Bringing Biology to Life: A Schema Theory Approach to Increasing Student Engagement in a High School Classroom

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An Action Research Project

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Reading Committee:

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The supervisory committee met with the candidate for a final evaluation in which all aspects of the candidate's program were reviewed. The committee's assessment and recommendations are:

Recommendations:

- ✓ Degree should be awarded

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- ✓ Exit Requirement has been approved

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Finally, I would like to thank my friends and family, who have truly made this action research project possible. I would not be finishing this project without the support of the most important people in my life. I could go on and on about the importance of my friends and family and how much they have helped me through my academic journey. Alas, a couple of sentences will have to suffice.

Thank you all.

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Chapter 1. Philosophy of Education

Throughout my K-12 education, I attended four different schools: Cascade View Preschool, Sublimity Elementary School, Sublimity Middle School, and Regis High School. Throughout those years, I lived in a rural community in a town of around 2,000 people. Each school I attended was predominantly white (almost entirely), and there was little diversity in the towns themselves. Class sizes were small, and students had the opportunity to get to know each other well at these schools. Regis High School was a Catholic high school, and during my time there, it had around 100 students enrolled.

As I reflect on my time in the K-12 school system, I can recall only a few instances where I felt misunderstood or overlooked, whether by a teacher, the curriculum, or the school as a whole. The times I felt I was misunderstood had more to do with my behavior than anything else. I had only white teachers at these schools; thus, many shared experiences could connect us. Never once did I feel unseen or underrepresented in my school. I am a white male, and because my schools were almost completely filled with white students, I never felt any negative pressure regarding my identity. Our education system, along with other movements and societal constructs, has been normed and structured around the experience of the middle-class white male. Because of this, I never felt as if I was affected by systemic oppression in any form.

However, I do believe my education was not as effective as it could have been, which was mainly due to the teaching practices in place. As I got older, I was met with loads of direct instruction from my teachers, and my enthusiasm for school decreased. Not only was this direct instruction problematic, as it centered the teacher as the holder of knowledge, thus creating an imbalance in power (Freire, 2018), but it was also incredibly unengaging. I largely felt unattached to my education during my middle and high school years, losing interest quite

rapidly. The majority of classes felt like this: lecture followed by a worksheet, then another lecture, and so on. Projects even felt confined by the specified parameters, which limited our choices. I vividly remember my middle school science class, not because it was interesting, but because it felt so mundane. In almost every class, we wrote the same notes as our teacher on the overhead projector, using the exact wording and structure they showed us, so we could memorize the notes to prepare for a test. I am sure I am not alone in this experience.

There were times, though, when I did feel motivated as a student, which was when I was able to apply my own knowledge or experience to something I thought was worthwhile. For example, I remember a middle school activity in which I researched and explained the adaptations that enabled an animal of my choosing to survive in its environment. I enjoyed it when a subject continually built upon itself, showing how each piece of content is tied to the subject, to make it "whole." When I was able to make these connections and apply them to different projects or assignments, I felt empowered. I also learned effectively when there was a social aspect to it. Learning came more easily when we did activities in pairs, groups, or as a whole class, compared to individual work. Shared ideas, quick discussions, and diverse perspectives helped me learn most efficiently, yet my teachers did not often utilize instructional approaches that incorporated these aspects. We did not have open-ended projects, group discussions, or partner work assigned regularly, even though these yielded the best results in the classroom.

I felt my motivation change in college, and this shift was mainly due to the difference in instructional approaches between my K-12 teachers and my college professors. In college, I developed a passion for biology. I loved how each class seemed to build on the others, and how the topics I learned in my first week of introductory biology were addressed in classes years

later. The knowledge we built was being reaccessed time and time again and built upon to make a sturdier foundation. Not only was our knowledge being built upon, but it was also being enriched with real-world examples, which often involved the world immediately around us in the Willamette Valley.

The education was also social. Professors encouraged us to form study groups, engage in class discussions, and collaborate with our classmates. The social approach made our learning experience much more impactful, filling our minds with meaningful knowledge that carried weight not just in my life, but in the lives of those around me. The social aspect of these classes helped me see different perspectives, ones I would have never considered without the collaboration and community fostered by my professors. Concepts I initially thought I grasped became much more complex when my classmates introduced perspectives I had not yet considered. Specifically, I remember completing a research oriented assignment based on photosynthesis rates of plants in different environments that required me to analyze results from an experiment, and compare those results with peers from the class. After comparing my analysis to others from the class, I realized how limited my explanation was, and it prompted me to think about the assignment on a deeper level. I found myself becoming more and more invested in the subject and my own personal growth as a "biologist." It was in these college classes that I realized I needed to become a teacher.

I want to address the issues I faced in my K-12 education as a teacher because I know how rewarding it can be to learn and fall in love with the learning process. I want to show my students their experiences matter- something I did not often feel myself. I want to show my students the concepts we teach are more than just notes on a paper, they are meaningful and can have a rich connection to our lives. I want to show students classes can be much more than just

memorization; they can be impactful, strengthening, and inspiring. To achieve this, I aim to shape my classroom to more closely resemble the type of instruction I received when I became invested in biology. The goal of this action research project is to increase student engagement and foster deeper connections between students and the content in a high school biology classroom through the application of schema theory. An approach that highlights student experience, celebrates diverse perspectives, and utilizes these through social collaboration. Students hold so much more value than just a bank to be filled up with facts and routines. Students bring rich, lived experiences that should be shared and celebrated in order to build a strong learning community, one that fosters motivation in the educational setting. The Schema Theory (McVee et al., 2005) provides a framework for implementing these aspects of education successfully in the classroom to support and enhance student learning.

Guiding Pedagogical Theory

The Schema Theory gained traction in the 1970s primarily in the area of reading and literacy. Schemas were thought to be mental structures that organized knowledge within the individual. When the learner experienced something new, it would be organized as a schema, which could be "accessed" to build comprehension and memorization further. Learning occurs when schemas are accessed, modified, or created as the learner navigates through their experiences. The main processes involved assimilation and accommodation, where assimilation involved adding new information into an already existing schema, while accommodation occurred when new information either created a new schema or adjusted a previous schema (McVee et al., 2005). The early theory was highly effective for recall and memorization; however, newer sociocultural theories, developed in the 1980s and 1990s, overshadowed it.

However, the Schema Theory was recently revisited in 2005 by McVee and colleagues, and adapted to become a more nuanced version incorporating many sociocultural components. Although the Schema Theory has been researched, written about, and explored by numerous individuals over the years, it was most commonly seen as a relatively rigid system in which humans were thought to learn. Research mainly focused on schema activation, rather than origins of the schema itself (McVee et al., 2005). The individualistic view of schema theory did not often account for the sociocultural aspects of learning that became more prominent in the 1990s. The newer theory seeks not only to understand the creation of new schemas but also to bridge the gap between schema theory and sociocultural perspectives on learning. The newer theory produces key aspects that further connect it to sociocultural theories of learning, while also retaining the importance of creating new and activating existing schemas.

From my reading, I highlighted three main areas of the schema theory as "pillars" I will keep in mind in the classroom. The first of these pillars is the integration of social learning theories, such as Vygotsky's sociocultural theory. Learning arises through meaningful social interactions, where schemas are shaped by factors outside the individual, including cultural and linguistic aspects. The second pillar is how student identity influences and shapes the creation of new schema and the activation of existing schema. Students are constantly drawing upon schemas which are tied to their very identities, and the aspects of their identity influence the way they learn through the use of language, their social positions, and the place they hold in their communities (McVee et al., 2005). The third pillar is the idea that schemas are not "fixed" or rigid, but somewhat fluid resources that are constantly activated and reconstructed through interaction and reflection. In this view, student learning is not seen as a straightforward process in which teachers simply instill knowledge into students; rather, students are viewed as wells of

knowledge whose experiences and perspectives can be valuable tools for supporting learning. Experiences shape lives, and the way students learn can vary significantly based on their past experiences and differences in social and cultural aspects. However, this diversity of students is a strength that can be accessed through informed teaching practices.

To address the first pillar in my classroom, I want to lean into the social and cultural aspects of learning and how to use these aspects to best support my students. According to McVee et al (2005), "Sociocultural theorists argue that schemas emerge from the social interactions between an individual and his environment" (p. 547). In other words, students create new schema when interactions between classmates, groups, and the material world come together to shape new meanings in their minds. I want to enable my students to engage with as many diverse perspectives as possible, thereby broadening their understanding of the world around them. After all, biology classes are about understanding the natural world around us, our place in it, and how the constant natural interactions shape the world we live in. It seems this is the perfect subject to integrate sociocultural aspects of schema activation and creation to promote student understanding.

Student identity also plays a significant role, as it is shaped by numerous sociocultural factors that, in turn, influence the way students perceive the world around them. I want to use these factors as a strength in my class. Students can construct meaningful schema from increased interactions between themselves through the implementation of partner and group projects, jigsaws, and a general increase in student talk. It is important to tie language to authentic experiences (McVee et al., 2005), as this allows for a more meaningful connection to be built, connecting the schema to real-world, lived experiences in the students' minds. Student identities are diverse, and it will be essential to ensure these identities are taken into consideration when I

conduct my teaching. Teaching becomes personal and connected when students' experiences and identities are taken into account. It becomes less detached and more meaningful to the students when they can connect their own experiences and views of themselves to the material itself. Meaningful connections can further increase student engagement, leaving fewer students feeling disconnected from their learning.

