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Developing A Science Curriculum With The Focus On Belonging

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DEVELOPING A SCIENCE CURRICULUM WITH THE FOCUS ON BELONGING

by

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CHAPTER ONE

Introduction

I spent my first year of teaching invested in the exploration of freedom and how it impacted students' perceptions of themselves, and their place in school. The team I worked alongside was constantly challenging traditional ideas about schooling, most notably the idea that if a student is to leave a classroom it must be transactional, and never through free will. Any thought that began with "Students need…" was met with the basic question of "why?". It didn't matter if it was 'structure', 'discipline', 'homework', or anything else. Our teaching team spent our time mulling over what we knew of school and what it looks like to challenge those ideas. As we dug deeper into our thoughts on schooling, we began to see themes.

I remember being younger and sitting in school, just waiting for us to do a project on animals, or the weather. Those were the topics I felt more passionate about, and instead I had to wait, all the while trudging through years of classes and the boring units about cellular structures and types of rocks. I recognize that my ability to feign interest in uninteresting topics was not the same for all, and many people just quit paying attention all together. As a teacher I have to assume the latter is the norm, and interest in what is being taught is my responsibility. Giving students one 3 week project where they choose their topic is not good enough, instead it needs to be a year long focus. So, *how do educators develop a sense of belonging within a science curriculum?*

Students want to learn, they want to obtain new information, they want to be talked to as if their teachers know for certain that they are capable of learning the most complex ideas. As a 6th grade teacher I know that I am not teaching a collegiate physics

class; I do need to see them as their future selves though. What skills would be beneficial to them? What understandings provide a solid foundation for them to build on as they continue through their education? They will not advance if they take everything at face value and assume all information to be fact only because they read it online or heard it from an adult. The development of questioning and criticality becomes the jumping off point.

Condon & Wichowsky (2018) reflected on the former teachings of John Dewey who persistently argued that science is not facts to be memorized, instead it is a way of thinking and a way in which we are to approach learning. "Dewey sought to equip students with the analytic skills he deemed essential to a robust and engaged citizenry" (p.197).

Students need to constantly be questioning, and instead of directing those questions at adults and seeing us as all knowing, we have to teach them to trust themselves in their capability to find the answer as will be expected of them in the future. Will they need guidance? Yes. Will they need correction and redirection? Definitely. However, they will also need trust and support in their frustration as it feels like every new question they ask might not yet have an answer, or it might prove their ideas wrong. How do we make failure enticing and motivational as opposed to defeating and overwhelming? The students must drive their learning, the curiosity must exist within them and not be bestowed by their teacher.

How'd We Get Here?

The exploration of freedom during my first year looked a lot like having young people move from room to room when they wanted and needed to. We led with trust that

what they had to have in that moment is what they would seek out, and then return to where they knew they needed to be.

This approach was not met with open arms by all at the school, there was a pushback about students having too much freedom. Our ability to teach is usually judged by our capacity to maintain order in our rooms. As our team was not actively attempting to reign in the bodies of young people, our teaching was heavily criticized. It was believed that allowing students to move as they please was not preparing them for real life; a point to which I disagree. As I look at all of my experiences in higher education and in work environments, I have always had the freedom to move around; I just need to also be aware of the consequences.

As we progressed through the year it became apparent that with the freedom to move as they pleased, students would find a comfortable spot. A place that was safe, a place that was interesting, a place where they felt a sense of belonging, and this is where their greatest work would happen.

The priority throughout the year of teaching was the development of relationships. It remained the priority, yet after the first two months their searching for connectedness began to slow down as students found the places and people with whom they had comfort and connection. As soon as students had a place to go when they felt stressed or on edge their focus shifted to curriculum and content.

So then my own focus shifted to how to develop a sense of belonging within a science curriculum. A teacher can only do so many icebreakers and "Getting to know you" activities before students begin to revolt, and crave learning. However, what they crave is not standards and these ideas that adults have deemed 'important'. They want to

learn what they are passionate about, they want to see themselves, and they want their burning questions answered. How is this made? How does this work? Why do these make that sound? Their questions are endless, and intricate, and rarely does one student's question overlap with another. Students want their curriculum to be exciting, they want to be in the driver's seat. They want to ask the first question, and the second, and the third. They are ultimately weaving their way through their education, on a map that is entirely their own.

Student centered learning is an abundance of work, it is time and energy that teachers are notoriously known to not be compensated. However, with the complete student driven curriculum it leaves space for teachers to not spend hours lesson planning. If the students focus and develop their own questions that they proceed to research, and then teach to their classmates, then our time can be used to meet students where they are and where they want to go, in a collectively responsible way. We can adapt and modify to every student's needs as the projects progress, and needs are noticed. We can hear excitement and connect students to extracurricular activities and community organizations that will certainly peak their interest. We can focus on our relationships with our students and help to build them as whole people, as opposed to just investing in one small block of content. Students do not want your content, they want your attention.

When the conversation turns to content, the argument to this approach will stem from how students will not be developing the skills that are required for their grade level. Policy makers will say that 6th grade is meant for Earth Science, so how will you teach those standards if students are not interested in researching plate tectonics and climate change? That question stands on the shoulders of this belief that only direct instruction

surrounding those topics will lead to knowledge gained. However, what I have noticed in the classroom is that when true curiosity is the driving force, that retention is much higher. The argument is that if I can teach them to research and inquire properly, then they can adequately learn about earth science, or anything, whenever they need to.

Students need to learn failure, how to state their points, give reasoning, and learn that things are not always going to go their way as their questions return with results they had not anticipated. They also need to have a way to participate in hands-on research as they practice lab safety, write-ups, procedures, and documenting results.

Families might not see the benefit of such a loose curriculum initially, not recognizing the teaching style as it will feel distinctly different from what they experienced in their K-12 schooling. As the semester progresses there is a hope that students will begin sharing their approaches to questioning and researching with their families. Families may notice them displaying a curiosity during conversation instead of just regurgitating information they learned during the day. They can also share what they are learning through their own lens, how they take what they understand and put it in their own words. This is not only an important piece for proving the retention of knowledge, it's also important practice for those developing their writing, and language skills.

