From Description to Explanation: An Empirical Exploration of the African-American Pipeline Problem in STEM – Brown et al.

This study examines the impact of social identity contingencies on African American science students. This study starts by explaining social identity contingencies, specifically focusing on how they can negatively influence academic experiences for students of color. Coming in with this assumption, the researchers create a survey for African American science students in college and Black scientists. This is a mixed methods study in which researchers analyze survey results given by participants. After identifying social identity contingencies, the authors then explain how they understand these contingencies. The authors share some statistics about how African Americans are currently performing worse than other races in science classes based on standardized test scores. Also, according to their stats, Black students are unlikely to participate in science (Biology, Physics, Chemistry) classes in high school. The authors share this data about Black students' high school experiences because they believe it highly impacts whether they pursue science majors in college. Statistics are shared that support that students need positive experiences in high school to pursue science in college. Once in college, the authors share stats that most Black students are not pursuing science majors (only 3% are pursuing science majors). Next, they start explaining some of the possible reasons this could be happening. The authors in their explanation, share a stat that most Black science majors are attending HBCU's (Historically Black College or University). The authors believe that this shows that Black students are more likely to pursue a degree in science when social identity contingency is not as strong. Social identity contingency will not be as strong for Black students attending HBCU's compared to those attending PWI's (predominately white institutions). Next, the researchers go over their theoretical framework which touches on a variety of articles that talk about African American experiences in science. They take on a few different lenses in this study which are: Microaggressions, Achievement Ideology, Communities of Practice, and Oppositional Identity. The researchers wanted to do a deep dive into the literature on this subject to help interpret the results of their study. They will use one of these lenses to help best explain the differences between African American science students and those who ended up with a career in a STEM field. Next in the methods section, the authors describe the survey they created. This study is considered mixed methods because the survey has Likert scale questions (quantitative analysis) and open-ended questions (qualitative analysis). For analysis quantitively researchers used Principal Component Analysis and qualitatively they used a 4-part process where they identified themes and checked them using peer review. In the findings section we discover that the quantitative analysis could not be done to the highest degree because the survey was still in its development stages. The authors admit that more work needs to be done on the survey after these initial results. When looking at ANOVA results, two measures had a statistically significant difference between our two groups (student vs scientists). The two measures were Alignment (alignment to your community) and Microaggressions. Scientists reported higher levels of microaggressions than students did. The students had a higher level of Alignment than the scientists. Researchers concluded that there maybe an inverse relationship between Alignment and Microaggressions. Next, the authors went through the open-ended responses and how participants responded to questions related to Alignment and Microaggressions. Often, in the Alignment questions, students and scientists explained some of there misalignments to the science community. For microaggressions, students and scientists talked about some of the racist

comments they received through their science experiences. Even though the groups had different levels for each of these measures all expressed being adversely affected by both categories showing the prevalence of othering within the science community. Lastly, analyzing responses in this way allowed researchers to aggregate the data more. For example, they found Black women talking more about their oppressions of being a woman of color in science rather than just focusing on race. In the conclusion, the authors make the point again that whether you are a student or scientist, Black people have felt a lack of Alignment and Microaggressions from those within the science community. They found that the scientists were more likely to provide reasons, such as meritocracy, as ways to overcome the racial biases in the science community. Students were less likely to be able to provide ways in which they overcame racial biases. This was seen as a reason that scientists were able to make it through their degree and find a job in STEM.

Social identity contingencies - The challenges individuals face because of widely held stereotypes about their social group (race, ethnicity, gender, etc.)

Microaggressions – subtle forms of racism usually transpiring in situations of racial and cultural differences

Sharpening the lens of culturally responsive science teaching: a call for liberatory education for oppressed student groups – Codrington