Students are to be seen as wells of knowledge in my future classroom. Their dynamic schema are constantly being activated, reconstructed, and combined to create fluid understandings of the world around them. These connections and their dynamic nature allow me, as the teacher, to access them in ways that further promote student learning in a manner that is personal to each student. I wish to learn as much from my students as they learn from me, and I want to use their individual and shared experiences as a tool for teaching, rather than viewing it as a daunting task to plan for. By actively addressing students' lived experiences through social discourse, I hope to further their understanding of not only the subject content, but also their understanding of learning as a whole.

Connection to InTASC Standards

The goal of this action research project is to increase student engagement and foster deeper connections between students and the content in a high school biology classroom through the application of schema theory. The schema theory will enable me to utilize a framework that allows students to engage with the content in various ways, such as social interactions, connections to their own lived experiences, and diverse perspectives of the individuals in our classroom. I want my students to view their education as personal, as a connection between content and their character, their lives, and their experiences. I want the instruction in my biology

classroom to foster a learning environment in which students feel safe being themselves, because they know their knowledge is valued, not limited.

The action research project aligns with InTASC standards:

- **Standard 2: Learning Differences**

  "The teacher uses understanding of individual differences and diverse cultures and communities to ensure inclusive learning environments that enable each learner to meet high standards".

- **Standard 3: Learning Environments**

  "The teacher works with others to create environments that support individual and collaborative learning and that encourage positive social interaction, active engagement in learning, and self-motivation".

- **Standard 4: Content Knowledge**

  "The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make these aspects of the discipline accessible and meaningful for learners to assure mastery of the content.

Standard 2 is addressed through the framework of the schema theory, as the theory itself is tied to the fact that students are diverse in their experiences and cultures, and these aspects are leveraged as strengths in the classroom. Specifically, Standards 2(c) and 2(d) are directly addressed when using schema theory, which celebrates and acknowledges students' prior knowledge and perspectives when tackling subject matter. In a biology classroom, this could look like asking students to discuss the traits that seem to be prominent in their families when introducing a genetics unit, or through the creation of a family pedigree project. These traits,

such as eye color, hair color, and height, are lived experiences students have interacted with and come to know during their lives. They are personal aspects of their prior knowledge that are accessed to further connect their lives to the material.

Standard 3 addresses the learning environment the teacher creates. A learning environment should be conducive to positive social interaction, collaboration, and active engagement. One of the pillars of schema theory is the importance of social interaction in effective learning. Collaboration and positive peer interactions are at the heart of the framework I will be using to support my students. Specifically, the framework will address standard 3(o), which emphasizes the role of the teacher when supporting students' learning from their fellow students. As I have stated before, the schema theory emphasizes the relationship between effective learning and social interactions. In the classroom, I could apply a host of strategies to address this standard, including increased student talk through jigsaw activities, Socratic seminars addressing the ethics of CRISPR and gene editing, partner study days utilizing homemade index cards, group projects exploring different biomes, and classroom roles emphasizing responsibility.

Lastly, Standard 4 addresses content knowledge, and the framework addresses 4(d) through the constant connections to prior content or personal knowledge to better support students. Prior knowledge is one of the most important aspects of schema theory, and the ability to support prior knowledge activation will help students succeed in my biology class. Standard 4(o) acknowledges that content knowledge is not static, but instead constantly changing, complex, and culturally situated. Students could complete projects based on observed pollution of the area in which they live, allowing students to connect the content directly to their lived experiences. The framework of schema theory directly supports these standards through its

pillars, which I have previously highlighted, and I plan to utilize these aspects to better support all my students.

Summary

In my educational experience, pedagogy was often unengaging and primarily led by the teacher, who tried to instill knowledge in their students through lectures, notes, and worksheets. The education I received largely ignored the knowledge my classmates and I already possessed. It overlooked the importance and value of the students' backgrounds, connections, experiences, and identity. Students are not static, and their understanding is impacted by these different factors, factors that teachers tend to ignore in their instruction. Meaningful connections to education arise from instruction that enables students to relate their experiences, lives, and identities to the content through social and cultural interactions. I want to support my students, placing value in their lives, not just in their education. To achieve this, I will utilize the schema theory to activate prior knowledge, connect material to students' experiences and culture, and provide opportunities for students to connect culturally and socially, promoting a positive learning environment. Ultimately, I hope to engage my students on a deeper, more personal level with the content I teach, something I wish I had felt while I was in school.

Chapter 2. Annotated Bibliography

Introduction

In my educational experience, I believe that the teachers were teaching the content of their subject, but were not teaching the students. Our perspectives, experiences, and prior knowledge were not accessed in ways that would benefit our learning, and were largely ignored. This disconnect between content and experience is what led to my low levels of engagement in class, and soured my motivation in school. To remedy this academic issue I faced as a student, I aim to increase student engagement and foster deeper connections between students and the content in a high school biology classroom through the application of schema theory.

I have gathered here sources of literature that helped shape the way I want to teach in my classroom. I have chosen the Schema Theory as my guiding framework for my ARP, however, there was very little information available about the connection between the Schema Theory and the subject of science. The Schema Theory has long been used in language instruction, but has not been as robustly covered in connection with other subjects. I have compiled a large body of work pertaining to the application of the Schema Theory, highlighting the different aspects the Schema Theory can be applied to in the educational setting and beyond. I used key words such as *framework, education,* and *application*, in combination with *Schema Theory* in databases such as ERIC (Ebsco), ProQuest, and the Hammersley Library of Western Oregon University.

Literature

Ensam, B. K. (2025). Implications of schema theory on teaching EFL and ESL reading comprehension: The role of pre-reading activities. *International Journal of Language and Translation Studies*. https://ijlts.org/index.php/ijlts/article/view/173/74

The purpose of this article was to identify relevant research, synthesize findings, and apply the Schema Theory to Moroccan ESL (English as a second language) classes. Ensam reviewed recent literature, specifically analyzing Schema Theory and the way it applies to instruction of English as a second language. The authors analyzed the literature from a Schema Theory based perspective, to identify links between the theory and how it affects ESL classes.The author concludes that the reading comprehension of Moroccan students learning English is decreased when teachers fail to activate or address prior student knowledge and experience. The author argues that pre reading instruction is important when addressing reading comprehension, and that it is often overlooked, especially the ability to activate prior knowledge at this stage. The author suggests that teachers move beyond the basics of covering the formal aspects of language, and start to address the schemata already present in the students. The strength of this article lies in the root problem that it addresses. ESL education is an integral part of many students' education, and the numbers of ESL students are rising. It is an incredibly important aspect of education that should be addressed. The researchers were able to robustly examine the influence Schema Theory has on ESL education, and the significance of this research will be impactful.

Farangi, M. R., & Kheradmand Saadi, Z. (2017). Dynamic assessment or schema theory: The case of listening comprehension. *Cogent Education, 4*(1). https://doi.org/10.1080/2331186X.2017.1312078

The article aims to compare two approaches that are claiming to be effective in enhancing English Language Learner's (ELL) listening capabilities, which include the Schema Theory and Dynamic Assessment. Farangi and Saadi used a quasi experimental design and recruited two classes of ELLs, one using dynamic assessment and one using the Schema Theory, and each

group conducted 15, one hour sessions working on their abilities. The article viewed the results through the lens of dynamic assessment and Schema Theory, to assess which, if any, were more effective at increasing the listening abilities of ELL students. The results showed that both groups attained improvements to their listening ability over the course of the study. The Schema Theory group had higher scores on the posttest, however, there was no statistical significant difference between the two approaches. The researchers concluded that multiple approaches may be used to improve the listening abilities of ELL students, and that both approaches can be used simultaneously to help support listening ability development in students. This article was impactful in demonstrating how the use of the Schema Theory can be used to develop foundational skills that will help students succeed across academic contexts. Listening skills are not only critical for ELL students, but all students, which is important for teachers to access. However, it does highlight the usefulness of cognitive schemas in memory and recall through the stability and transfer effects seen in the study.

Hewson, P. W., & Posner, G. J. (1984). The use of schema theory in the design of instructional materials: A physics example. *Instructional Science, 13*(2), 119–139.

Researchers attempted to address the question of what are the implications of cognitive science for the design of institutional materials given its central concern with meaningful learning. Researchers interviewed two students after they used the created course materials that were in line with the Schema Theory, and used their answers to the questions to interpret the efficacy of their created materials. Hewson and Posner conducted the study under the lens of Schema Theory to assess the efficacy of creating instructional materials using the Schema Theory as a guiding framework. The two students that were questioned to assess the effectiveness of the

created course materials offered two contrasting answers. One student thought the materials, which addressed schemas and prior knowledge, were helpful while the other thought they had no effect. The researchers suggested the Schema Theory should be investigated in a more in-depth manner when related to the construction of instructional materials. When examined critically, the experimental setup was not robust enough to offer any concrete data on their course materials, or to answer their overarching research question. It should be suggested these materials be provided in a quasi-experimental setup, where a much larger number of students could be assessed after through questions according to the researchers.