The development of those skills is the grounding point when a curriculum that steers so far from traditional is discussed by colleagues. Their challenges with our team's approach to relinquishing the reins of control were continuous conversations, so it is expected that a freedom within curriculum will garner the same response. This discussion, much like the ones with policy makers, will have to be rooted in the benefits

of inquiry based learning. Inquiry into what a student loves creates interest, and interest is a challenging thing to keep for an abundance of students. A student without interest is a student without motivation to remain in a space or even come to school in the first place. Our curriculum must be a driving force that tells a student "this place is for you", and how much clearer can I make that then by letting them drive their own learning?

"If they are driving their own learning, then how will you grade them?" is a question that I imagine will be brought to me. How do you maintain equity if all of the approaches are different? And the answer is, through narratives and one-on-one meetings, as opposed to letter grades. Letter grades might be motivating for some students, and completely derailing for others. Again, I have to assume the latter for all because even if the majority of students are motivated by the use of letter grades, that is entirely outweighed when even one student feels defeated. The evaluation of a student's work should be another tool used for building confidence as the students learn new skills. The evaluation will be done through asking questions about how they arrived at certain places in their research. and asking for clarification. This allows them to reflect on what worked and what did not, and how they might be able to explain themselves better. I found this approach incredibly beneficial in my room during the past year, and intend to continue using it throughout this curriculum development.

The semester will be involved and exhausting, and at the end it will result in students who are excited to learn and have found out how to craft their own learning to best serve themselves for the future; a group of young people that have confidence in questioning statements from adults and peers, and that still have a desire to understand "why?".

Summary

The months in my first year teaching were spent researching the importance of helping students find themselves. This aided in the understanding that not only do they need that support socially, they also need it academically. Students need to find their best way of learning and retaining information, so they can move forward understanding that piece of themselves. Students need a course that will allow them to ask, experiment, and continuously research without the oversight of a teacher showing them one way and declaring any other approach as wrong. Though this might be challenging to prove through discussion with policy makers, families, and colleagues, I hope the execution of the project will result in changed minds.

In the following chapters the reasonings and approaches to this type of approach are laid out. Chapter 2 is a review of literature supporting the need for creating space for students to self-identify their interests and to create a feeling of connection and ownership to what they are learning. Chapter 3 describes the project and how the curriculum created allows for students to create their own direction with their research. The chapter also describes the timeline for the project throughout the school year. Finally, Chapter 4 provides a reflection on the development of the project. The reflection discusses how the project ties back into the reviewed literature, and also highlights any limitations, policy changes, or benefits to the profession that might come along with the implementation of the curriculum.

CHAPTER TWO

Review of Literature

Chapter Overview

The development of belonging for students within the classroom and the school as a whole only aids in the success of all students. Creating belonging within social spaces is one component, and then creating belonging within curriculums might feel to be entirely different. Delving into the question of *how do educators develop a sense of belonging within a science curriculum?* it becomes understood that the creation of belonging socially is directly tied to how belonging within the curriculum is also developed.

Belonging needs to be understood as different from equality, equity, or acceptance, in that it is the culmination of those components. It is accomplished when students feel seen as an entire person, and feel that the expectations and support of them are not only the same as everyone around them, they are given by everyone around them. Belonging is felt within each student, and that feeling is provided through a school culture that recognizes the differences within its walls, a school culture that helps everyone discover place and purpose for their true selves.

The place and purpose for all students are uncovered through relationship building and curriculums that reflect their importance back to them. Curriculum development tends to fall to teachers; however, relationship building moves outside the classroom to all school staff, and peers. Not every relationship is going to be a memorable and lifelong connection; however, individuals responsible for the well being of students need to approach every new relationship as if it might be. These relationships

give an opportunity to truly know a student, and for connections within and outside of school to be made. These relationships also drive curriculum in knowing that students' educators are able to plan and prepare lessons that support the unseen pieces of those in their classrooms, and give space to students to comfortably name what they are not seeing. Allowing for students to name what they are not seeing means there is no hierarchy of power, and therefore no power struggle. A student making a request and asking for a change to better reflect their experiences in the classroom is not labeled as insubordination by educators. Instead the conversation with the student needs to be used as a point of self-reflection for teachers as to how they can help students feel that they are a part of the process of curriculum development.

An Understanding of Belonging

Belonging is a need for an individual to feel connected and included in the decisions and actions around them. This feeling when acquired by students within schools has been connected to self motivated learning and an interest in their education (Goodenow, 1993). This section of the paper will be focused on defining belonging and how it is beneficial to creating positive learning environments for students. The second section will be highlighting the problems with teacher mentalities that only focus on curriculum, and the dehumanizing nature of traditional schooling.

Defining Belonging

Belonging within a school is a connectedness to the interpersonal pieces that are in place for students. Belonging comes when students feel heard, seen, valued, and understood within their day by the people around them (Chhuon & Wallace, 2014).

Those people can be teachers, support staff, peers, and anyone else who interacts with the student during the day (Goodenow & Grady, 1993).

The work of Goodenow and Grady (1993) was centered around researching the importance of belonging and its link to friendships, and how those impacted academic motivation. The researchers used this study to begin to understand how the motivation to do well in the classroom had little to do with what a student was learning, and instead hinged on if the student felt they belonged where they were learning. The study described belonging as "... the extent to which they feel personally accepted, respected, included, and supported by others - especially teachers and other adults…" (p. 61). They had students fill out a questionnaire at two separate middle schools, and because the results were so similar between grades and schools, they combined results. Questionnaires were given to all participants and focused on four measurements: School belonging, friends' values, academic motivation, and effort/persistence in school.

The students' answers yielded important results in regards to belonging and how that impacts their motivation. Goodenow & Grady found that " If students believe that others at school are rooting for them, are on their side and willing to help them if necessary, they have reason to believe that they have the resources necessary to be successful." (p. 68). This shows that through the construction of solid relationships, students not only see school as a place to exist, they see it as a place important to growth and success.

Those relationships must entail understanding of the entire student and who they are as a person, their experiences, and where they come from. Knowing a student at this level will require more than a periodic surface level discussion about the weekend.

Those types of basic interactions offer the opposite feelings for students, feelings of detachment and that there is no time or space for them to be known (Chhuon & Wallace, 2014). Their research centered around acquiring the perspectives of high school aged youth through focus groups across multiple states, and different makeups of students in regards to socio economic status, gender, and racial identity. The focus groups asked questions that had to do with the students' perspective on teachers, what makes for effective teachers, and what helps students feel known and seen.