In this paper, the author offers their reflections on a different paper written by Wallace and Brand. The paper written by Wallace and Brand focused on culturally responsive science teaching and used critical race theory/social justice as their frameworks to guide the paper. In this paper, the author (Codrington) uses a frame for culturally responsive teaching that specifically focuses on the education of African American students. The author of the paper works professionally as an African-centered psychologist and plans to bring that perspective into the paper. The author looks to push the field of culturally responsive science teaching, so it includes a lens of liberatory education. The author critiques Wallace and Brand's view of social justice because they only focus on environmental topics (i.e. Climate change) rather than anti-racist education topics. Then, the author goes on to credit Wallace and Brand for mentioning educational approaches for African American children. But the author critiques Wallace and Brand for not understanding the fundamental purpose of education from the point of view of oppressed groups, which is, liberation. He does this by focusing on Wallace and Brand's use of standardized test scores in their comparison of African Americans to white populations. The author believes the use of standardized test scores is not the proper way to understand African American education because it does not value processes of learning which are in a liberatory education model. The next section tries to further define liberatory science education. The author gives questions that focus on using science education in a manner that challenges Western ideas to science education and empowers oppressed people. Then, the author gives examples of teaching practices using liberatory science education, such as, incorporating a curriculum that shows the many ways different cultures (Egyptian, Indian, Chinese, Pre-Islamic, etc.) use science. In the following section the author acknowledges the barriers (school standards, standardized testing, lack of resources in urban schools) folks typically see for adopting a liberatory science education model. He pushes educators to work around these barriers as they are the status quo and not helping the African American student. In the final thoughts section, the author reiterates the point that the goal for science education should be one that provides support for anti-racism and social justice. Science education can take on these topics along with teaching students about current day issues such as global warming or water pollutants.

Liberatory Education – Education specifically geared towards children of color. They learn to create and discover the transformation of their world.

Critical pedagogy: Loving and caring within and beyond the classroom

Learning about critical pedagogy and love in theory is easy, however, implementing it in real life classrooms is much more difficult. Teaching can and should be considered an act of love. This is not a passive emotion, but a deliberate and equitable action that shows solidarity, honesty, respect, care, and listening. This love and care needs to be for our students, but also for ourselves and our communities. It is an active choice and it's rooted in acceptance, appreciation for student assets, confidence, and hope. This love is learned in- and outside of the classroom through friends and peers and it's a fundamental concept in feminist theory. It's also an essential component to promote imagination, teaching of social responsibility and freedom, and critical thinking. Loving is an action that demands constant and continuous effort as well as reflection.

White scholars, students, and educators have always been at the forefront of education, research, and even standardized tests, and although they have been trying to help, they have sustained racial hierarchies. A non-hierarchical approach would be a better option. In such an approach, everyone gets to speak freely. They are respected and cared for, and everyone's thoughts and feelings matter equally. Since actively caring for each other and mutual aid are radical acts of love, they are essential in defying a capitalist system and authority. This alludes to a pedagogy that refuses authority in favor of sharing, collaboration, cooperation, and nurturing.

An important thing to remember is that everyone deserves to have their needs met without having to give up their dignity. Discussions about pedagogy need to allow space for people's wants, hopes, dreams, and voices because this creates the opportunity to build solidarity as well as shows the challenges in the road to liberation.

Key Terms

- Feminist theory: Feminist theory is the opposite of masculinist education, which is a banking model often seen in regular classrooms/education. It's competitive, rational, socially detached, emotionally distanced, and socially detached. Feminist theory on the other hand attaches great importance to love and care as actions and emotions.
- Liberation: Love is a central part of the movement toward liberation. It involves affirmation, respect, and the commitment to care for students as individuals and human beings and ultimately empowers both teachers and students to promote social change.
- Solidarity: In this context it is seen as the same as "love". Engaging in actions that promote equality and address issues of inequality and oppression. For there to be solidarity, there needs to be a mutual attachment that is based in compassion, altruism, love, and a desire to end inequality and oppression. It's not rooted in pity (like empathy), but instead, it protests injustice as an act of love.

Culturally responsive teaching in special education for ethnically diverse students: Setting the stage

A disproportionate number of students of color are being placed into special education because teachers lack both the appreciation for and knowledge about different cultures and their learning processes, values, etc. Oftentimes these students are diagnosed with a learning disability and placed in special education based on differences in home values and cultures rather than actual biological or intellectual disabilities. In these cases, diagnosing students isn't an objective process, rather, it's based on a Eurocentric, white, middle-class idea of what is the "norm" for students, their learning, and their behaviors.

An example of this may be how African Americans are diagnosed with ADHD or disruptive behavioral disorders while using more movements and being more energetic is simply part of their culture. Another example may be Latinx students being considered unmotivated when they don't want to engage in individual and competitive learning activities. However, this just may be because they are more used to collaborative/community activities in their home culture.