Liu, D., He, P., & Yan, H. (2025). The impact of cognitive schema on learning transfer ability and stability of classical Chinese poetry. *PLoS One, 20*(11), e0336135. https://doi.org/10.1371/journal.pone.0336135

The article examines the effectiveness of cognitive Schema, based on the Schema Theory, and its influences in transfer ability and stability of students learning Chinese poetry. Dawei et al. used a quasi-experimental design which included a control of 64 students and an experimental group of 63 students. The experimental control group used schema based mnemonic strategies on a test, while the control group did not. The findings were analyzed using the Schema Theory and Cognitive Structure Migration Theory to determine the application of these theories in the different aspects of learning and retaining Chinese poetry. The researchers concluded the experimental group outperformed the control group, meaning cognitive schema have a positive impact on transfer and stability of Chinese literature. Students who were able to use the cognitive schema mnemonic devices during the test were able to score better than those who were not able to utilize the devices, showing the power of cognitive schemas. The article should have included

a more robust evaluation of their experimental procedures, as the testing period that the students conducted was only 10 minutes long. The study seems to neglect the aspect of learning styles, and overall student attitude towards their learning.

Liu, Y. (2015). An empirical study of schema theory and its role in reading comprehension. *Journal of Language Teaching and Research, 6*(6), 1349. https://doi.org/10.17507/jltr.0606.24

The article investigates the role relevant prior knowledge plays in reading comprehension. Liu used two groups of students, one with relevant prior knowledge, and ones without, to read a specific passage. Students were then quizzed with immediate recall and delayed recall to test the effect of relevant prior knowledge on reading comprehension, recall, and memory. The findings were analyzed using a Schema Theory lens to investigate how prior knowledge affects reading comprehension. The findings showed students with relevant prior knowledge (the appropriate schemata) performed significantly better, on both the immediate and delayed, recall quizzes than students without the appropriate schemata. The findings suggest relevant prior knowledge not only aids in immediate comprehension, but long term retention of the passage. The article reinforces the importance of Schema Theory when instructing students in areas of reading comprehension. Understanding the role relevant background knowledge has on reading comprehension can allow teachers to significantly improve the amount of support I can lend my students through my instruction. The experimental setup allowed for the researchers to gather quality results that showed the importance of Schema Theory use in the classroom.

McVee, M. B., Dunsmore, K., & Gavelek, J. R. (2005). Schema theory revisited. *Review of Educational Research, 75*(4), 531–566. https://doi.org/10.3102/00346543075004531

McVee et al. re-examined the role and use of Schema Theory in today's literature, and the role that it could play in the future undergoing a reshaping. The researchers did not conduct an original experiment, but rather conducted a literature review of Schema Theory, tracing the theory from its origins to its more nuanced uses in today's literature. McVee et al. analyzed the body of literature pertaining to the Schema Theory through a sociocultural lens to revise the theory to fit modern education. The researches suggest the traditional Schema Theory holds an important place in the history of learning theories, but has been overshadowed by more developed theories that incorporate more nuanced ideas when it comes to human learning. The researchers push to reframe this theory to include more aspects of sociocultural theories, to move from individual learning and rigidity to a culturally relevant and embodied practice. This article was very impactful on my understanding of the Schema Theory, as it was the seminal piece that shifted the theory from its traditional place in the literature. The researchers examined each literary piece thoroughly and were able to ascertain conclusions that were strongly rooted in previous findings. Because of this, the Schema Theory is now seen as a culturally relevant way of utilizing prior student knowledge and experience to support student learning. It has shaped the way I think about instruction, and my goals for how students may interact with the subject matter.

Meylani, R. (2024). Innovations with schema theory: Modern implications for learning, memory, and academic achievement. *International Journal for Multidisciplinary Research, 6*(1). https://doi.org/10.36948/ijfmr.2024.v06i01.13785

The article explores the Schema Theory, its core components and processes, as well as the role it plays in guiding attention, facilitating comprehension, and influencing memory processes. Meylani synthesizes a large body of literature surrounding the Schema Theory and provides a conceptual analysis in line with the literature. The article is written through the lens of Schema Theory to synthesize modern literature surrounding Schema Theory and its implications on different aspects affecting student education. The findings suggested Schema Theory aids in academic comprehension and other factors that affect academic performance. The article also highlights the vast applications of the Schema Theory in more areas than strictly academic performance, areas such as cross cultural communication and advertising. However, the findings do highlight the limitations of the Schema Theory as well, finding that it may often be oversimplifying learning and the inability to fully address individual learning differences. The strengths of this article lie in the breadth of the content covered within the topic of Schema Theory. The author covered the academic importance of Schema Theory including the specific ways in which it aids student performance, and also the potential impact the theory has on the construction of curriculum. The author also highlighted the overall practical implications of the Theory as well, noting some foundational impacts that the theory has on our lives.

Moody, S., Hu, X., Li-Jen, K., Jouhar, M., Xu, Z., & Lee, S. (2018). Vocabulary instruction: A critical analysis of theories, research, and practice. *Education Sciences, 8*(4). https://doi.org/10.3390/educsci8040180

The purpose of this article was to find the underlying theories that guide vocabulary instruction, and their potential impact on teacher performance and/or student performance. Moody et al. dissected articles published in *The Reading Teacher* and *Journal of Adolescent and Adult*

Literacy between 2007 and 2017 to identify and code embedded word learning strategies, grade levels addressed, target student populations, and desired outcomes. Their findings were not directly analyzed using a guiding theory or framework, but rather to *identify* the most common guiding theories and frameworks used by educators. The researchers found that a combination of theories guided most strategy recommendations in the articles. Social constructivism and sociocultural theories (88%), Schema and psycholinguistic theories (76%), motivation theory (47%) and DCT (32%) were the influential theories they assessed. Another finding was the fact there was rarely explicit mention of these theories grounding the strategies mentioned in the articles they dissected. The researchers also encountered few articles pertaining to middle school vocabulary learning and very few associated with high school. The strength of this article resided in the fact it was a literature review, and it showed a lack of explicit naming of theories used to guide vocabulary learning strategies. The authors showed many articles referenced a combination of effective learning stratified, but failed to explicitly state the foundation of these strategies, the theory that they are rooted in. The article sheds light on a flaw in the body of literature that can be, and should be, addressed to better help teachers support their students.

Quinlan, C. L. (2019). Use of schema theory and multimedia technology to explore preservice students' cognitive resources during an earth science activity. *Contemporary Issues in Technology and Teacher Education, 19*(3).

The researcher aimed to find connections between the use of multimedia technology and activation of student cognitive resources, and how the Schema Theory plays a role in the effectiveness of these connections. Quinlan recorded the dialogue of five pre-service elementary teachers during an Earth Science activity that incorporated multimedia use. The dialogue was

analyzed for common themes and patterns. The dialogue of the preservice teachers were analyzed using Schema Theory as a guiding framework to discover patterns that could inform future instruction. The findings suggest multimedia resources were a large factor in student engagement and use of higher order thinking skills. They showed that science activities letting students use their prior learned knowledge (PLK) activated higher order thinking, even without large amounts of scientific background knowledge. The study shed light on the importance of activating student PLK due to the increased engagement of their cognitive resources. The article provided strong connections between student PLK activation and the use of foundational scientific skills. The article strengths lie in the connection between science content and PLK, multimedia integration, and the importance of the Schema Theory. However, the study did not have a large sample size, and the study did not collect data on the pre-existing schema of the students, which may limit their findings.

Shen, Y. (2008). An exploration of schema theory in intensive reading. *English Language Teaching, 1*(2). https://doi.org/10.5539/elt.v1n2p104

The article aims to explore how the application of the Schema Theory in intensive reading classrooms can positively affect student understanding, specifically a global understanding of the texts. Shen analyzed available literature regarding Schema Theory and its application in reading education. The literature was analyzed to determine the effectiveness of Schema Theory as a guiding framework in intensive reading activities aimed at increasing English language skills. The literature showed schemata can play a more important role in reading comprehension than language proficiency. Background knowledge can act as a bridge between input and output, increasing comprehension of texts. The author also suggests teachers making institutions more

student centered and interactive to help schemata activation increase. The strength of this article was the fact that the author not only supplied proven information in the form of the literature review, but also used this information to inform suggested practices that can directly affect student learning outcomes. The connection between the data and the ways in which the researcher suggests to implement their findings are strong and can be perceived as viable. However, without proven testing supporting the suggestions, the research is limited.