Results were able to be categorized into three main categories, the first being that teachers need to have passion and interest in their career because students see through a teacher that is only their to teach and not make connections, which makes any interaction feel like a "depersonalized act" (p. 387). The second, and alternative perspective, is that students also see teachers as setting low expectations as far as their academic ability, when teachers come across as wanting to be friends and never being a teacher. This ties together with the Goodenow & Grady article as a removal of resources, making students see themselves as less than capable. The third point Chhuon and Wallace (2014) make is that if students do not feel seen or recognized in their existence, it is assumed that any lack of effort is associated with an apathetic approach to school, as opposed to impacts brought on by extraneous circumstances.

It is understood that it is an impossible feat for every teacher to know every student at such a deep level, and that is why the creation of belonging is connected to the school culture, and not just one person or classroom. If all people within the school have adopted an approach that understands that knowing the student is more important than knowing the content, the students will find their space and their people (Goodenow &

Grady, 1993). Ryan and Stiller (1991) emphasize that programs and content devoted to creating more connection between students and staff are not just filler and fluff, they are intrinsic to fostering educational achievement within schools.

Traditional Schooling and the Loss of Belonging

Within schools we have created a system of learning that makes students feel that if they do not succeed in the form of grades they are a problem (Chhuon & Wallace, 2014). The student is no longer a person, and instead is a wrong that has to be corrected (Ladson-Billings, 2006). There is a documented drop in the strength of teacher and student relationships when students move from elementary to secondary education (Goodenow, 1993). Teachers begin to see teaching as the development of young people in only the realm of academia. Students cease to be young people, and now must be prepared for the 'real world'; in the eyes of educators they have become adults and must be treated as such (Chhuon & Wallace, 2014).

In the switch to secondary, students lose show-and-tell, recess, and the ability to learn through trial and error. This transition marks the removal of components of the school day that Yuval-Davis (2006) referred to as important pieces in the "construction of self and identity" (p. 203). Show-and-tell allows students to share pieces of themselves that they viewed as important and asks the rest of their peers to listen and ask questions. Recess is an active space where students who learn through movement and performing are celebrated and find their space. Learning through trial-and-error helps develop young minds to see that there can be multiple ways to arrive at the same conclusion.

Even before students leave elementary education, schooling shapes minds to focus on procedural learning, right and the wrong, and an expectation that behavior and

attitudes will develop in one way. Students who learn differently, or prefer to arrive at the same results in an alternative way, are excluded and othered instead of embraced (Vickery, 2017). That development of positive self-identity is now marred due to a student's inability to understand a certain procedure or accept their teacher's policing of bathroom privileges as just. This student's way of thinking now no longer belongs in the school, as educators actively try to force this way of thinking to change. The modes that educators and school staff use to change a student's way of thinking or behaving is through failing grades or discipline. The lack of flexibility that teachers tend to have in regard to grades and discipline gives students two choices, both of which end in a loss of belonging. The first choice is that students accept the label of failure or being a 'bad kid' believing that who they are needs to be corrected. The other option is assimilation, resulting in an entire loss of themselves to avoid discipline or failure (Vickery, 2017). This assimilation is more prevalent for students of color and creates a continuation of oppressive practices that maintain or increase the achievement gap, as the students' "... perspectives and experiences are consistently minimized." (Leonardo & Porter, 2014, p. 140).   Belonging flourishes in a space that allows for understanding and compromise, not one that is rigid with a 'one size fits all' mentality.

The cross-cultural study of Smith, Walker, Chen & Hong (2018) found a link that showed academic interest improved with a holistic approach to young people, and that finding was mirrored in Chhuon & Wallace's research. The Smith et.al. study took place across six countries including the United States where they had fourth grade students complete a questionnaire that centered around interest in science and feelings of belonging at school. The results were incredibly similar across all six countries, where it

showed that a student that feels cared for and understood is going to engage in the classroom and within the school as a whole. This research also discussed the importance of bringing in parent and community engagement so that learning can be supported and encouraged outside of school. If there is a reason to be present and there are people who help students see their worth, a student will more likely want to be present in that space as opposed to detaching consistently (Chhuon & Wallace, 2014).

One philosophy as to why belonging has gone by the wayside in traditional education is raised by Keating (2005), where they highlight the ideals of United States culture. The celebration of individualism and people making it on their own or within their small communities is so highly regarded that the loss of full inclusion is happening outside of the school walls as well. Keating goes on to say that an emphasis on coalition building aids in the focus of inclusion and support for everyone.

School staff can not expect young people to want to be a part of something that they have actively been excluded in creating. Within the literature it is acknowledged time and time again that a student who feels no connection between who they are and where they are is not going to invest time or energy into the space. Inclusivity in the classroom and support by staff and peers of their whole student must be experienced within the school to not only encourage attendance and improve academic proficiency, it must also exist to support the development of the entire student as they grow throughout their schooling.

The Development of Belonging through Relationship Building

Relationship building is a known fundamental piece of teaching when it comes to being an effective educator. This section will focus on the importance of creating safety

in the classroom through the development of individual relationships with students and how their interactions with educators . The second section will create understanding around the need for the creation of belonging to be the focus throughout the entire school. One classroom where students feel welcome is not going to be sufficient in helping students feel that school is a place for them to come and thrive. The entire school culture must adopt the creation of belonging as their goal, to make sure they are fitting the needs of every student who walks through the door.

Individual Relationships

Research consistently shows that belonging is directly related to the viewpoints that students have of their teachers, and how they believe their teachers view them. Gatambide-Fernandez (2012) explains how there must be a coexistence within life in order for people to be defined. He elaborates on the ideas of Nancy (2000) that a teacher does not exist without students, and visa versa. The ways in which people define themselves are directly linked to others, and within education the ways in which students feel they are defined by their teachers can make or break feelings of belonging. Goodenow and Grady (1993) emphasize the importance of students feeling like their teacher is "for" them. This might mean that teachers learn basic phrases in the home language of students to support and encourage them, and teachers can also educate themselves and create spaces of inclusion of students' culture. This celebration of culture within the classroom builds respect necessary for belonging, and encourages participation in the classroom as well (Cruz, Manchanda, Firestone, & Rodl, 2019). This show of respect means their teachers see them as a person who deserves respect without the use

of the transactional mindset that educators must feel respected before they give it back to the student.