By implementing culturally responsive teaching, these wrong diagnoses can be avoided and the disproportionate number of students of color in special education will diminish, giving both the students who are not supposed to be in special education as those who are a fair chance at an equal, high-quality education.

Implementing culturally responsive teaching starts with determining, addressing, and eliminating existing practices as well as beliefs such as misunderstanding diversity vs. disability and negative attitudes that teachers may hold regarding certain groups of students.

Differences in cultural backgrounds, values, beliefs, etc. for different cultures mustn't be ignored. Instead, educators should educate themselves on these differences and they should be honored. After all, if a teacher unable to teach a child that is not white, able, or middle-class (what would be considered "the norm"), they oftentimes will end up blaming the child for not learning rather than looking inward and acknowledging their own lack of cultural competency. And when a teacher holds a negative bias towards a student with a marginalized identity, that will automatically and unconsciously result in that teacher's perception of the student's behaviors being negatively impacted.

A teacher should also be aware of their own culture, values, attitudes, and beliefs, because this all directly influences classroom activities, teaching styles, and classroom management.

There are four specific practices that altogether make up culturally responsive teaching. They are culturally responsive classroom climates, critical cultural consciousness, culturally congruent instructional strategies, and learning communities.

A culturally responsive classroom climate is important because when ethnic stereotypes are introduced into a classroom, it negatively influences academics of members of these groups, regardless of whether they believe these stereotypes to be true. Therefor it's important to identify curriculum content, classroom strategies, and educational assessments that are biased.

Critical cultural consciousness allows teachers to recognize behaviors, values, and attitudes in their students that are culture-bound, and they can use these to improve their teaching.

Implementing culturally congruent instructional strategies is helpful because every person connects best with and learns best if what they know is being used. Effectively applying these strategies would be easiest if the primary focus of teaching would shift to substantive elements (e.g., skills, values, ideals, etc.) rather than content.

Lastly, learning communities are important in culturally responsive teaching because when students help each other with and through learning, their academic achievement, their satisfaction with school, their self-efficacy levels, and their relationships with peers across ethnic groups all improve.

Key Terms

- Critical cultural consciousness: Teachers becoming aware of their personal culture, values, learning and teaching styles, ways of communicating, and attitudes and the ways in which these affect their views on and behaviors towards people of other ethnic groups.
- Culturally pluralistic classroom climates: The psychological and emotional tone, social interactions amongst students as well as between students and educators, and the physical features of a classroom. A culturally pluralistic classroom climate feels warm, supportive, and caring, but there are also high expectations. Differences between students and their cultures aren't viewed as previously set limitations, but rather, they just are. Ethnically diverse images are displayed in the classroom that show the desirability of diversity as well as different accomplishments, positions of power, and leadership.
- Multicultural curriculum and instruction: Using materials as well as teaching techniques in the curriculum that are compatible with students, is familiar to them, and their lives, is challenging for them, and interests them.
- Diverse communities of learners: Rather than taking a competitive and individualistic approach to learning, there is cooperation and collaboration of students. No student needs to fail in order for another student to succeed; instead, no individual student's learning is complete until all of their peers have succeeded to learn to the best of their ability. This is a call to participate in political and mainly social reform actions.
- Culturally responsive teaching (CRT): Implementing the cultural backgrounds and lived experiences of students into the classroom in order to improve the curriculum and make education more equitable for all students and less European-American, middle-class, white focused.

But That's Just Good Teaching! The Case for Culturally Relevant Pedagogy. – Gloria Ladson Billings

In this article the author describes what she sees as “culturally relevant teaching”. After 3 years of monitoring teachers who were effective in teaching African American students the author uses these experiences to describe what she calls “culturally relevant teaching”. The author describes what she saw as culturally relevant teaching using three categories: Academic success, Cultural competence, and critical consciousness. In each section the author provides examples of each and connects them to culturally relevant pedagogy. In the critical consciousness section, the author talks about connecting the community to what is going on in school classrooms, specifically providing inner city students with more up-to-date textbooks. In the cultural competence section, the author talks about how African American youth culture is often ostracized in schools through punitive punishment. Teachers are pushed to challenge these norms if they want to achieve cultural competence. For Academic success, the author talked about holding all students to high academic standards even when their culture does not match the teachers. At the end of the section, the author provided an example. In the example a teacher worked with her African American male students to promote academic success in different ways because she saw that these students had social power in the classroom. The author points out that these students’ social power is often used in negative ways which creates an antagonistic relationship between them and the teacher. But in this example the teacher encouraged the students to use their social power in a positive way. To end the article, the author provides common themes she saw from 8 teachers who were all effective in teaching African American students. These teachers were observed for a 3-year period and interviewed throughout this period. The teachers all built strong connections with students, parents, and the school administration. These teachers were present within student’s community spaces such as libraries, barbershops, and grocery stores. Lastly, these teachers held all their students to high academic standards. The author says that all teachers of minoritized students should use this article to understand the tenets of culturally relevant teaching.