Wang, Y. (2025). Study on the application of schema theory to the teaching of college English reading. *Journal of Education and Educational Research*. https://drpress.org/ojs/index.php/jeer/article/view/13362/12990

The article, using a literature review, seeks to understand Schema Theory's place in college level English instruction, and the role it plays in reading comprehension. Wang used a literature review strategy to assess the theoretical underpinnings of the Schema Theory and the outline of the three Schema Types. The author analyzed different sets of literature to review the outcomes of Schema Theory used to apply to college level English instruction. The literature was synthesized to assess the effectiveness of the Schema Theory as a guiding framework for college level English instruction. The author used a literature review to inform the argument that both “top down” and “bottom up” learning styles do not adequately address reading comprehension. Instead, an approach utilizing the Schema Theory would allow reading to become an interactive process, the student’s prior knowledge interacting with the text. The author suggests by addressing all three types of Schemata, teachers may more effectively support student reading comprehension. The article brings up interesting and supported suggestions, but without empirical data to directly support their claim, they only remain suggestions. To further solidify

their findings, it should be suggested the author conducts an experiment to test if their suggestions are viable in college level English instruction, because without data to uphold their claim, the researchers can only "project" these findings.

Yu, Y. (2019). Schema theory-based flipped classroom model assisted with technologies. *International Journal of Information and Communication Technology Education, 15*(2), 31–48. https://doi.org/10.4018/IJICTE.2019040103

This article examines the effectiveness of flipped classroom models compared to non-flipped classroom models through the utilization of schemata assimilation. Yu and Zhu collected and summarized around 70 publications in order to analyze the Flipped Classroom Assisted by Technology (FCAT) model of teaching. The authors also conducted a comparative study between flipped and non-flipped classrooms, comparing student's cognitive development over the course of the class. Their findings were analyzed through the lens of the Schema Theory because the author wanted to determine the effectiveness of the Schema Theory-based FCAT model of instruction. The authors concluded the FCAT model of teaching is much more effective at promoting schemata assimilation and adaptation for students, promoting higher levels of cognitive development than the non-flipped classroom model. However, the authors also found limitations of implementation for the FCAT which included inequitable student access to technology, an emphasis on teacher-centered instruction, and a lack of resources necessary to create the FCAT model at some schools. Thinking critically about this article, researchers show the benefits afforded to students through the activation and assimilation of schemata through the FCAT model. However, the possibility that some students may not have access to the technology needed to effectively access and interact with the learning materials outside of the classroom

should not be overlooked. I think the research here highlights clear connections between the Schema Theory and the use of technology in education, but that there are many real life complications with the implementation of these ideas in schools.

Summary

The goal of this action research project is to increase student engagement and foster deeper connections between students and the content in a high school biology classroom through the application of schema theory. In completion of the bibliography, there are some common themes and key points that should be addressed in order to achieve the goal of the action research project. The first is that Schema Theory has proven to be an effective guiding framework for academic achievement and works to promote important skills such as critical thinking. The Schema theory has also been connected to foundational skills we learn as humans, not just content specific knowledge or skills learned in school. The activation and utilization of prior knowledge and experience that form such the basis of the Schema Theory have been used to create effective activities and promote student learning.

The more recent "rework" of the Schema Theory done by McVee et al. (2006) bridges some of the gap between the Schema Theory of the 1980s with the sociocultural theories that came to overshadow it. The connection of certain aspects of these theories has given the Schema Theory a stronger foundation, remedying some of the downsides of the original theory. Overall, the Schema Theory has shown to be an effective guiding framework, and one that I will use to help guide my instruction in better support of my students as learners, but as humans.

Chapter 3. Methods

Introduction

Action research is an active reflection of current educational practices. It is a "process of inquiry *by* and *for* those taking the action" (Sagor, 2000, p. 11). In other words, individual teachers, groups of teachers, or entire school faculties can engage in action research to improve educational strategies. Teachers find action research empowering because it is relevant to their goal of providing effective education. Action research is a strong way to test instructional practices and helps teachers become more reflective practitioners.

Action research is conducted in seven sequential steps: 1) selecting a focus, 2) clarifying theories, 3) identifying research questions, 4) collecting data, 5) analyzing data, 6) reporting results, and 7) taking informed action (Sagor, 2000). To begin, educators conducting action research must first select a focus that is worth their time. Areas of pedagogy that, after deep reflection, are found to have had a positive effect on teacher success and enjoyment are worthwhile. Once a focus has been selected, researchers must then adopt a theory or approach to base their research upon. The chosen theory must be directly tied to the educator's beliefs and values and also serve the needs of the student population. With a guiding theory in place, the researcher must create a set of research questions that are personally relevant. After a focus has been selected, a guiding theory chosen, and deeply meaningful research questions created, the researchers move to data collection.

Educators should always base their classroom decisions on the best possible data. Having established research questions, the next step is to collect data that is both *reliable* and *valid* (Sagor, 2000). To best ensure the reliability and validity of data, researchers should collect data from multiple sources to triangulate their findings. Fortunately, schools are filled with valuable

sources of data that can ease a busy teacher's feelings about data collection. Once multiple sources of relevant data have been collected, researchers can begin analyzing them. When analyzing data, researchers aim to answer two questions: "what is the story being told by this data" and "why did the story play itself out this way?" (Sagor, 2000, p. 12-14). By answering these two questions, researchers can gain a better understanding of what is being investigated and provide more grounded results.

With reliable data collected and analyzed, researchers can proceed to what is often considered the most rewarding part of action research: sharing and applying the findings. Educators need to report their results to those who will find them beneficial, such as colleagues or administrators, to spread the important findings. The ultimate step of action research is taking informed action. Much of teaching is trial and error, but action research can help teachers avoid making the same mistakes in their classrooms (Sagor, 2000). Teachers must use the knowledge they have gained from their action research project to inform their future classroom endeavours.

Action research is, without question, the proper method for my study. It is my goal as a future educator to best support my students in their academic endeavours, their life goals, and them as people. To achieve this continuous goal, I need to effectively implement, adapt, and monitor the instructional approaches I use in the classroom. Not only is action research relevant to my situation, but it is also reliable and valid, promoting teacher effectiveness. The goal of this action research project is to increase student engagement and foster deeper connections between students and the content in a high school biology classroom through the application of schema theory. By utilizing the seven steps of action research, I will be able to reflect more deeply on the practices I implement in the classroom. Stagnation is never an option in education, and I believe action research will promote continual personal and professional growth. Each new group of

students I will have will have different experiences, which means the ways in which I engage students will need to be constantly evolving. For this reason, I have proposed the following research question:

- How does the use of instructional strategies that connect students' lived experiences to biology content impact student engagement in a high school biology class?

Participants and Setting

I am conducting my student teaching at a Title I, urban high school in Salem that serves a predominantly Latinx community. The school has an enrollment of 2,190 students. In my classroom, these demographics are similar to the school's. In total, there are 35 students in my junior-level Biology classroom, split almost evenly by gender (51% female, 49% male). There are four students on IEPs, and two students on 504 plans, which means 17% of the students require special education services/extra instructional support. The racial demographics of the classroom are as follows: 66% Latinx, 14% white, 8% Asian, 6% Multiracial, and 6% Pacific Islander. A couple of students are identified as migrant students, totaling 6% of the class. There are nine different home languages spoken among my students, and 54% of students are in the ESOL program. The majority of students in the ESOL program are "active," while a few are "transitioning," meaning they require less support. There are also students who are no longer in the ESOL program, but are still monitored after completion, which makes up about 17% of the students in the classroom. Many of the students are from low-income families, totaling about 70% of the class. The class is composed predominantly of Christian and Catholic beliefs, as well as atheist beliefs.

In my classroom there is an incredible diversity among the students who all bring their own specific cultural, experiential, and academic funds of knowledge. This bank of student knowledge is rich in lived experiences, cultural understanding, and real-world expertise. As noted previously, many of the students in my class come from low-income families and therefore have priorities in their lives extending beyond academic achievement. The priorities many of my students face are providing familial support in the form of child care, contributing to the family, or providing general help around the house. Students in this position learn important life skills many other high school students may not have developed yet. What my students have is a work ethic. Students attend school and do their best in all of their classes and immediately start extracurricular activities, care for younger siblings, or go to work. This knowledge of my students leads me to believe they have resilience, more resilience than they are given credit for because of where their priorities lie. Their practical knowledge lends itself to their passions as well, as many of my students have an interest in autobody work on cars, starting their own small businesses, or looking into fields where they can help people (such as the medical field), as they have been helping their family for a long time now. This practical and lived experience is what makes my students amazing. This drive they show day in and day out is inspiring, and it can take them far in life if they are given opportunities to demonstrate it.

My students' academic funds of knowledge are tools to be accessed to further their education, although it is apparent this aspect of their prior knowledge is not treated the same way. As stated previously, many of my students have priorities extending beyond their academics, into more immediately important aspects of their lives. Because of this, school is not their top priority at times, which can negatively affect their academic achievement. The students my school serves come from a generally low socioeconomic background and are often held to

lower expectations. That, in turn, can create a loop: the lower the academic expectations are, the lower the student may perform. I believe this has led many of these students to adopt a negative outlook on their academics, which can, in turn, influence teachers' perceptions of their performance. It is apparent to me these students have not had high academic expectations set for them, nor have their teachers spent time truly engaging them on an individual level. Their lives equip them with the foundational skills they need to succeed, such as resilience, perseverance, and determination. They just need the chance to show how truly capable they are as students.

