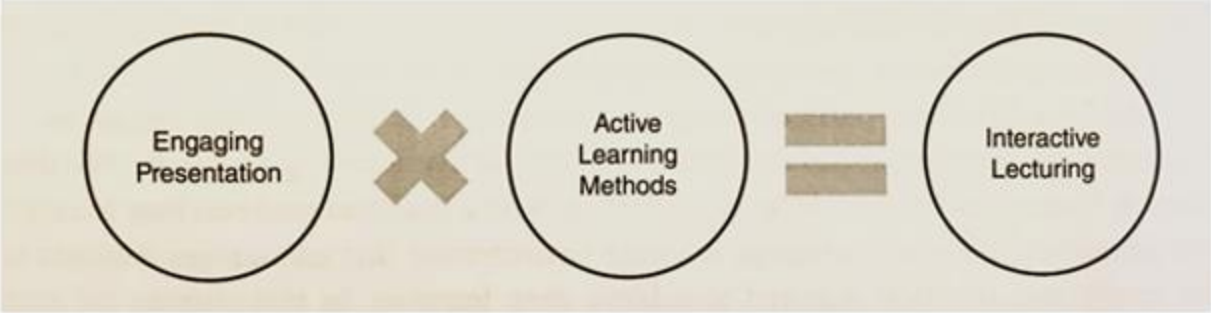


Figure 2: *The Interactive Lecturing Model includes an engaging presentation and active learning methods in the classroom.* (Barkley & Major, 2018)

To use interactive lecturing effectively you must first incorporate an engaging presentation. This means creating a presentation using interactive strategies throughout the lecture where the learners are active participants in the presentation (Barkley & Major, 2018). Some key aspects of engaging presentations are allowing the presentation to spark the student's curiosity and interests. The instructor usually speaks with enthusiasm and respects the learners.

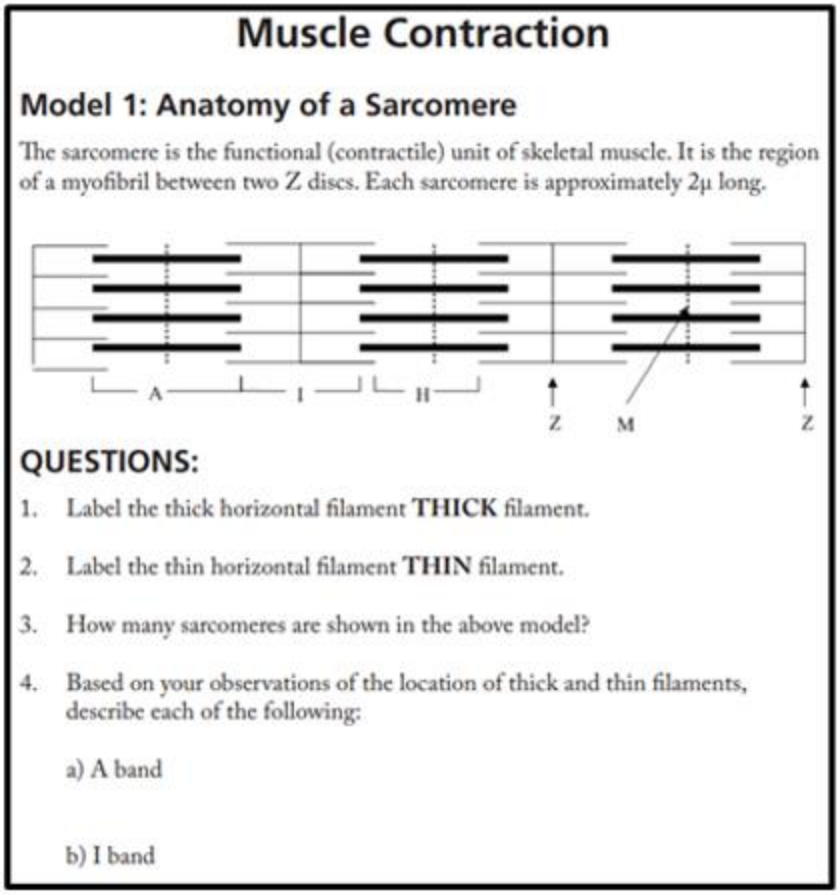
After the instructor has constructed an engaging presentation the instructor must use active learning methods throughout their lecture. Active Learning can support interactive lecturing through four themes. These themes include preparing the lecture for active learning, getting students attention during the lecture, application of learning throughout the lecture and how to use active learning during the course of the lecture (Barkley & Major, 2018). First, teachers should engage the students before presenting new information through pre-instructional assignments. This may include gathering students' interests about the upcoming topic to see what they want to learn about a particular topic. Also, engaging students in prior knowledge activities can improve student learning (Barkley & Major, 2018). Instructors also should get students attention throughout an interactive lecture. They can do this by using guided-notes and asking questions throughout the lecture. Instructors can also during the lecture break students into

groups where students can complete activities that pertain to the topics in the lectures (Barkley & Major, 2018). Lastly, to design effective interactive lecture instructors can conclude their lectures with quizzes and student reflection of the learning that took place during that lecture. One strategy during closure is called metacognitive reflection where students can reflect on their learning during the interactive lectures (Barkley & Major, 2018).