Teachers being "for" their students also means seeing them as being capable of understanding challenging concepts academically and socially (Zosel, 2018). Students want to feel that their presence is an integral part of the school day and that when they are absent they are missed and when present they feel welcomed.

School Culture

The feeling of belonging must not stop at the doorway to one classroom, it must extend throughout the whole building. Students must feel welcome and appreciated within the walls of the entire school, for it is when they do not feel their value reflected back to them that both social and academic interest become lost (Goodenow & Grady, 1993).

The focus on an entire school culture as opposed to individual classrooms shares the responsibility between all school staff, and not just upfront educators. Haney, Thomas, and Vaughn (2011) talk about the development of belonging requiring a step back from the immediate and traditional focus of simply teaching to the standards for yearly test grades. Instead, teachers and administrators must be flexible in their approach and capable of adapting at a moment's notice. Adaptation can be the changing of a lesson focus to allowing a free day when students are showing signs of burnout or intense frustration. Support from administration is entirely necessary, as teachers can fear losing their jobs if they do not perform the job that is expected of them (Vickery, 2017).

In his work, Milner (2020) references an interview he completed with a teacher of color who taught during the Civil Rights movement. The teacher and his co-workers

were not supported by their white superintendent in educating young people about the murders of innocent people of color at that time. In that denial by the superintendent to acknowledge the experiences of students within the school, suddenly those students see their lives as expendable and not worth referencing. That reaction not only removes their feeling of belonging from school, it removes their feeling of belonging within the entire community. Vickery (2017) discusses the importance of looking past one's self in order to best continue building feelings of belonging and welcome within a space. In reference to Milner's interview, Vickery's stance means the superintendent would acknowledge what the school community needed at that time, instead of only focusing on his belief as a white man.

   As the school culture begins to shift from what adults believe students need to becoming a place of understanding and equal voice, the concept of punishment needs to be addressed. Belonging is tethered to punishment in that the practices tend to "result in student exclusion from learning." (Milner, 2020, p.157). If a student is removed from a space or an entire building, it is hard for a student to believe that their presence is wanted or valued. Haney, Thomas, and Vaughn (2011) researched how that problematic approach to punishment can be resolved through the use of restorative practices. However, they say "... a culture of respect, inclusion, and accountability are paramount. But if a perpetrator never feels membership in the school community s/he cannot experience the necessary restorative practice of 'reintegration'..." (p. 76). This means that even if restorative practices are in place, the student must be feeling this sense of belonging well before the practices have to be implemented. These ideas are echoed by Jacobson (2013) as they write about the need for transparency with students during times

of possible discipline as far as the students rights and possible outcomes of actions are concerned. The researcher also discusses the importance of using collaboration between staff and students when formulating any penalties that might be forthcoming.

The construction of strong relationships between educators and young people becomes a motivational tool for academic achievement, becomes a route to curriculum development that is meaningful, and allows for two-way discussion surrounding any disagreements. The understanding and recognition of students who fill the classroom and the school by staff gives space to draw on experiences that students have had, and how those experiences can be integrated into the learning space to create more connection not just to the content, but between all those involved.

Science Curriculum, and the Need for Belonging

An effective science curriculum is rooted in students believing that they are capable of understanding the curriculum and that it directly impacts them. The first section will highlight the need for belonging within a science curriculum, and its link to teacher relationships. The second section will show the need for a curriculum that is student centered. This means that the development of the curriculum should be created and implemented with students, and lessons created must represent all members of the student body. The third section is devoted to the importance of creating connections between the curriculum and the communities that students live in. Students should never have to ask why they are learning a certain topic because their teachers should be making direct connections between the daily life of their students and what is being discussed. The fourth and final section is spent talking about the need for student voice when it comes to curriculum development. Students know what they want to learn, and what feels

important to them, the ability to help create curriculum gives them ownership of their learning.

A Need for Belonging

Much like Goodenow's (1993) research discussed the drop in student and teacher relationships between elementary and secondary education, the study by Smith et. al. (2019) referenced earlier discovered a drop in science interest within that same age range. Smith et. al. (2019) and Chhuon & Wallace (2014) both agree that the focus on belonging is not just a focus that should be made for the positive impact on social and emotional areas of school, but that the focus on belonging has a positive impact on academic interest as well, especially science.

The research of Condon & Wichowsky (2018) highlighted the importance of overlapping fields of study to allow for students to see themselves within their learning. In the study they combined science and civics and it was shown to aid in the development of students' scientific interests. The study asked students to use their real world information regarding consumption of resources, and to research best ways to practice conservation. Conservation was shown through the continued collection of their consumption. Consumption of resources was shared between teams of students, in hopes of aiding students to understand the ability for small changes to make larger differences in their day to day lives. The creation of an interdisciplinary connection with civics allowed for community connection and for students to become civically engaged. Civic engagement allows for students to perform inquiry based science studies within the communities that they live in, which helps to make science feel more relatable to everyone in the classroom and that it is directly linked to a place of belonging.

The feelings of belonging developed through the combination of civic engagement and inquiry based science approaches help students see the positive that they can do with science in their community and also allow them to feel a sense of belonging to the scientific community as active participants (Williams, Brule, Kelley & Skinner, 2018). The research of Williams et. al. was focused on using community gardens as a year long hands on curriculum for students to actively engage in their science class. The lessons allowed for students to "experience different ways of learning science" (p. 38) to help them see that they belong in a science classroom. The approaches to learning led to the results of students seeing themselves as "competent, related, and autonomous" (p.38) which not only increases their confidence as learners, it allows for students to see themselves as contributing members of the school to which they belong.

Interdisciplinary Importance

The research of both Condon & Wichowsky (2018) and the team of Williams, Brule, Kelley, and Skinner (2018) highlighted the ease with which science, especially the NGSS, can be matched with other content areas. The importance of interdisciplinary work can also be noticed in the creation of relationships throughout the school that allow for multiple educators to know the student as opposed to one. This creates a true community approach to the development of young minds, and gives students a wide range of classrooms or other spaces within the school that they feel comfortable to enter. A space that feels safe allows for students to openly discuss both academics and anything else that is on their mind with staff or peers. As more spaces become safe for a student it means that more people within the school are able to support and appreciate them not just as a learner, but as an entire person and are able to deepen that sense of belonging. A

student that knows they will be greeted, valued, and respected in a space is able to focus more on the task at hand than on the perceptions of others (Goodenow, 1993).