I have worked with this group of students for six months now, and will continue to work with them for the rest of the school year. Because of our time together, I have been able to form strong student-teacher relationships with them, which has contributed to a positive classroom environment. I feel as though the rapport I have cultivated in the classroom makes all students feel comfortable and allows them to be themselves. The positive classroom atmosphere has not only helped me become a better teacher of the content, but it has also allowed the students to become closer to each other. At the start of the year, not many students would talk with each other during group discussions. However, as the year has progressed, group discussions have become a staple of my lesson planning. Although my relationship with the students is strong, and I have learned more about them each day, I do not truly understand each student’s situation. I will never truly understand their situation because I have not lived it, nor have I felt the intersection of their culture with the situations they face in life. I can do my best to keep learning as much from them as they are learning from me.

Data Collection and Analysis

The data for this action research project was collected during a unit in February 2026 in a junior-level high school biology class. To ensure the validity and reliability, I collected data from

multiple independent sources, as suggested by Sagor (2000). The first set of data I collected was the lesson plans for the specific unit mentioned previously. The lesson plans were then arranged into a timeline of instruction, a useful tool as it provides a chronological sequence of instructional activities (Sagor, 2000). Data was also collected through a daily reflective journal. Teacher journals are an effective way to capture trends in student behavior, providing insights into sequential patterns of the story you are following. Because daily journaling is not immediate and happens after class, I decided to also incorporate clipboard notes into my data collection process. Here, using a clipboard, I could quickly jot down important events such as breakthroughs or regressions as they happen, as well as observational data about student engagement. Both journaling and clipboard notes provided robust data when each were compiled alongside the timeline of instructional activities drawn from the lesson plan. Collecting this type of data allowed me to see trends and patterns in the order of introduction. A student survey was also administered before the unit ended promoting reflection on engagement.

I began by open-coding the data sets to identify initial patterns and trends. I then used deductive coding focused on the three pillars of Schema Theory—social learning, student identity, and schema formation (McVee et al., 2005)—to help organize and interpret the data. I centered my analysis on identifying themes directly aligned with the guiding pedagogical theory, ensuring my analysis was consistent and grounded in evidence. To strengthen my analysis, I used triangulation by connecting at least three sources of evidence to each theme. This helped ensure the patterns I identified were consistent across multiple data sources and clearly aligned with each core pillar. From there, I dug into the data and assigned codes to provide further detail and connection to the Schema Theory and its effect on student engagement. To further validate my analysis, I asked my clinical teacher to review my work. They provided feedback, prompting

further introspection and analysis of the data in relation to the Schema Theory, thereby ensuring the internal validity of the analysis.

Researcher Positionality

As a future educator, it is my purpose to support my students in every way I can at all times. However, my students live drastically different lives and have educational experiences that are very different from the ones I had when I was their age. Although I acknowledge I am ignorant of their experience and culture, I am learning as much as I can. I identify as a cisgender white male, and I attended a private catholic high school, which has led me to have completely different experiences in my life than my students. I know student experience and funds of knowledge are among the most important aspects of education, and yet they are often forgotten or pushed aside in the rush to teach content. I want my students to feel as though their experiences and cultures are valued in my classroom. If I felt as though my personal experiences were not valued in my education, as a white male, then I can only imagine how little my students have felt valued in their education.

While collecting data, it is important to note my positionality, as it may affect the collection and analysis. I do not speak a second language, which can limit my classroom awareness, as many of my students converse in their home languages with one another. That means I may not be able to collect all available data, especially given my clipboard notes, as I do not fully understand the depth of the conversations students are having in their native languages. However, any data collected is useful, and if I want to increase my effectiveness in engaging my students, I will need to be as thorough and honest as possible during this action research project. I acknowledge that I will not be able to connect as deeply with my students' lives and

experiences. However, I will continually work to learn as much as I can about my students to create an engaging classroom climate that values their rich lived experiences.

Chapter 4: Findings

Three major themes emerged from the data analysis. The first theme was that social learning structures increased behavioral engagement. Social learning structures in the classroom can take many forms, but most commonly include group work, jigsaws, and turn-and-talk opportunities. The second theme was that connecting content to students' identities and experiences increased emotional engagement. Students come to class with a wealth of lived experience, which can be used to strengthen their connection to the content. The third theme was that ongoing schema development supported increased cognitive engagement. Schemas can develop and change over time, and the process of reshaping schemas helps students stay engaged. Each theme is discussed with supporting evidence.

Social Engagement

The first theme that emerged from the data analysis was increased student behavioral engagement when supported through social learning. The theme aligns with one of the core pillars of the Schema Theory, which suggests student learning is significantly influenced by social factors. When I started teaching the genomics unit, the fourth unit of the year, I wanted to emphasize social learning in the lesson plans. Social learning, as detailed by Vygotsky (1978), deepens student understanding and can increase student engagement. The revised Schema Theory directly aligns their core pillar of social learning with the more prominent learning theories of the 70s, which have been intensely studied for some time. I set a goal to provide students with plenty of opportunities for social learning and implemented many ways for students to socially construct meaning into the unit plan (Fig. 1). The emphasis on social interaction shifted the classroom environment toward one that valued shared meaning-making and collaborative problem solving.

Lesson Number	**Lesson Title**	**Key Activities**
Lesson 1 (40 Minutes)	4.0 Notebook Setup	-Notebook setup
Lesson 2 (75 minutes)	4.1 Genetic Variation	-Trait Survey -Genetic Variation Worksheet
Lesson 3 (85 minutes)	4.1 Genetic Variation	-Genetic Variation Worksheet
Lesson 4 (75 minutes)	4.2 Punnet Square Intro	-Punnet Square Modeling -Ladder Activity -Punnet Square Practice
Lesson 5 (85 minutes)	4.2 Punnet Square Intro	-Punnet Square Practice -Spongebob Activity -Summative Assessment

Fig. 1 Unit Plan

One way I incorporated social learning early in the lesson plans was through structured student talk. For example, students were tasked with completing a genetic variation assignment in the second and third lessons of the unit (fig. 1), which used varied instructional methods. Students would watch videos, participate in class discussions, and use manipulatives to answer the prompts. However, before each student answered the prompts, they were given an opportunity to socially contextualize their meaning and understanding through different approaches. Not only did this allow students to explain their ideas and thoughts, but it also helped them learn different perspectives, enabling them to view the content in a new way. Students across the board seemed engaged with the content and their peers. I made this note on my clipboard as I circulated through the class: “There is so much student talk, each group is working at a different pace, but each group is collaborating!” Before implementing this structured student talk, students would often work alone, which often led to disengagement with the material. I found this especially true with many of my emergent bilingual students.

Consequently, emergent bilingual students benefited most from the lesson's social learning aspects. I reflected in my journal after the first day of the genetic variation activity, saying:

> It seemed as though the students were engaged in the learning process throughout the majority of the class. I think the additional time for group work helped many students remain engaged in the learning process, especially when they became confused or uncertain. By far the biggest change I saw was with my emergent bilingual students! Speaking conversationally in their home language about the content seemed to make a world of difference today!

A specific example from the genetic variation worksheet where I saw an immediate benefit from the social learning opportunities was through a Venn diagram activity contrasting meiosis and mitosis (Fig. 2). Students were tasked with completing the Venn diagram based on an informative video they watched. Each student would pair up, and one student would fill in the meiosis side while the other filled in the mitosis side. When the video concluded, each “expert” was prompted to verbally explain their side of the diagram to their partner. Then, together, the students would identify similarities between the two processes and fill in the middle portion of the diagram. While circulating around the room and observing students, I noted that engagement was extremely high and even recorded my thoughts on the clipboard, writing: "Wow, what a great activity; this has got to be the strongest of the lesson so far." I had opened the third lesson of the genomics unit with this activity, and students started class fully engaged. Throughout the remainder of the day, student engagement levels stayed around 85-90% of the class.