One reason teachers may hesitate to create lessons using the interactive lecturing model is teachers have reported that they have anxiety and a sense of fear that they will not cover all the material needed (Steinhart & Snell, 1999). It is known that using an interactive lecturing approach will not allow the teacher to cover all the facts on a particular topic, but it is also known that the more information you present the less students will retain the information (Steinhart & Snell, 1999). It is helpful to teach the main concepts in the interactive lecture so students will get the most out of the lecture and then do activities to enhance those main concepts.

Science, Engineering, Math and Technology (STEM) Activities. There are many ways to have students become actively engaged and interacting in a science classroom through STEM activities. STEM activities also allow students to become good problem solvers (Nilson, 2016). STEM education also incorporates inquiry- guided and student centered learning. In STEM courses teachers can change their lectures by interspersing conceptual multiple-choice questions where students individually answer the questions and then they get in groups to determine the right answer. Teachers can also do experimental demonstrations during lecture to make the class more engaged in the material (Nilson, 2016). Students can also participate in their own laboratory investigations where they formulate a hypothesis on a given problem and collect data to support their hypothesis. Additional research in STEM activities, includes Process-

Oriented Guided Inquiry Learning (POGIL) ("What is POGIL," n.d.) and Student-Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) which first originated at North Carolina University. The teachers will lecture for some of the class, but then the students will do interactive activities such as these to promote student learning. POGIL is used a lot in chemistry and biology courses and has been found to increase student interest in the subject matter, improve learning skills and test performance (Nilson, 2016). In POGIL activities there are models and images that students look at and discuss with their groups. There are then a series of questions based on the models that students answer. All the answers can be found by looking at the models and studying them. For example, figure 3 is a POGIL model on muscle contraction. In the model is a picture of a sarcomere with all the important components labeled. Students will look at the model and answer the questions, which they can find all by studying the model. In the first questions, students can see that the thick filament is the A band because it has the thickest black line compared to the rest of the components in the model.



Muscle Contraction

Model 1: Anatomy of a Sarcomere

The sarcomere is the functional (contractile) unit of skeletal muscle. It is the region of a myofibril between two Z discs. Each sarcomere is approximately 2μ long.

QUESTIONS:

1. Label the thick horizontal filament **THICK** filament.
2. Label the thin horizontal filament **THIN** filament.
3. How many sarcomeres are shown in the above model?
4. Based on your observations of the location of thick and thin filaments, describe each of the following:

   a) A band

   b) I band

Figure 3: *A POGIL activity on muscle contraction.* ("What is POGIL," n.d.)

In a study, by Rumain and Geiebter in an experimental physiology laboratory they found that students that used POGIL inquiry- guided activities performed better on achievement tests than students that did not use them (Rumain & Geliebter, 2020). Since POGIL activities are group oriented learning, ELLs can benefit by not only practicing English with other students but also their scientific knowledge on a topic (Ellinger, 2019). One professor at the University of Tokyo, James Ellinger, used POGIL activities in his biology classroom of ELLs (Ellinger, 2019). 33 students participated in this study, where 30 of the students' first language were Japanese (Ellinger, 2019). The professor administered a POGIL activity each week on a particular biological topic and asked students to fill out a survey after each POGIL lesson (Ellinger, 2019).

Students felt like working as a team helped improve their English skills because they were able to participate in oral communication with their groups (Ellinger, 2019). They also found that the POGIL activities were beneficial in helping gain more knowledge of the subject matter (Ellinger, 2019). Figure 4 below summarizes the students' understanding of particular molecular biology topics after participating in the POGIL activity (Ellinger, 2019). Many of the students found these activities very helpful in learning the molecular biology topics.