Culturally relevant teaching – A pedagogical strategy typically used when teaching students from minoritized populations. It often refers to connecting the school’s classroom culture to the student’s home culture.

Moving Culturally Relevant Pedagogy From Theory to Practice: Exploring Teachers' Application of Culturally Relevant Education in Science and Mathematics

We know that it's easier to know the theory behind CRT, CRP, and CRE than it is to implement these concepts into a classroom in practice. We already know that instruction in education needs to reflect both cultural nuances and distinct cognitive nuances. We also know that cultural relevance is just as important in STEM education as it is in English, history, or any other subject. Therefore, in order to improve CRE, it's important that teacher education programs also teach using CRE.

There are many ways in which STEM can be made culturally relevant. In this article, cognitive apprenticeship in combination with CRE is the framework of choice.

The different steps in cognitive apprenticeship are as follows; first, students should be taught in the context of problems that are meaningful. These are called contextual problems. Second, a teacher should model solutions to these problems. Third, students should start trying to complete their own activities and problems while being coached by a teacher and each other. Last, Students should be able to solve problems on their own with minimal help from a teacher, using their new skills. This is considered the scaffolding phase. Cultural relevance can be implemented in each phase, but especially in this last phase, students are able to explain and solve problems in culturally and socially relevant ways. The modeling phase often seems to be done by watching a video or completing a reading about the problem presented in phase one.

In this study, teachers were surveyed about their knowledge and skills in culturally relevant teaching before and after professional development. Initially, it seems that many teachers know what it is, but don't know exactly how to implement it in practice.

At the outset, teachers believed CRE meant teaching while using a curriculum that focuses on learning about/around students' cultures, experiences, and the things they can understand based on their backgrounds and showing them all how things they learn are useful in real life. They also believed there needed to be a focus on their interests and on what engages them.

This translated into practice by means of using real life examples or teaching in locations other than the classroom and by integrating student interests after specifically asking for them.

Some topics teachers used include shoes and gift cards for a math problem (it's a superficial topic, but was of particular interest to the students), a science/math lesson about creating inexpensive habitats for pets and affordable pets, a lesson about the water cycle using the California drought as an example, and a lesson on purchasing Icee's to learn about properties of matter.

Once teachers were able to implement the four phases of cognitive apprenticeship, teachers included activities such as playing a game in which they had to act out different parts of plants, playing charades to act out what might happen to different plant parts if there was a water drought, and having students explain to one another what sediment and erosion are and how these would impact the city in which the students live. Overall, the application of CRE gets more dynamic after professional development about the topic.

Key Terms

- Culturally Relevant Pedagogy (CRP): A framework that focuses on cultural difference between students as well as students and teachers. This way of teaching and learning allows students to move from a more passive role to an active one in which they obtain meaningful knowledge that can make them into social justice agents.
- Culturally Responsive Teaching (CRT): A framework within education that helps teachers make whatever they are teaching more relevant for students by connecting the curriculum to students' personal experiences and cultures. It's a form of assets-based instruction in which students as well as teachers are encouraged to value their cultures.
- Culturally Responsive Education (CRE): A theory-to-practice framework that is a combination of CRP, which consists of macro-scale paradigmatic thinking, and CRT, which is a more classroom focused approach
- Cognitive apprenticeship: A contemporary framework which provides a model for how learning occurs within the context of interactions that are meaningful. This framework is a model consisting of four phases in which a teacher conveys their skills to their students. These four phases are contextual problems, modeling activities, coaching activities, and scaffolding activities.