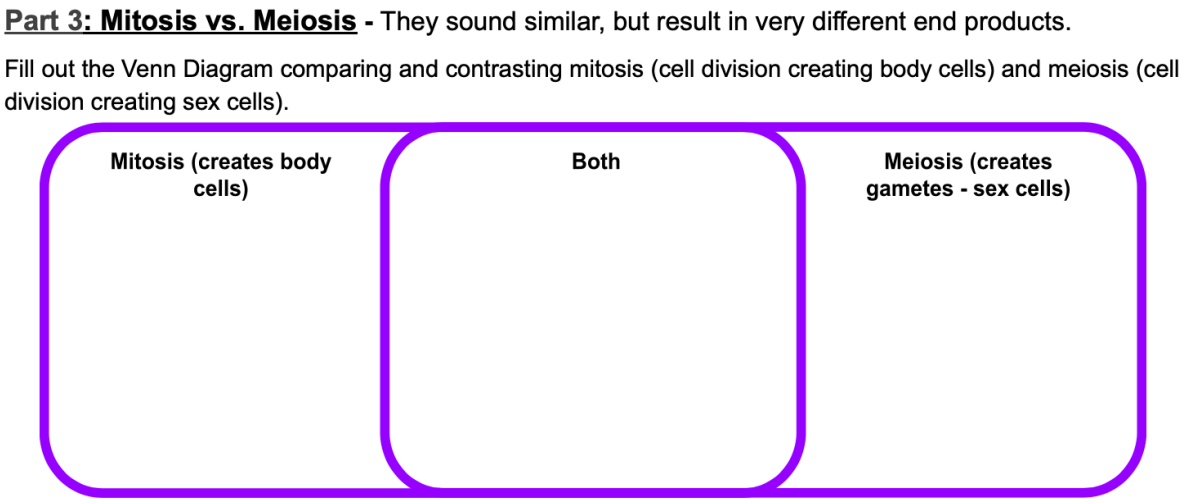

Fig. 2 Mitosis and Meiosis Venn Diagram

Although my observations convinced me that social learning opportunities were positively affecting student engagement, I wanted more concrete evidence. One way I gathered quantitative data was through student attendance. Before this unit, student attendance averaged about 66% (23 of 35 students); however, during this unit, it averaged 83% (29 of 35 students). In fact, student attendance did not drop below 74% (26 out of 35 students) at any point during the unit. To my clinical teacher and me, this was a huge accomplishment and a large step in the right direction. Attendance is one of the most important aspects of a student's ability to engage with the materials and achieve high academic performance. At the Blah blah blah high school, it is one of the most emphasized areas we are trying to improve. The fact that this unit saw such an uptick in attendance brought me great joy, energy, and inspiration. The students felt the increase in energy, too, as one student told me, "This unit has felt different somehow." I echoed the student's sentiment when I journaled after completing the unit:

> This entire unit has felt so refreshing. It is a reminder of why I teach. Of course, there were hard parts and ways I could improve, but overall, this was an excellent experience. I

loved the energy in the classroom, where student worktimes were sometimes loud and proud, but I would much rather have that than quiet worktime every time. The collaboration and interaction that I saw was extraordinary.

Another way I collected evidence was through a student survey. At the end of the unit, I asked students to complete an opinion-based survey about their learning. One question asked students, "How much did working with classmates (discussions and group work) help you stay engaged with genomics concepts?" Students responded on a scale of 1-5 (1 = not at all, 5 = very helpful). Over 88% of students reported a 4 or 5 on the scale (fig.3). Overwhelmingly, students perceived their social learning as beneficial. In addition, 76% of students believed hearing different perspectives from their classmates contributed to their learning of genetics. These results helped solidify the idea that not only did students enjoy social learning, but it also helped them stay engaged with the material and deepen their understanding. Thus, the results showed tight alignment with the first core pillar of the Schema Theory.

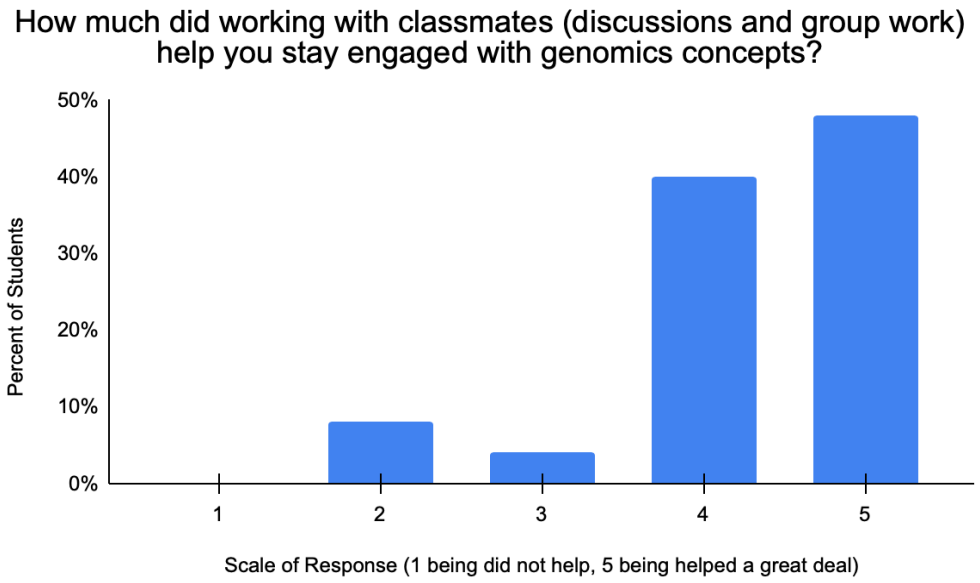

Fig. 3 Graph of Student Survey Responses I

Emotional Engagement

The Second theme that emerged from the data analysis was the increased emotional engagement of students when the content was connected to their identity and personal experience. The theme aligns with one of the core pillars of the Schema Theory, which suggests schema activation and creation are strongly influenced by identity and experience. I included many activities and opportunities for students to connect their experiences and identities to the content throughout the genetics unit. The data showed that students not only participated more fully during these activities but also gained a deeper understanding of the class content.

One way I tied the content to student identity and experience was through the trait survey in lesson two (fig. 1). Students were provided with a list of different heritable traits, such as color blindness, hitchhiker's thumb, free or attached earlobes, eye color, hair texture, etc. For each trait, students were to inspect themselves and others, as needed, to determine whether they held that trait. Then we gathered class data on the traits to see how varied the class's physical features were. The goal of this activity was to introduce students to the concepts of heritable traits and genetics, piquing their interest in the content. The survey's approach is to show students their very physical identity can be tied to these fundamental genetic concepts. Another major aspect of this activity was to show students that no trait makes a person better than another. Throughout the activity, I reiterated the idea that because one student has a specific trait does not make them better in any way; it just makes them different. This aspect of the activity is incredibly important because the majority of the students I serve come from marginalized communities, which have undoubtedly influenced their identities and experiences.

I put extra effort into the trait survey activity, showing each student my own traits to help engage even the most hesitant students. Science content can often feel disconnected from student

experience, and I did not want this incredibly important and relatable unit to fall short of its potential with my students. I felt some initial hesitation heading into the trait survey activity, as its effectiveness relied on full class participation. However, the hesitation quickly melted away; each iteration of the activity was incredible. Not only were students fully engaged in the activity, but many asked important questions , which deepened the lesson's impact and understanding. Students were excited to survey their own traits and learn about the variation in class. Multiple students were eager to ask their friends which traits they had and compare them. The university supervisor tasked with observing my lessons was present for the trait survey and commented on its effectiveness as an introductory activity for the students. In fact, 56% of the students responded with the trait survey when asked which activity from the unit was the most engaging (fig. 4). Additionally, I noted 100% student engagement during this activity during lesson two, which was a large increase from previous lessons.

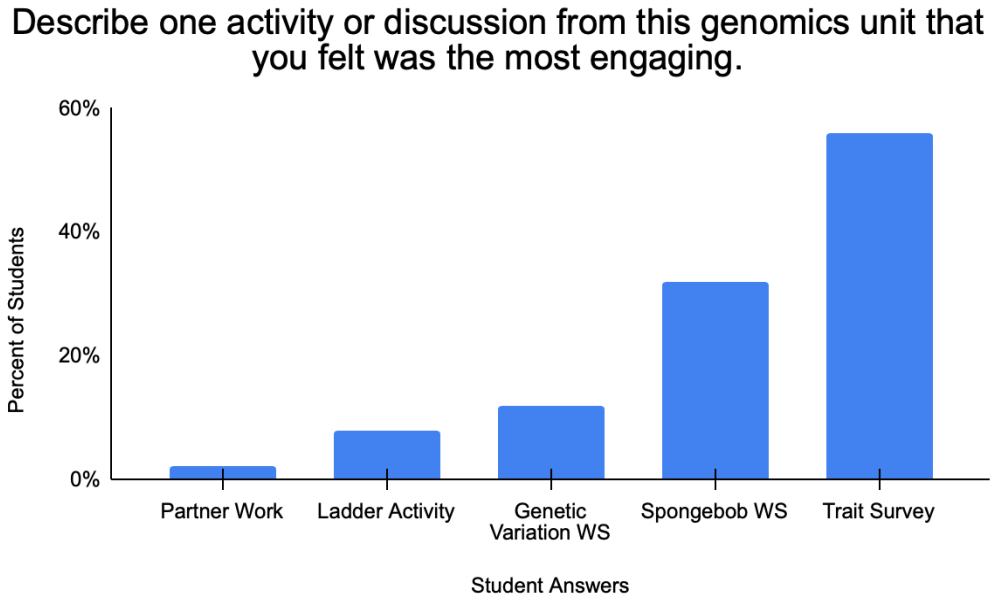

Figure 4. Graph of Student Survey Responses II

Another way I intentionally tried to connect the content to student experience and identity was through short-answer questions in the genetic variation assignment from lessons two and three (fig. 1). Here, students are tasked with developing explanations for the incredible diversity we see among the humans around us. One question in particular seemed to stand out to my students. The question centered on genetic variation within families, specifically siblings. The students I serve have repeatedly shared with me how close they are with their families and how important family dynamics are in their lives. Many of my students watch their younger siblings and cousins after school or on weekends. It is apparent just how important family and siblings are to my students, which is why this question encountered so much effort and detail from students. I could tell from student responses that the question resonated with them in a way other questions do not. Even students who normally do not fully attempt short-answer questions turned in lengthy and correct answers, which I attribute to the fact that this question connects their experience and identity to the content at hand.