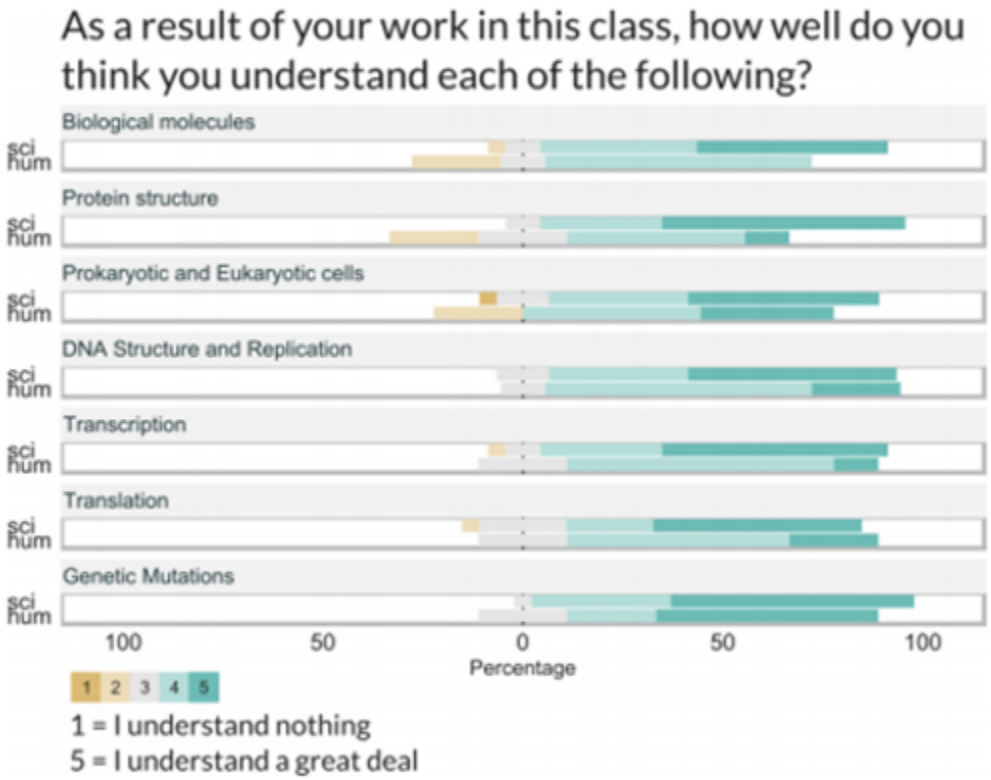


Figure 4: *Summary of students understanding of the material after doing the POGIL activities pertaining to the molecular biology topics.* (Ellinger, 2019)

SCALE-UP was introduced in physics courses and it has been found that students have a deeper conceptual understanding, better problem solving skills and test scores (Nilson, 2016). SCALE-UP is an ALC that was previously discussed where students sit in tables with

whiteboards so they can discuss the materials as a group. The instructor roams around the classroom asking questions and guiding students' discussions. Lots of STEM based courses are using this approach in the classrooms and in some subjects, such as physics there is no need for a separate lab class (Knaub et al., 2016). A study was done at North Carolina State University in a calculus I class where the failure rates were studied between a traditional classroom versus a SCALE-UP classroom. In this study, as observed in figure 5, most students among different cultural classes had a decreased failure rate in participating in a SCALE-UP classroom (Knaub et al., 2016).

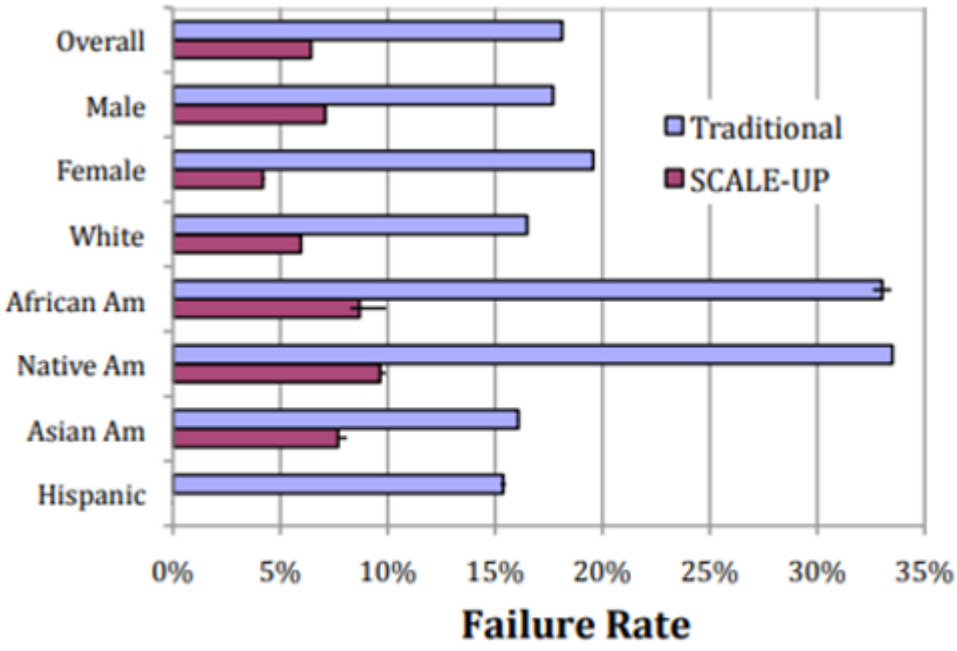


Figure 5: *Students among different culture classes have a lower failure rate in SCALE-UP classrooms than the traditional classroom.* (Knaub et al., 2016)

Students typically do better in the SCALE-UP classroom because it is a more hands on approach to learning where students can answer higher order questions and be able to ask questions in

groups and discuss outcomes within the group. Students can build upon each other's ideas in a collaborative learning environment.