Interdisciplinary work aides in the creation of belonging in the ways mentioned above, and can also help develop skills that increase criticality, Ladson-Billings (2006) talks explicitly about the need for educators to have a vast array of approaches to teaching students about their curriculum. An interdisciplinary approach to teaching not only allows for the collaboration of multiple educators to share their techniques, it also gives students the ability to use different lenses when approaching a problem or lesson (Condon & Wichowsky, 2018). An example is that a student who has never felt truly connected to science would be able to approach a language arts and science collaboration from more of the language arts perspective. This means a student utilizes their strengths and comfortability to approach a content area that they may have never felt a connection.

This development of confidence in multiple areas of learning allows for students to begin questioning both the educator and the entire institution. The development of a critical learner allows students to notice what is missing, and if they feel their education is not meeting their needs they can ask for a change. When educators are able to develop a true sense of belonging for students, and can create enough safety for them to feel comfortable questioning perceived authority, students and educators are able to create a much more personalized and collaborative approach to learning.

Student Centered Learning

The implementation of a student centered learning approach to all curriculums, not just science, is necessary. In her work Gloria Ladson-Billings (2006) discusses the need for teachers to constantly revisit their curriculum stating that teachers should

"...deconstruct, construct, and reconstruct" (p. 32) curriculum to meet the needs of students and show them that they matter. She goes on to discuss the importance of understanding that unlike college where students choose to be there, education in K-12 is an expectation in the United States. A student who does not necessarily want to be part of a classroom or invest in the curriculum must be given the opportunity to connect by the educator (Ladson-Billings, 2006).

Acknowledgement of the student within the curriculum can be the reflection of the student physically such as race, age, or gender (Vickery, 2017). It can also be done through discussion of who students are outside of the classroom (Ladson-Billings, 2006). Corbett & Wilson (2009) discuss the need for skill mastery to feel purposeful, as students, especially in science, are not connecting their curriculum to anything that applies to them. This means that a student without an interest in science is not going to have any feelings of connection or belonging to that classroom. The reconstruction of curriculum that Ladson-Billings mentions is pertinent in this area, she calls it "filling holes" (p. 32) where educators must connect content to the lives of their students, asking themselves 'how does this help students make sense of what they see daily?' as she understands that the believed direct route of teaching content is not necessarily going to be relevant or relatable for all.

Williams, Brule, Kelley, & Skinner (2018) share multiple ideas with the writers above as they encourage educators to "bridge academics with students' everyday experiences" (p. 11) and to build off of prior knowledge so students can feel more connected with their already existing understanding of the content. Being linked to the prior knowledge of students does not come simply through pre-tests or other assessments.

Understanding the prior knowledge that students possess is also done through fostering strong relationships and knowing a student's history. Other means of tapping into prior knowledge can be done through talking to members of the school community who are strongly connected to students that some educators might not know as well (Williams, Brule, Kelley, & Skinner, 2018).

Community Connection

The connection to community is a spot that aids in creating belonging in a classroom and within a curriculum (Vickery, 2017). Vickery's research highlights the need for student understanding about how they "fit into and contribute to their community" (p. 333). Chhuon's (2014) research exemplifies that a teacher who is able to connect with their students and understand where their students are coming from can connect the community to the curriculum. Milner (2020) discusses the concept of "curriculum punishment" (p.155) and its serious impacts on oppressed communities. Milner focuses on black communities within his article, and how a predominantly white staff at a school can unintentionally do harm with what they do *not* teach to a majority black and brown students. In the Ladson-Billings (2006) chapter mentioned earlier, she examines the same idea through discussion of necessary constant construction of curriculum. If white educators place their own emphasis on what they believe is important, while ignoring people and events that their black and brown students see as important, they are telling them that those items are not important enough to be acknowledged. This, in turn, is telling black and brown students that certain pieces of who they are do not fit or belong within the classroom (Milner, 2020).

Milner goes on to talk about how the community connection is not just what students define as important, it is also drawing in and upon the families to which students belong. Educators need to hear the experiences of the families and assemble lessons that validate and connect the stories students hear at home, and bring those into the classroom (2020). Milner states later on "... because the racial identity of teachers is connected to their preferences, interests, and priorities in the curriculum, who teaches the curriculum to whom impacts students learning… " (p. 157). Further recognizing the importance of creating community connections and the need to not only reference the community within class, to also physically bring the community in.

Student Voice

One of the most substantial learnings from research done by Corbett & Wilson (2009) is the need for student voice to be a part of the development of curriculum and programs within the school. Student voice allows for young people to feel engaged and that their thoughts on what is being discussed are actually being taken seriously. Students desire input and to be seen as what they are, the most informed individual on what feels best for them. Corbett and Wilson go on to say that when it comes to discussions and decisions their voices need to be amplified. To voice an idea or share an experience that a student sees as important, and then to have that idea show up in a lesson, not only creates interest, it gives space for ownership and builds trust. A lack of ownership or buy-in from students oftentimes is attributed to behavior challenges in the classroom, and instead of teachers acknowledging the lack of interest in the lesson as the teachers responsibility, they place that responsibility on students.

Relying on the voice of students can also even out the struggle for power that can often lead to disagreements or disengagement for students. Making sure that the voices of students are brought forward not only strengthens relationships in the classroom, it helps students understand that what is happening within their life needs to be discussed (Williams, Brule, Kelley, and Skinner, 2018). As stated earlier, this direct involvement then allows students to focus on the science, instead of trying to find the point or connection in what is being discussed.

The need to create belonging within a science curriculum goes far beyond any idea that traditional education might have in regard to making this important. Understanding science has become a necessity when attempting to make sense of everything that is going on around the world today. Climate change, vaccinations, renewable energy, deforestation, and so many more are not just buzzwords, they are items that impact everyone. Without the investment in understanding these complex pieces of the world, they will continue to be issues. If students leave school believing that science will not be a part of their life or their community because they are not interested in being a chemist, that idea needs to be corrected. Educators need to connect science to the most minut items in the lives of students and not only help them understand how science impacts their life, but also help them understand that they can improve the world by simply understanding basic principles within complex ideas in science. Welcoming students into the world of science through support and connection only increases the internalized belief that science is for them, and science needs them.