Later in the unit, during lesson five (fig. 1), students completed an activity sheet on punnet squares and dominant/recessive inheritance. The activity sheet featured the traits and characteristics of a plethora of characters from the *SpongeBob SquarePants* cartoon. I thought the students would find the worksheet childish, but I was wrong. Students were all in on the *SpongeBob* worksheet. Again, my implementation strategy was to present it with energy and enthusiasm, which was well met by my students. The activity began with guided practice to reinforce the foundations of genetics concepts, including labeling dominant and recessive alleles, identifying homozygous and heterozygous genotypes, and assigning the correct phenotypes to each genotype. The use of visuals and familiarity with the characters and their obvious physical traits seemed quite effective at supporting a wide range of student needs.

With these supports in place, students were able not only to access the material but also to connect with it. Evidence of this was shown during student work time on the *SpongeBob work*sheet: I circulated around the room and noted 90-95% of students consistently engaged with the activity. One student even asked me after the class finished if we could "have more SpongeBob science examples." The impact showed with the student survey, as 32% of students identified the SpongeBob activity as the most engaging activity of the unit (fig. 4). A moment I captured on a clipboard shows the increase in emotional engagement; I heard a student express to a friend their excitement about working with their favorite cartoon characters. I saw my students' interest soar when they felt a connection to the material beyond mere textbook examples. The journal entry preceding the lesson reflects this view, as I wrote:

> They seriously ROCKED it! I tried to find a worksheet that could be equally relatable to their own knowledge, and also informative enough to help them learn. I think there were bonus points for it being SpongeBob-themed as well, because they seemed to LOVE that aspect. I could hear so many great conversations going on, directly relating to their worksheets and their hilarious knowledge of SpongeBob and Patrick.

Students also completed the student survey at the end of the unit, which provided additional insight into their levels of emotional engagement. The majority of students (60%) reported that their ideas and personal experiences were valued during the unit. In addition, no students indicated that their contributions or experiences were ignored; however, 40% selected a neutral response. Another question asked students how much their experiences (family traits, culture, community, or interests) helped them make sense of genetics concepts. Similar results were attained, as 62% of students reported a positive relationship between their personal experiences and their learning, while the remaining 38% selected a neutral response. While these

numbers point to the generality of the theme presented in this section, the students' short-answer responses cement these findings. When asked which activity was the most engaging in the unit, 78% of students chose the *SpongeBob* worksheet or the trait survey (fig. 4). While the previous questions did not yield the most concrete results, the students' short-answer responses proved the most telling in my data analysis. Students did not have options to choose from, and selected these activities of their own accord. What this showed me was that students genuinely felt meaning in these activities, which was why they felt they were the most engaging. One student even told me they had a deep conversation with their parents and grandparents about their ancestry and shared family traits as a result of the trait survey activity. All of this data suggests students were able to connect learning to their own experiences and identities, and their emotional engagement increased in meaningful ways.

Cognitive Engagement

The third and final theme that emerged from the data analysis was students' increased cognitive engagement throughout the unit. This theme aligns with one of the core pillars of the Schema Theory, which suggests that students' dynamic schemas are constantly activated, reconstructed, and combined to create fluid understandings of the world around them. I found the third pillar of the Schema Theory was the hardest to intentionally implement and guide student learning during this unit. However, after much effort and collaboration between my clinical teacher and me, we were able to properly align our unit plans with this central pillar. Student Schema is constantly in flux, which the classroom teacher can use to support their students. To tightly align our construction to this pillar, I focused on student revision, misconceptions, and growth.

In the unit plan, one major activity was entirely focused on student revision. In lesson three, students participated in a ladder activity with three "rungs" containing questions on dominant/recessive inheritance patterns and basic Punnett square concepts. Each rung had to be checked off (by me) before the student could move on to the next, climbing the "ladder." If students did not have a fully completed or correct rung, I would circle the question(s) that needed revision. If a student returned to my check-off station with continued misconceptions, I would take time to guide their revisions. Here, students were intentionally given no feedback (on their first visit) so they could use their notes and resources to revise their own work. Here, students are actively reshaping their own schemas through revising their own work. When these misconceptions persisted, I would step in to facilitate further revisions, often asking guiding questions such as "how do we know which allele is dominant?" or "What is the difference between genotype and phenotype?" When students realized their misconceptions and intentionally remedied their mistakes, they reconstructed their existing schema. Students also reconstructed their schema through collaborative learning, which was encouraged while they worked on each ladder rung. I noted on my clipboard that student collaboration during this activity was very high, especially given the group work during the activity was completely optional. While collaborating, their Schemas undoubtedly underwent reconstruction, which was the goal of the activity.

The ladder activity was incredibly successful due to the instructional strategies implemented and the Schema Theory's guiding principles. I made quick observational notes on class engagement while students worked on the activity, which showed that 100% of the class was engaged and participating. Coincidentally, I was videotaping this lesson, and I noticed that each time a student reached a new rung, they had a triumphant look on their face, ready to tackle

the next challenge. During this activity, I could see and feel the increase in confidence of every one of my students, which was supported by the low-stakes, revision-centered activity we were doing. Not only that, but I could see evidence of the change of student thought in real time, which really tuned me in to the strength of these revision-based activities, an important aspect of fluid schema formation. I believe the ladder activity was a resounding success, which was mentioned in my journal after the lesson was taught:

> Each class was a resounding success today, one of those days that let you know you chose the right profession. These students have so much knowledge in them already, and they are so adept at using social interactions to further their learning. It makes me realize just how lucky I am to be able to teach these students and learn as much from them as they are learning from me. Not to mention, the ladder activity was a SUCCESS.

Student cognitive engagement remained high for the unit, supported by countless opportunities and activities that encouraged schema reconstruction and creation. Evidence of this was found in their performance on the summative quiz. At the end of the unit, students were required to take a quiz to measure their learning. The quiz was designed to be shorter than a summative exam, with opportunities for students to elaborate on their knowledge. The results show growth in student performance when compared to previous assessments. According to the analysis, 53% of students scored in advanced or proficient (A or B respectively), and 23% of students were nearly proficient, which was a grade of a C (fig. 5). Additionally, only one student attained an ‘F’ grade for the quiz (fig. 5). Not only does this show growth for student academic performance, it also shows how much room for improvement there still is, which will be attained through consistent effort and alignment with the core pillars of the Schema Theory.

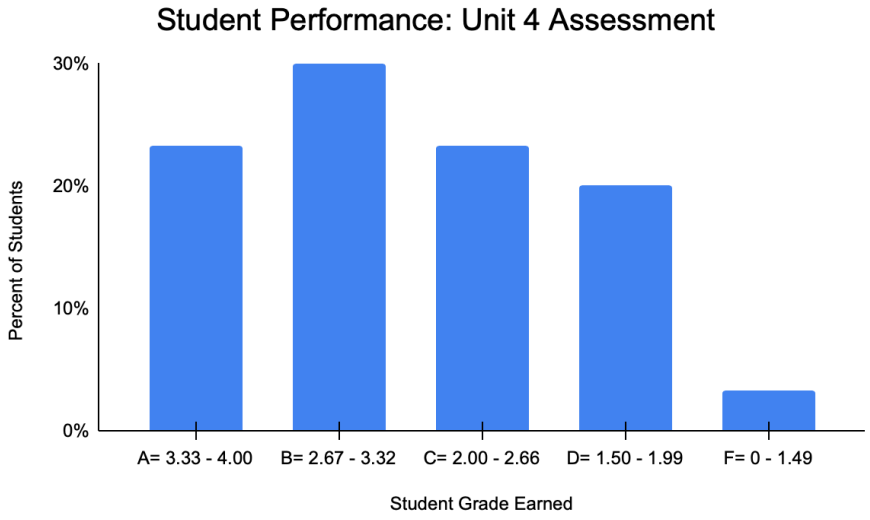

Figure 5. Student Quiz Scores

Another aspect of this quiz that provided further evidence of students' cognitive engagement is the retake policy. Students can retake quizzes, exams, assignments, and other graded material to demonstrate they have gained a deeper understanding of the content. For this quiz specifically, four students decided to retake the exam. Three of these students had previously earned a ‘D’ grade, and one had earned a ‘C’ grade. All four students improved their previous scores and earned a ‘B’ grade, suggesting they became proficient with the content. Not only does this highlight the sustained cognitive engagement of these students, but it also shows just how much their schema changed. These four students not only interacted with the materials outside the classroom, but in ways that allowed them to reconstruct and revise their Schema regarding these genetic concepts. After factoring in their newly earned grades, 67% of students were proficient or advanced in the unit's genetics concepts, an increase of 14%. Additionally, the percentage of students who were not proficient (D grade) dropped from 20% to 10% after student retakes.