Interactive Technology in the classroom. There are many strategies that can be used in the classroom to engage students through technology. One strategy that has been used is the interactive whiteboard to enhance classroom instruction (Wood & Ashfield, 2017). Interactive whiteboards take the one computer classroom and transform it into hands on learning environment for students (Wood & Ashfield, 2017). In previous studies, interactive whiteboards have increased student achievement by 16% (Marzano, 2009). Some ways that these whiteboards can increase student achievement is by using pictures and visuals for learning. For example if the instructor is teaching about the nephron, the functional unit of kidney, it would be very helpful to students to see diagrams of the nephron and to outline the steps of filtration on the whiteboard. Teachers can also use interactive whiteboards as assessment tools. Teachers can ask students a question and using a hand held device students can plug in their answers and it can be displayed on the whiteboard in a bar graph. This will also allow teachers to understand if the topic needs to be re-addressed with more clarity.

Another strategy that has been helpful in college science classrooms are computer response systems like the use of clicker questions (Bruff, 2020). Clickers are an audience response system where students log in their responses to a small computer device to a particular question that the teacher displays on the board (Meguid & Collins, 2017). Teachers embed clicker questions to assess students throughout the lecture. The questions are in the form of multiple choice questions or free-response questions (Bruff, 2020). These clicker questions can be used before class begins as a pre-assessment to give the teacher a sense of what students

remember from the prior class period or after the lesson to assess understanding of the material as a formative assessment.

Another great interactive technology strategy to use in the classroom for a Human Body Systems class is 3D software that allows students to visualize the human body. One great application is called Visible Body (Visible Body, 2020). Students have the ability to go through each body system in detail and are able to remove body organs, muscles and bones for an enhanced learning experience. Technology can enhance the learning experience in any classroom by incorporating a visual aspect to learning and can incorporate interaction among students in the classroom.

Interactive Group Activities. One strategy that is used in interactive classrooms is Think-Pair-Share (TPS) (Nilson, 2016). This method allows students to ponder a particular question first and then come up with a finalized answer by talking through ideas with another classmate. Students become engaged in the topic and become more motivated because they are asked to participate (Nilson, 2016). Teachers can use this TPS during their lectures to keep the students engaged in the topic. Teachers can also do formative assessments by quickly checking for understanding by listening in on group discussions and collecting responses (Nilson, 2016).

Another strategy that is useful in an interactive classroom is brainstorming techniques (Goswami et al., 2017). The teacher poses a question or problem and students gather in groups and discuss the possible answers. Brainstorming facilitates group discussion with group members and it allows the students that normally don't participate in class to speak up and express their thoughts. It allows equal participation and avoids criticism (Goswami et al., 2017).

Brainstorming is also a great strategy to use with ELLs because it allows students to talk with their peers allowing more practice with the English language.

Flipped Classrooms. Creating a Flipped Classroom is also another way to create an interactive environment for students. Teachers record lectures, videos or podcasts and post them on the classroom websites for students to review before class. Then class time is spent doing interactive activities such as labs, group work, and discussions. In Flipped Classrooms, students get their first exposure with the new material outside of class and then can ask in depth questions during class time (Nilson 2016). Therefore class is not taken up with long traditional lectures but instead allows more time for students to ask questions and work together.

Summary: In this section, useful interactive and teaching strategies were discussed that can promote an active, collaborative and interactive learning environment. Most of the strategies use a hand-on learning approach where students have the ability to work in groups and access higher ordering questions. Students are engaged in the material and allowed to take charge of their learning by being active members of the classroom. All of the above strategies can be used in teaching ELL students and will be discussed in more depth in the next subsection to answer the capstone question, *What interactive strategies promote engagement for English Language Learners in a post-secondary science setting?*

Strategies for English Language Learners in the a Science Classroom

In this subsection, I will review the current literature on specific strategies that can be used when teaching ELLs in science classrooms. As mentioned previously, the attendance rate of international students has nearly doubled in U.S colleges (Bergey et al., 2018). Schools are

having to teach students where English is their second language with the same academic requirements as students that speak English fluently (Kareva, 2013). Most ELLs are learning the English language while attending regular subject classes such as biology. Biology is a very difficult subject to learn while learning English because science is a language in itself, which has a complex vocabulary. There are many ways that teachers can enhance the learning of specific science content with ELLs by carefully planning the presentation of material, using technology, and setting high expectations for ELLs. Teachers should create curriculum around the big concepts and involve a lot of reading and writing to practice the English Language (Short et al., 2011).