Summary

The feeling of belonging for young people within school needs to be a constant point of discussion in the realm of education. Educators should never believe the development of belonging is less important than their content, and instead need to see it as part of how and what they teach. There needs to be an understanding of how educators can develop and continuously provide spaces of support for the whole student, and help students feel welcome especially when they fall into minority categories within the school.

School needs to quit being a space of small cliques where only the grade level teachers know the ins and outs of the lives of their students. Yes, individual relationships with students are important; however, so is an overall welcoming school culture. Just because a student leaves a classroom does not mean that they should suddenly feel any less important or seen. Adults can model and do their part by acknowledging that hallways are spaces to meet students with niceties, and not accusations, to meet them with a conversation and not a complete avoidance of the student once a hall pass is visible. Relationship development is where you show a student that they are worth getting to know, and that you remember what they share with you and you want to know more.

As school staff, specifically educators, develop those relationships it becomes imperative that what they have learned about their students feeds their curriculum development. Shown over and over in research that the ability for students to see themselves within their education, specifically science in this write-up, increases interest, participation, and ownership of learning, there is no reason not to be adapting. Students

should be able to access their education through multiple avenues whether that has to do with lessons being presented in more than one learning style, or an interdisciplinary focus where one educator's content ideas are presented through the lens of a different content or educator. This might look like bringing in community members who have knowledge on a subject and connections to real world experience, or educators in the building coming in as guest speakers who have experience with a certain subject, creating a moment of learning and the possibility of long term connection. Through the use of community involvement and student voice, the development of curriculum begins to shape itself as educators find ways to overlap their standards and what their students see and experience in their day-to-day lives.

Chapter Three will entail the use of these findings in describing how to best develop a curriculum to answer the question: *how do educators develop a sense of belonging within a science curriculum?* The curriculum will begin with utilizing student voice to develop community within the classroom, and create a "community science question" to begin the year. As students research an answer to this question, they will begin to select new questions to research, individually. Giving them voice and ownership over the direction of their education, with focus on development of skills and not specifically the content.

This allows for the flexibility that is necessary as an educator begins to know their students as the year progresses. Utilizing the information from the students' research questions the educator will be able to shape what they teach. As educators craft their curriculum through the topics of students, educators can enlist the help and voice of students to teach what they have researched. This hand off creates a constant space for

students to use their voice with each other and drive where their learning is headed, and

allows for a start in the development of belonging within a science curriculum.

CHAPTER THREE

Project Description

Chapter Overview

The continuous challenge with science education is that even though students might find content interesting, it rarely feels as if it is connected to them. Students are able to mix chemicals and build and launch a trebuchet, but those projects lack their voice and input. Other challenges arise when students enter a science classroom believing they are not a "science person" and feeling that they do not belong there because of historically bad grades, or less than desirable interactions with teachers.

Science tends to be seen as following the written procedure and landing on the right answer, as opposed to its natural state of learning through failure. Students who want to try and accomplish a task in a differentiated way have oftentimes been asked to leave, or are reprimanded in other ways. The goal of this project is to provide a curriculum to students that they feel connected to, and that they feel they belong within as they manipulate and shape their own learning. The hope of the project is to provide answers to the question of *how do educators develop a sense of belonging within a science curriculum?* so that students can feel they have a comfortable space to continue their learning.

There is an immense importance in understanding science that is critical to the day to day lives of people. Science is part of our daily conversations, the nightly news, and most political decision making. However, to understand science students do not need to know the endless complexities of specific fields of science. What students need is to know how to view everything labeled as a 'fact' with a critical lens. They must know

how to research and experiment to prove or disprove information they have been given. Learning those skills becomes challenging when students have no connection to the curriculum, classroom, or educator. This project is the creation of a curriculum that will allow students to create, connect, and belong within their scientific learning.

Students and Location

The project is intended to take place in a public secondary school, grades 6-12, in a small suburb of a major Minnesota city. The city has a population of just under 31,000 as of 2019 of which just over 15 percent live in poverty. The school has open enrollment, and houses 573 students, of which 82% qualify as low income. The school struggles with student retention, and students who leave oftentimes reference the desire to attend elsewhere as their reason for leaving.

The specific audience for the project is the 6th grade class, consisting of 124 students. There are two science classes offered in the 6th grade, and students are required to take both of them. The first is an engineering focused class that lasts one semester, and the second is a general science class that runs the entirety of the year. The general science class is specifically geared towards Earth Science per the new Next Generation Science Standards (NGSS) requirements. This curriculum will be implemented within the general science class throughout an entire school year.

The 6th grade population of students proved to be the best choice when attempting to gauge belonging within the science curriculum because of the introductory status of the sixth graders. Students are new to the school and staff, and besides possibly knowing older students from the elementary school, their peers are likely new as well.

This provides a great setting to implement a curriculum with the goal of creating belonging, if students begin the year with little to no connection to their location.

The Curriculum

As stated earlier, the new NGSS requires Earth Science to be taught in sixth grade, and the new standards compliment this project. The standards are rooted in inquiry-based learning, which aids in the removal of the highly structured and procedural feel of a standard science class. This breakdown of those structures gives students more space and freedom to learn through doing, as opposed to needing to arrive at the answer in one specific way. The benefits of inquiry-based learning are discussed in Condon and Wichowsky's (2018) research that continuously highlights the positives of the ownership that it creates for students. Inquiry-based learning is more focused on learning the process and blazing the trail of understanding scientific discovery, as opposed to providing a cookie cutter bread crumb laden path on how to do everything.

The label of Earth Science can make the curriculum feel challenging to adapt, yet with an understanding of the civic pieces that exist in Earth Science curriculum, the opportunities are ripe for creating connection to students. The majority of the standards that students are required to meet at the end of the grade are based on understanding certain tools within science, and those tools can be taught and utilized in a multitude of ways. Whether it's through the use of experimentation with specific questions about certain standards, or students developing their own questions surrounding topics of their interest.

Creating Space for Student Voice and Belonging

The ownership in inquiry-based learning is incredibly important when it comes to students using their own ideas to test out their hypotheses. The NGSS has shifted to being project based, as opposed to traditional textbook learning. Students participate in hands-on work and research which has proven to be retained at a higher level (Main, 2015) as it allows for their own creative thoughts to be the driving force of their learning.