As shown in the previous paragraph, student schemas were constantly reconstructed throughout the unit through participation in social learning processes and the meaningful ways in which the content was connected to their identity and experiences. Ultimately, students were able to engage with the material for the first time and create new Schemas, and as the unit progressed, they reshaped how they engaged with the material and reconstructed their existing schema. When asked how much their knowledge of genetics changed throughout the unit, 68% of students believed it changed a great deal. Not only was I able to witness the fluidity of their knowledge and the way they interacted with the learning process, but they were able to identify this as well. According to the student survey, 72% of students reported being engaged or highly engaged throughout the unit. Additionally, no students reported disengagement from their learning during the unit, while the remaining 28% offered a neutral response. The quantity and variety of learning opportunities throughout the unit played a significant role in the high levels of student engagement.

Chapter 5. Discussion, Limitations, and Conclusion

I centered my research on the Schema Theory (McVee et al., 2005) and its core pillars. My research supported previous findings and confirmed the effectiveness of multiple different instructional strategies in increasing student engagement. Firstly, Quinlan (2019) found science activities that activated students' prior learned knowledge activated higher-order thinking and increased engagement during specific aspects of the activities. My research supported this finding as activities that activated students' prior knowledge saw high levels of student engagement. For example, one of the more successful classroom activities in my research was the SpongeBob worksheet, which allowed students to engage with science problems in a more familiar fashion. Students may not feel a connection to the content specifically, however, delivering the content through a prior connection can help students access it. Although my research supports major aspects of Quinlan's findings, it did not incorporate interactive multimedia to the same degree as the previous study. I focused my instruction on social collaboration, which I have found to be most effective when activities and assignments are on paper. However, incorporating multimedia technology using the guiding framework of the Schema Theory could be implemented in future research on student engagement in a high school science classroom.

Meylani (2024) suggested that the Schema Theory could be beneficially applied to more areas than strictly academic performance. The use of Schema Theory in an educational setting can not only increase academic performance but also aid in cross-cultural communication. My research supports these findings, with specific examples especially prevalent in the area of academic performance. My action research found that student assessment performance increased during the unit specifically designed with Schema Theory in mind. Student engagement levels

remained consistent and focused throughout the unit, resulting in more proficient assessment performance. There is also evidence of increased cross-cultural communication within the classroom due to the application of the Schema Theory. When students engaged in the trait survey, much of the dialogue focused not only on their physical traits but also on where they were from, both physically and culturally. Students of all cultures participated in the activity and discussed the intricacies of genetic variety within the human population, supporting Meylani's suggestion. Students also increased participation in structured social learning activities over the course of the unit. Students began to feel more comfortable with each opportunity, building momentum over the course of the unit. As students grow in confidence to speak, interact, and learn with each other, their engagement with the class as a whole increases, which could have led to the increased test scores and engagement levels seen in the study.

Ensam, B.K. (2025) explored the use of Schema Theory in English as a Second Language (ESL) instruction, specifically through pre-reading activities. Although their synthesis did not formally examine effects on student engagement, they nonetheless provided important suggestions. The researchers suggest pre-reading strategies that utilize Schema Theory not only increase motivation among ESL students but also improve reading comprehension. The authors suggest that not enough teachers are emphasizing the schemata students already possess, which can decrease reading comprehension, especially among ESL students. My findings support the author's suggestion, as the ESL students in my classroom became more engaged with the scientific concepts when their prior knowledge was accessed. Specifically, the lesson plans included sections of front-loaded vocabulary to support students' comprehension of scientific readings. The trait survey and spongebob worksheet activities also served to assess student prior knowledge, and each of these activities were among the most successful of the unit. Students

engaged with the content because their prior knowledge was used as an asset, which allowed students, especially emergent bilinguals, to effectively access the content. Although more pre-reading strategies were not implemented in my research, students demonstrated increased reading comprehension. Student assessment scores remained proficient, even when faced with a difficult CER question, indicating increased comprehension.

One aspect of current research I deviated considerably from is the use of a Schema Theory-based flipped classroom approach. Yu (2019) found that a flipped classroom assisted by technology (FCAT) model, grounded in Schema Theory, was much more effective at promoting schema assimilation and adaptation than non-flipped classroom models. The author found the FCAT model not only increased schema formation but also increased higher-order thinking skills. I was unable to adapt this research to my action research project for a multitude of reasons, which prevented me from determining support for or against it. There are considerable concerns for the equitable implementation of the FCAT model. Specifically for the students I serve, many would not be able to participate in this classroom model, as they often work jobs, babysit younger siblings or family members, or participate in extracurricular activities. Many families may not have effective access to the internet, the proper technology, or the tech support needed to equitably implement this model of education. For these reasons, I did not implement this aspect of current research into my action research project.

Liu (2025) found that the Schema Theory greatly assisted students' learning of Chinese poetry by using mnemonic devices. The study suggests schemas help students establish meaningful connections between new material and existing knowledge. By connecting new material to prior knowledge, students were able to understand and retain it more effectively. My research did not implement structured mnemonic strategies for students, which was a focus of

this study. However, as mentioned previously, the activities that drew on prior student knowledge were the most engaging and enabled students to learn the new scientific material more deeply. Students had more *connections* to the content, which allowed students to construct meaning in regards to the new material. Liu highlighted the importance of accessing prior student knowledge not only to increase student learning but also to improve retention. In my study, I observed an increase in student information retention, as evidenced by summative assessment performance scores. Students were able to connect with the materials on a deeper level by connecting their lived experiences to the content in the classroom, and that strong connection promoted long term learning, rather than rote memorization. Additionally, the majority of students identified the most engaging activities as those that activated their prior knowledge. All of this, in combination, supports Liu's work, even if students did not use specific mnemonic devices. Future research could view the effectiveness of mnemonic strategies, guided by the Schema Theory framework, in secondary science classrooms.

Limitations

One theoretical limitation of the study was that the science department uses a predetermined curriculum, which did not allow for aligning every instructional choice with the three core pillars of the Schema Theory proposed by McVee et al. (2005). Each material and lesson plan was adapted to align with the core pillars as much as possible, but complete alignment was not truly attainable. Because of this, I was not able to fully incorporate the third pillar, specifically, which states that schema creation and activation are a fluid process, into my instruction. I was able to center one activity on this pillar, but was unable to concentrate more instruction in alignment. Assessment data were also gathered as evidence of student schema formation; however, further analysis was not possible due to the lack of activities and

instructional decisions focused on the third pillar. While my research generally aligns with the core pillars identified by McVee et al. (2005), future research would benefit from the development and implementation of a focused curriculum, fully aligned with Schema Theory. This approach would ensure each pillar of the Schema Theory was adequately investigated with respect to student engagement in the classroom.

Methodological limitations are found in this study. First, the study's duration was not ideal, with most data collected during a two-week unit. Because the study did not span the entire school year, I was unable to have a ‘control’ unit to compare my findings with. Had I started the study at the start of the school year, the findings would have been more comprehensive, and the analysis would have been more extensive. Due to the study's time constraints, the collected data were limited in scope and did not detail long-term student engagement. Furthermore, in-depth student interviews could not be conducted due to logistical constraints in student teaching, which could have provided greater depth to the subsequent findings and analysis. Action research projects are tools for deep self-reflection; however, student voice could arguably play a larger role in each participating teacher’s reflection. A longer, more extensive study would proffer more robust results, allowing researchers to compare student engagement throughout an entire semester or school year.

There were also a few practical limitations present in my study. First and foremost, because of the curriculum, the materials and lesson plans are not widely available to teachers for implementation in their own classrooms. To combat this, I attempted to make instructional choices and strategies aligned with the Schema Theory, but other teachers may not have the freedom within their curriculum or PLC to adapt and alter their materials. In addition, not all of the pedagogical approaches used in this research would be applicable to all classrooms. Teachers

undoubtedly serve students with varying backgrounds and abilities, unlike the students in this study. The instructional strategies implemented within this research project do help a wide range of students, but were specifically intended to serve my students, not the general population. With some adaptation, other teachers could use this research to inform their own practices, but they would not be able to effectively implement it step by step into their own classrooms. Future research should focus on implementing the core pillars of the Schema Theory across diverse schools, settings, and demographics to assess its effectiveness in increasing student engagement.

Conclusion

The goal of this action research project was to increase student engagement and foster deeper connections between students and the content in a high school biology classroom by applying schema theory. The research provided critical insight into the effectiveness of schema theory-based instruction on student engagement. Centering instructional activities and strategies around the core pillars of the Schema Theory can significantly increase student engagement in the classroom. The use of structured social learning, connection to prior student knowledge, and revision-based activities helped students access and engage with the content on deeper levels, more often. Although my research has limitations, namely in the length and scope, it provides a foundation for future research, especially in science-specific classrooms. This study inspired me to continually reflect, refine, and adapt my teaching practices to best meet my students' needs. To do this, I will create a classroom that highlights student experience, celebrates diverse perspectives, and utilizes these through social collaboration. As I, and other science educators, continue to address challenges related to student engagement, Schema Theory provides a practical and meaningful approach to science education that can positively impact student learning.

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