For ELLs, science is another language for them to learn as well as learning English (Short et al., 2011). The academic language of science can be very dense and challenging even to native English speakers so learning science for ELLs can be a great challenge (Short et al., 2011). When students are reading a scientific text, many scientific terms are found in one paragraph and students can't just skip over these words when reading because then students won't understand what they are reading. The reader can't rely on previous knowledge of the material to determine what the paragraph means. Students must learn the new vocabulary first before being able to understand the paragraph text. In many classrooms, there is insufficient support for ELLs in learning new science vocabulary. There was one study of 23 linguistically diverse classrooms and only 1.4% of the instructional time in core subjects was spent developing vocabulary knowledge (Short et al., 2011).

The Sheltered Instruction Observation Protocol (SOIP) was developed by the National Center for research on Education and the Department of Education where it was a seven year

research study that incorporated teachers and researchers thoughts on the best practices for English Language Learners (Kareva, 2013). The SIOP model has been proven to be an effective way of meeting the academic needs of ELLs by providing a modified curriculum and learning through academic language (Kareva, 2013). According to the SOIP model, teachers develop academic skills for reading, writing and practicing oral language (Kareva, 2013). One aspect of using the SOIP model in science classes is science vocabulary can be reinforced as a student progresses through school because the vocabulary words are continually being repeated. Repeated exposure to scientific terms can help ELLs comprehend the academic language of science. Science related terms also have close cognates in Latin based languages such as Spanish that can greatly benefit English language learners that speak Spanish (Short et al., 2011). In current research it has been shown that ELL's learn science better when they are engaged in literacy-related activities (Short et al., 2011). If ELL students had the opportunity to read, write and orally produce words during science classes, difficult scientific vocabulary will be reinforced helping ELLs master the English language.

According to the SOIP model, increasing student engagement in the classroom with ELLs will help them learn the material more (Short et al., 2011). Increased interaction among teachers and students encourages more responses in the lesson concepts, which help ELLs retain information. One approach teachers can use in a classroom with many ELLs is the conversational approach. This is a great approach for ELLs that have only had a few years of school in the United States and have lower reading and language proficiency and lacking in basic vocabulary. This approach helps practice oral language, allows students to express their meaning, time for students to process information and hear other students speak, and provides a great opportunity for teachers to model academic language and vocabulary. Using a

conversational approach, a teacher can assess students' prior knowledge and gauge student understanding as students are working in small groups where each student can participate (Short et al., 2011). This group discussion among students also helps to create a supportive positive classroom environment (Short et al., 2011).

Another strategy that is helpful for teaching ELLs is adapting the text for the students. Science textbooks can be very overwhelming for ELLs therefore adapting the text can allow students to focus on the essential information in each chapter. Teachers can create fill in the blank note handouts that identify key points of information and bold key vocabulary words. Guided note taking in which students fill in notes throughout the lecture has improved student performance because oftentimes students are poor note takers and need directions on what information to write down (Barkley & Major, 2018). Guided notes also help to engage the students cognitively and help focus their attention on the lecture (Barkley & Major, 2018). Also allowing students to draw pictures of a certain science process in the text can help students conceptually understand the material. For example, having students draw a picture of what is happening in the process of external and internal respiration can help distinguish the difference between these two processes in the respiratory system.

Building a background of the science material is also very important in teaching ELLs. Knowing what students already know either from previous classes or the lesson the day before will help teachers understand what topics students have mastered or what topics students need more help on. One strategy called *Quickwrite* is a helpful way for students to remember and connect to prior knowledge (Short et al., 2011). When students are participating in a *Quickwrit*e there is no right or wrong answer. The teacher will ask students a question pertaining to the topic

that was discussed in class and for about 2-3 minutes students write what they know about that topic. Typically, students must be writing the entire 2-3 minutes. After the *Quickwrite* students share their writing with a partner or a small group. This strategy does not only help English Language Learners practice material but it gives the teacher insight into what the students know or do not know about the topic.

Another strategy in building background knowledge is using the 4-corners vocabulary strategy. This strategy allows students to learn complicated vocabulary words with different perspectives. For example a hard word in Anatomy and Physiology that students struggle with is the nephron. Students will use a piece of paper and fold it lengthwise and width - wise to make four boxes (Short et al., 2011). In the first box they draw an illustration of the nephron, in the second box they write the definition of the nephron, in the third box they write a sentence using the nephron in context and in the fourth box they list the actual vocabulary word- the nephron. This activity can be done with any difficult science terms.