Their own ideas will first be tapped into and developed in the first weeks of school in the creation of the original classroom question. Students will then branch off of that question into their own areas of study that give them excitement and keep them engaged. As they develop their research skills, they will also be compiling information about their topic so that they are capable of leading a short lesson to their peers, allowing for their voices in the community space. As the year continues, students will have increased opportunities to lead, creating a classroom where they collaborate with their educator and peers as opposed to feeling as if they are a subordinate in a hierarchical system. The importance of developing that piece of identity and achievement is not only critical to their continued growth as young scientists, it is also crucial in their continued growth as young people (Williams, Brule, Kelley, & Skinner, 2018).

In the first two years of teaching this was an approach I utilized often in my classroom, and it aided in retaining interest not just for the students doing the research, it also piqued the interest of the whole class. Allowing students the freedom to choose topics that they are interested in, even outside of traditional science, also drew in the curiosity of their peers as the topics tended to be of interest to many.

Curriculum Format and Timeline

The curriculum takes place over the entire school year, students spend 90 minutes in science class every other day. Depending on the week students either have science two or three times within the typical five day school week. The first day that students have science is their research day, the second day is spent discussing intersectionality between the content and day to day life, and the third day is spent doing hands-on experiments.

The research days begin with each class developing their own classwide research question, the one job of the educator at this time is making sure it is broad enough to encompass all types of interests, so that students have a choice in what they research.

The first three weeks are spent learning about different types of research with the help of the media specialist at the school. Students will learn how to identify what is reliable and what can be questioned. Students document their findings, and come up with ways to answer the original question posed based on their discoveries. During the research portion students are asked to compile more questions about what they are learning. When they reach the end of those first three weeks they choose a question from the list they compiled, and begin their research process over again for the next set of three weeks. The second three week block of research has less hands-on assistance from the educator as students begin to hone their skills. Again, students create a list of questions that are interesting so they can research further, and then proceed to the next three weeks of research. The three week research blocks continue throughout the year, and each time the research becomes a little more involved with asking for more sources and more intense summaries of those sources. At the end of the quarter students develop a way to

present their findings to the class, they have the freedom to teach whichever question they feel most excited about.

This pattern continues throughout the entire year, with students researching new topics every three weeks until the final end of the fourth quarter where the scaffolding leads to a much more involved level of research, and students are given six weeks instead of only three.

The second day students have science, the content days, utilize Wiggins & McTighe's (1998) emphasis on backwards planning for lessons. Starting in what they refer to as "stage 1" (p. 9) where the goal is to identify what the educator is hoping to accomplish with the tasks. This is necessary because not every round of research focuses on the same outcome, and students will be expected to grow in their skills continuously. Backwards planning also allows for the educator to truly focus on how to connect the content pieces to the daily lives of young people. This is not something that is done easily with all of the areas of content, so spending specific time to focus on how students see themselves in the lesson is important. Backwards planning also allows the educator to see if there are research projects that students have completed or are working on that might make them the expert during the lesson. Asking that student to lead the class, or lead alongside the educator, is another way that connections and support take place.

The final day of curriculum in the week is where students focus on experimentation. The experiments might relate to the curriculum or might be something completely removed. Having experimentation be completely removed allows for the creation of excitement around doing something different, almost feeling like a break.

However, the purpose of the hands-on activities is always centered around having students develop their own means of discovery.

Assessment

In order to better build relationships with students and understand the ins and outs of their research, educators create time for one-on-one conferences during the week of presentation preparation, and use it as a summative assessment. The conference is not strictly for science questions, and instead is a time to check-in and make sure that students' stress levels are manageable, and to find out if there is any support that educators can provide or connect to them. This is also the time when the educator develops the individualized approach to supporting the growth of students. Students set goals with the teacher in that meeting for the next meeting at the end of the following quarter so that they know where to focus their energy while working. When students show growth and proficiency those pieces are discussed along with the new goals in a narrative write-up for the quarter as opposed to a letter grade. This grading system is used throughout the year so that each student is recognized for their specific growth and focus.

Informal assessment takes place throughout the quarter with the teacher checking progression of research, and using discussion points during experiments and labs to gather the level of understanding, and degree of critical thinking that students are using.

My first year our entire team utilized the narrative based grading system and had great success with student and family response. There was an appreciation for how individualized and personal the story about the student was, and the ownership of the qualities that were highlighted and celebrated was palpable. In turn the direct

conversations about areas of possible improvement were taken to heart, as they were not just attached to a low letter grade, it was feedback from someone who saw all the equally great things in the student as well.

Summary

The purpose of this project is to develop the sense of belonging within a science curriculum for students. The way in which this will be accomplished is through the creation of a curriculum that allows students to create and discover on their own terms, while also allowing them to claim their discoveries and share them out. The celebration of their findings as something worth sharing creates a feeling of place and responsibility to their work and peers. As students become the expert in their area of study, they will see themselves as necessary to the space, and incredibly knowledgeable. All of these words 'necessary', 'knowledgeable', 'expert', 'place', are avenues to feeling a sense of belonging, and not only to the classroom or curriculum, but to education as a whole.

Chapter 4 will provide a reflection on the creation of the full curriculum and what unforeseen challenges and successes come from this project. The chapter will also provide a summary on *how do educators develop a sense of belonging within a science curriculum?* in hopes of easing the path to creating belonging, and dismantling the science curriculum that opposes that development.

CHAPTER FOUR

Conclusion

Chapter Overview

Throughout the research and development of this project, addressing the question of *how do educators develop a sense of belonging within a science curriculum?* There was a lot of learning surrounding the development of a curriculum. However, for as many questions about how to best "fill a day" there were a substantial number of questions that needed to be internally focused for me as a teacher, they were not going to be directly answered by a journal article or any other literature.

Questions like, what are the pieces of a curriculum that remove personhood from students, and why do we insist on keeping them? Why do I feel like I always need to "fill the day"? If I make questions and lessons directed towards students and what they love, is that truly an attempt at belonging or is it a fresh coat of paint over the same system? As a science teacher our main goal is to teach students how to actively participate in science, with trial and error and understanding that inquiry is not just taking place in the lesson I prepped for the day, it is happening continuously. Is this student pushing back on the assignment? That is science, something to be studied. Is a student purposefully pushing the buttons of a classmate, again this is something to be researched. As I tried to craft a curriculum that checked the boxes of every standard, and still maintained full support of each student's individuality it started to become apparent that less is more.