Student Achievement in Interactive Teaching and Learning

In this section, current literature about how interactive teaching and learning has increased the overall student achievement will be explored. Interactive learning has many forms as discussed such as active learning, collaborative learning inquiry-based learning, transformative learning, and problem based learning. Some questions to answer about interactive learning are: Can creating a more interactive format of learning increase student achievement? How can teachers measure student achievement in these types of classrooms? The answers to these questions will be explored through the literature review as opposed to project since it will be hard to measure student achievement through the project approach.

There was one study done in Ball State University in an English linguistics course where student achievement was measured in an interactive learning space and a traditional learning space (Vercellotti, 2017). In the interactive learning space students were exposed to interactive teaching and learning methods such as flipped classrooms, the use of learning management students and the use of interactive whiteboards (Vercellotti, 2017). Both methods were taught by the same instructor (Vercellotti, 2017). The data that was collected on this study was students were given a pre and posttest of the class material. These tests were statistically analyzed in the two teaching formats (Vercellotti, 2017). Data was also collected on various classrooms preparation assessments and student activity, such as attendance (Vercellotti, 2017). Lastly, there was a questionnaire survey with open-ended questions asking them to evaluate the learning strategies that took place in both teaching methods (Vercellotti, 2017). The conclusions of this study were mixed (Vercellotti, 2017). Overall, the class that represented an active learning pedagogy reported a higher level of engagement, however there was not clear evidence that the two classrooms impacted the overall student achievement (Vercellotti, 2017). The study did find that after instruction in the traditional classroom the range of scores from the pretest widened (Vercellotti, 2017). The range of scores in the interactive learning classrooms narrowed (Vercellotti, 2017).

Conclusion

In this chapter, different interactive teaching pedagogies were discussed such as collaborative learning, active learning and interactive lecturing. All these pedagogies enhance the learning experience by increasing student engagement, particularly English Language Learners. Also current strategies on how to approach teaching science with English Language Learners was explored as well as general strategies involving interactive teaching and learning. Interactive

lecturing is a great approach that can be used in college classrooms to engage students in the material instead of a traditional lecture. Interactive lecturing can also increase student achievement in higher education. In chapter three, the rationale and outline of my project will be discussed to answer my capstone question: *What interactive strategies promote engagement for English Language Learners in a post-secondary classroom?*

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Chapter Three

Rationale

Chapter Overview

After conducting a literature review on interactive lecturing and strategies that can be used, I created a website of instructional strategies for college biology teachers to use when teaching English Language Learners in their classrooms. I am currently an instructor at a community college, teaching Human Physiology and Anatomy, so I tried out some of these strategies in my own classroom and put examples on my website. By incorporating strategies found in the literature review and creating a website of interactive strategies, I answered the question: *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?* In this chapter, I explain my overall project design, theories used in my project, the setting and audience used and the timeline for completing my project.

Research Theories

The theory I based this project on will be the interactive lecturing model. In completing my project, I have combined engaging presentations about a particular human body system and incorporated active learning strategies throughout the class. I did not use the traditional lecturing format where I did most of the talking (Barkley & Major, 2018). I used a more student- centered approach to learning where the students were actively engaged in learning the material.

Also when I explored the main question of my capstone, I used a qualitative data collection approach as a technique to gain insight into the instructional strategies I used in class. According to Creswell, qualitative research occurs in a natural setting where the researcher is the key component and multiple sources of data are collected (Creswell & Creswell 2018). In this study the research will be done in a natural setting where the participants are in their own classrooms (Creswell & Creswell 2018). In the qualitative data approach, I collected data on student observations and surveys. According to Creswell, the type of research was considered emergent (Creswell & Creswell, 2018). The initial plan serves as a foundation for research, with adaptations and additions made as the research is conducted in the natural setting. Of this process, "*qualitative researchers would say it mirrors real life and the ways that events operate in the real world*". (Creswell & Creswell, 2018, p. 182)

Setting

I conducted this project in an urban community college. The class I conducted my project in was Human Anatomy and Physiology class offered at the college. Students attended a Human Anatomy and Physiology and then attended my support class once a week. The support class offered was free support class that allowed students more guidance, practice, and study skills on learning about the human body. The last demographic study for this urban community college was conducted in 2014. School demographics include 39% white, 29.4% Black and African American, 17.2% Asian and 8.0% Hispanic. The students that attended the support class were first required to take a TABE reading test because the program is funded through Minnesota based programs on helping non-native speakers succeed in college. The TABE is a test for adult basic education and aligns with the College and Career Readiness Standards (U.S. Department of

Education, n.d.). Most students' reading proficiency is between 9th and 10th grade standards, so this additional support class benefited them greatly.

Audience

Approximately 15-20 students took advantage of this support class and on average there were about 7 students a class session. The sessions were small to allow more small group practice and discussions. Most students that attended the support class are English Language Learners who have been out of college for a while and are pursuing a nursing or health care degree. Many of the students would like to go into the medical profession so doing well in this course is a high priority for them. Most of the students either work full-time or have children to take care of at home. My project was conducted in a small group setting of about 15 students. However, the instructional strategies that are useful to ELLs in an intense biology course can be used in a variety of science classrooms in postsecondary schools.

Timeline

This project took place over two months of teaching in the Human Body Systems Support class. I tried various interactive lecturing strategies discussed in chapter two throughout my daily lesson plans and observed students learning through the instructional strategies. To assess if students understood the material I would call on students to answer the questions that were done in the group activities. I also asked students for their feedback with a short survey at the end of each lesson so I got an idea of how this strategy has helped them learn the material. After incorporating strategies throughout my lectures, I designed a website covering my lessons from

February through April including all the interactive strategies I have used. I then wrote my chapter four and reflected on this process and the construction of my website.

Data Collection and Recording Procedures

To investigate my capstone question I used a qualitative method approach incorporating many data collection procedures. One data collection procedure I used was qualitative observations. I observed students in the interactive lecturing model by observing students' interaction with one another and engagement while participating in interactive activities that are mentioned in Chapter two literature review.

Another data collection technique I used was qualitative interviews. I created short surveys for the students to provide feedback on the interactive strategies that were used in class that day. I incorporated this feedback into my website to give teachers live feedback on what students thought of the strategies in their learning processes. Below is an example of the survey questions I administered to the students.

1. How do you like using the fill in the blank note sheets for each lesson?
2. What was the best thing about this class today?
3. What was the worst thing about class today?
4. Did the interactive strategy help you understand the concepts more?

I begin collecting material for my project by teaching the following topics below in an interactive lecturing format with various interactive strategies. I taught two sessions of each topic with a different group of English Language Learners.

Week of Study	Topic	Strategies Used
1	Respiratory System	Think-Pair-Share activities
2	Muscular System	POGIL activities
3	Digestive System	Brainstorming with mini Whiteboards Exit Slips
4	Urinary System	4 Corners Vocabulary
5	Tissues	Three minute Quick write Inquiry based Activities-Sorting Activity of Tissues

During each topic I incorporated various interactive strategies for English Language Learners in my interactive lecture that was outlined in Chapter two and in the table above. In each session, I used a very helpful strategy for teaching English Language Learners, which was to fill-in the blank note sheets for the chapter that was discussed in class that day.

Website Design

After I have taught these strategies in the Human Body Systems class and received feedback from students I constructed a website of the interactive lecturing strategies that I used. Future biology teachers can then use the website as a tool in planning lessons in their classroom with English Language Learners. I also can use these strategies in my future classes teaching biology concepts of the Human Body and incorporate throughout my lectures for a more

engaging experience for the students. For each strategy, I explained the rationale of why this strategy is useful for ELLs in a biology classroom, a description of the strategy, and an example of how I used it in my Physiology class with a few feedback remarks from the students on the particular strategy.

Conclusion

In chapter three, I summarized the research theories I incorporated into my project plan. I discussed the timeline, setting and audience of the project. I also explained how I would collect data which would be feedback from my students when I used the interactive strategies in my classroom. Lastly, I discussed how I would design my website and what I would incorporate into my website to be able to answer my capstone question: *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?*

Chapter Four

Conclusion

Chapter Overview

The goal of my capstone project was to answer my research question, *What interactive strategies promote engagement for English Language Learners in a post-secondary science setting?* For my capstone project, I created a website with an explanation of what interactive learning is and various interactive strategies and assessments tools I used in my Human Anatomy and Physiology classroom with English Language Learners. For every strategy my website includes a feedback page from my students on how the strategy helped them learn the material.

Chapter four will summarize the design process of creating my website. First, I discuss what I have learned when designing my website. Second, I will reflect on the literature review and how it has helped me in the design of my website. Third, I will describe the limitations and implications of creating my website. Next I will touch on some possible future research projects around the area of capstone projects. Last, I will discuss the benefits of my website to teachers in my profession.

Learning Reflection

First, I would like to discuss what I have learned throughout writing my capstone paper and designing my capstone project. I would like to comment on the process as a writer and a researcher. Through writing my capstone paper, I have reviewed the overall writing process and formatting using APA guidelines. As a science teacher it is not often I get to write papers

like my capstone and use APA formatting so it was a great way to review this whole process. I also refreshed my overall writing skills and corrected for grammar, which is also very helpful for teachers that are needed to review student's papers or write letters of recommendations for students. As a researcher, I have learned to navigate through search databases and incorporate key ideas from current literature to make solid points in my capstone paper. I have incorporated a lot of primary sources in my literature review and I think it is important as a researcher to make sure your ideas are backed up with current primary sources. Also as a teacher, it is great to have a good foundation of searching through academic databases so I can teach my students the importance of good research.