I ended with a project that lasts the entire year with eight different research questions that students choose entirely on their own. The questions are a continuation of the research done weeks prior when a student has come across information that is

interesting and they want to investigate it more. The subject matter does not have to have any connection to traditional science concepts or be related to state standards, it is interests that are all their own. Each quarter there are class presentations for students to share their learnings, and individual meetings with me as we discuss the project, their process, and the students feelings regarding anything inside or outside of school.

Within the conclusion of this research and project I will revisit literature from chapter two and how I saw what I had read play out in the development of this curriculum, and the relationship to the results. Then discussing how the results can benefit the profession as a whole as teachers adapt their curriculum on a regular basis. I will also touch on the importance of policy changes when it comes to how this transition to free teaching can become easier when pressure of certain benchmarks have been removed. Finally ending the chapter talking about future research and how that could further create a relaxed atmosphere of education, and a more comfortable place for students.

Revisiting Literature

The literature cited in Chapter Two became a true grounding point as I tried time and time again to create a curriculum that succeeded in hitting all of the science standards and also allowed for freedom in learning. I was always attempting to fill every moment with a lesson or project, as this is what has been taught in educational programs. The quote of "always over plan instead of underplan" rings through my head from multiple professors. That direction feels to me that it is in direct conflict with the research of Yuval-Davis' (2006) ideas regarding how students lose time that is focused on the construction of self and identity. This loss of time for students becomes a loss of space

for self-discovery as instead teachers pack the day full of what is expected to be covered in the year.

Those ideas paired with Chhuon and Wallace (2014) discussing the need for students to have a reason to be present and feel connection kept driving me towards the less is more mindset. Having a never ending barrage of lessons never allows for the dust to settle, or for students to inquire far beyond what the standards instruct their teachers to tell them. I reflected on the "What if…" questions that students tend to ask in the middle of a lesson, and oftentimes teachers are instructed not to follow the tangent, but I disagree with that mindset. There is such an immense feeling of power and interest when we respond with "let's find out". In my experience the student that asks the question tends to be a student that usually has no interest in the topic or science in general. So why not allow all students to ask their own "What ifs…" with no limitations, and instead of redirecting, it's always "let's find out". With that support we create the system that Chhuon and Wallace discuss, and we also give back that time that Yuval-Davis highlights for self-discovery. The delivery does not feel like our linear ideas on science, but it is science paired with space for connection and acquisition of knowledge, and time for students to unearth what they love and are passionate about.

Communication of Results & Benefits to Profession

Where my research led me in the construction of this project was not a cut and dry curriculum bound together with a one size fits all approach to students and helping them feel a sense of belonging. The idea that something like that will ever exist is what created the need for my research question in the first place. This curriculum relies greatly on the capacity of the educator to focus less on the "right and wrong" and lean into the process

of learning. It requires an examination of what science truly is outside of the linear construct that common sense teaching has shaped it into. Instead of telling students what must be learned and making those plans for them, we allow them to dictate the direction of their learning. Once we as teachers identify the curiosities that students have we can do more direct work with them. Asking what did you learn and how did you learn it? This gives time for the student to truly share where they are coming from, and also gives the teacher an inside look as to what those driving forces are for their student.

One of the main pieces I wanted to keep for my project no matter how much it changed and shifted through research and development was one-on-one meetings between myself and my students. Using self-evaluations to help provide feedback on their progress, and to create agreed upon goals as far as what they know they can improve upon, and what I know they are capable of completing. This becomes beneficial to teaching as goals are not only set by the teacher, it is understood where the student is coming from and they too see the goal as necessary and recognize its importance to the process.

This curriculum is also heavily dependent on the understanding that this project is just a jumping off point. Belonging comes from us as educators listening and adapting when students voice opinions and concerns. This approach supports the development of students trusting their voice, and knowing that it has a place in their learning environment. The feeling of belonging is derived from a relationship between the student and the emotions they feel within the space.

Policy changes

The most important policy changes that would come from further research on this project would involve the removal of standardized tests. The push for educators to make students "test ready" interferes with an educators desire to focus on the emotions and development of the whole student in their classroom. The seemingly cemented measurement of how we calculate accumulated knowledge and progress binds the hands of educators. Teachers want to do good, and they want to support their students in every capacity, but the inflated importance of standardized tests makes teachers feel as if they cannot teach anything except the standards. Some teachers live in fear of losing their job if their students do not perform well on tests, and oftentimes because teachers' lives encompass so much more than just their work they can begin to feel trapped between what they feel they must teach, and what they know would serve their students better.

Limitations

The limitations on this research and continued development of this project are the internal struggles of educators as we attempt to shake the antiquated ideas of how education is supposed to look, and how exactly we measure the accumulation of knowledge by students. When the majority of teachers were students, we learned in a particular way. Every year we did the same projects as the students before us and we watched the same movies and read the same books. School was taught like an assembly line where you received a bucket full of knowledge, then went on to the next grade to obtain your next bucket. I remember very little of the specifics of what I learned in my K-12 education, but I do remember the skills I was taught. I believe because most educational spaces are run in this particular fashion, we as teachers have an insanely hard

time thinking outside the box when it comes to teaching certain necessary skills to young people. My largest limitation in this project was second guessing many of my ideas because I had never learned in this way, so it was hard to see it as possible.

Future Research

After the development of this curriculum I can only hypothesize about the feelings of belonging within the classroom. The necessary future research within this area would be the use of a long term qualitative study where students would have the ability to rate their feelings of belonging within the school system while utilizing this curricular approach. Asking questions about if they feel valued and seen, or if the less structured classroom creates a sense of feeling lost and ultimately results in the opposite of the original intent. Recognizing that no student's experiences are going to be the same, the results of future research would have to be approached with understanding of what overall success would look like, and creating spaces for discussion on why certain pieces are not working for some students.

Summary

A student that does not know themselves is a student that does not know where they belong, and if we as teachers demand that a student find themselves within parameters that we have set for them, we find students who claim they are "not a science person". We have students who feel that they do not belong in our classrooms, and who feel that science is just another hoop to jump through as opposed to an important foundation for the acquisition of all the information they take in inside and outside of school. Whether it's asking questions, critically analyzing information, or understanding the importance and commonality of failure. Outside of school there is no prescribed way

of learning and there is no limit on what can be learned, so we need to quit spending so

much energy teaching students that that is not the case.

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