Throughout designing my capstone project I have learned to create a website. This is by far the most I have learned throughout my capstone project. Before taking this capstone course I have never tried or even thought of designing a website. I used WIX (wix.com), which is an online tool for making and publishing your own website. It has been a really fun and rewarding experience constructing my own website and will be very useful in my future career as a teacher if I want to add to my website to create other useful websites of teaching resources. Using WIX as a tool for creating a website was very straightforward and easy to navigate. I would recommend WIX to others that want to create a website.

Literature Review Revisited

As I was conducting my literature review, I realized how important it is as a teacher to incorporate interactive learning strategies in teaching, particularly when teaching English Language Learners. I learned a great deal on interactive teaching such as using active and collaborative learning in the classroom. I believe creating an active learning environment in the

science classroom is essential to really learning the material. Using the strategies I researched in the literature review in my own classroom was very helpful for my students and I received wonderful feedback that is portrayed in my website. I asked students how these strategies helped them and there were a lot of positive responses. One main point throughout my literature review research that continued to come up and resonated with me is that interactive teaching allows students to become the center of the class and not the teacher (Wassmerman, 2017). I believe this is so important creating an active learning environment for students. I think when students work together on going over the material and solving problems pertaining to the material they learn the material better. This is especially important when teaching ELLs. According to my literature review research, the SOIP model states increasing student engagement in the classroom with ELLs will help them learn the material more. The interactive strategies incorporated in my classroom such as using blank note sheets, think pair strategies, and Process-Oriented Guided Inquiry Learning (POGIL) activities showed just this. Based on the ELL students' feedback on using these strategies in my class they were able to learn and understand the material more in -depth.

Implications to my Project

One possible implication to my project regarding a policy implication is to have schools, policy officials, educators to see the importance of interactive lecturing and using interactive strategies in post-secondary education. Often post-secondary institutions use the traditional teaching method such as delivering material through PowerPoint slides and the teacher is doing most of the talking. Some universities, such as the University of Minnesota, are adapting their classrooms into ALC classrooms as described in the literature. The post-secondary institution I teach at has a 2030 goal to incorporate more Active Learning techniques

into classrooms and has various professional development seminars on this topic. It would be great to see more post-secondary institutions incorporate interactive teaching into their policies.

Limitations to my Project

One limitation to my project is my website incorporates some major interactive strategies that can be used in the classroom, but there are definitely more that teachers could use. My hope is that throughout my teaching career I will be able to explore more strategies and update my website with these strategies. That is one reason I wanted to create a live website so I can add to it at any time. I also have included a feedback form where teachers can send me ideas that they have used as well and I can incorporate this to my website. Another limitation to my project is the accessibility and time of using these strategies in the classroom. If teaching at a postsecondary institution usually teachers have the flexibility to do what they want in their classroom but often the time is a limiting factor. Some of these strategies take time to implement and do in the classroom so some teachers may feel like they can't teach all the material they need in a class period. Incorporating these strategies in the classroom will take time and commitment to adapt into daily lesson plans.

Future research

A future research project I would like to work on after this capstone project is to continue to update my website as I use more of these interactive strategies in my classroom. I would also love to begin to develop lesson plans for Human Anatomy and Physiology for each chapter incorporating these strategies. I will be teaching again this class in the fall so my goal this summer is to switch my instruction to the interactive lecturing model explained in the literature review. Interactive Lecturing is considered the pedagogy of engagement where you are

combining an interactive lecture and active learning to create a learning environment where students are the center of the lecture (Barkley & Major, 2018). I want to make all my lectures using this model in my future teaching.

Benefits of my website

After creating my website and trying all of these strategies in my classroom, I hope that other educators in secondary and postsecondary teaching will benefit from my research. All the strategies are based on Human Biology material but other non-science educators can use the same strategies but for their subjects. This will also greatly benefit educators teaching ELLs in science classrooms. These strategies will help ELLs understand and retain complicated science vocabulary more thoroughly than in a traditional classroom setting.

Conclusion

In chapter four, I summarized my process of writing my capstone and creating my capstone project to answer my research question, *What interactive strategies promote engagement for English Language Learners in a post-secondary science classroom?* In this chapter I reflected on the process of writing my capstone and creating my website as a whole. I also summarized what information of my literature review was most important for answering my capstone question and creating my website. I also discussed the implications and limitations to my project. I talked about some future research ideas I had after my capstone project was complete. Lastly, I summarized how my capstone paper and project would benefit other educators in my field.

Overall, I learned a lot in writing my capstone and creating a website. I really learned a lot of writing and researching about interactive learning theories and strategies for my

literature review. I believe this whole process will also help me to become a better teacher for my students and allow my students to learn the material better, especially my ELL students. I hope to continue to use my website as a toolkit for my future students and hope other educators will see the value in my website.

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