The necessity of a relational R ethics alongside Noddings' ethics of care in narrative inquiry

This article is meant to describe how the authors used "the ethics of care" as a theoretical frame to guide them in their study. The author's study was a narrative inquiry with kids in an after-school art club, specifically indigenous youth at a rural school environment. First, they focus on one day with the students in which a major snowstorm hit. Before this event, the authors were unsure how connected they were with students and whether students were felt any sort of "care" from the researchers. When researchers saw all the kids and researchers showing up to the Art club even during the snowstorm this showed them that the club was a space where the students felt cared for. This was an example of the "ethics of care" to the researchers. They next give an example of relational ethics as a researcher and a student participant shared personal stories about dealing with death. The student was dealing with a death in their home culture (which was an indigenous tribe). The students did not feel comfortable telling any of their teachers about their experience and they were planning to leave school early until they saw one of the researchers in the Art club. The researcher in the Art club was also thinking about a death in their community as the anniversary of one of their friend's deaths was on this day. The student and teacher had an unplanned meet up at the school. During this time, each of them shared what they were going through, and it brought them closer together. This showed some of the unwritten, ever morphing rules of the ethics of care. The authors used narrative inquiry in this study and used the "ethics of care" as a theoretical frame to guide it. They built relationships with the students and used this relationship to inquire more about the children's community. The authors argue that the ethics of care was needed to understand more about student's home culture and the theoretical frame allowed them to do the narrative inquiry. Authors think that without "care" students would not of opened up in the manner in which they did.

Ethics of care – A term used to describe the unspoken rules humans bring when they establish relationships with one another.

Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the STEM Workforce?

Currently, the STEM pipeline metaphor is commonly used to show who is entering STEM careers, based on different benchmarks throughout one's life, or who "leaks out" on the way to getting to such a career, even if they did meet the first (few) benchmarks. This metaphor may be useful in some ways, but it has several limitations. The trajectory that it implies fails to include many people who end up in STEM careers, but who did not enter the pipeline at the beginning of it. It's a one size fits all approach to describe people's paths from middle school to STEM careers. It is also used to inform policies and policy changes, but since there are limitations, these policy changes may not be (as) useful. The pipeline metaphor suggests that if more people start at the beginning of this pipeline (e.g. by taking algebra classes by middle school) and if they patch the leaks, more people will flow out at the end of it and end up in STEM careers.

This isn't fully accurate, since there are many reasons why a person may not end up in a STEM career even if they enter the pipeline. After all, there is an assumption that a person needs to reach/go through each benchmark and if a person accomplishes all benchmarks, they are certain to enter a STEM career. Additionally, the skills and requirements needed in STEM careers change too quickly and the pipeline metaphor is too rigid to accommodate for this. There are also huge differences between different types of sciences and thus between the benchmarks needed to get into such a career (e.g. life sciences). Two or more pipelines could be an alternative to solve this issue, however, this still doesn't solve any of the other limitations the metaphor has.

Another model that is more flexible and includes different factors as well as allowing for later access onto the STEM pathway would be better. The pipeline only focuses on academic benchmarks, but factors such as the quality of education as well as access, interest in STEM, and motivation are important as well. It would also be beneficial to include efforts to understand why people enter or exit pathways to STEM careers and in which other ways, besides academically, STEM skills can be acquired.

Overall, the pipeline and its benchmarks reflect the path, learning style, and socialization of white men. Career decisions are influenced by life contexts, especially in early adulthood. This means that getting married or having children may push someone in a certain direction when it comes to their career.

The newly proposed model is a four-composite typology model that allows for nuances such as scientists who do not follow the traditional pipeline, yet still end up as scientists.

For example, one out of three people who didn't show any interest in science in middle and high school, nor took all the benchmark classes (e.g. algebra, calculus, major in science in college) still ended up with life science degrees. And over 60% of people who became scientists or engineers either did not take calculus or didn't develop that early interest in science.

This all indicates that taking calculus isn't a necessary benchmark (many people who didn't take calculus still become scientists or engineers), nor is it a sufficient benchmark (many other people who did in fact take calculus ended up in a non-STEM related career). It's very important that we keep in mind that people who don't have all the "required" benchmarks according to the pipeline metaphor are still able to enter successful STEM careers. It's oftentimes minoritized people who are less likely to be able to flow throughout the entirety of the pipeline (if they even get to enter it at all).

Limitations to this four-composite model include that it isn't as easily interpretable visually as the pipeline model, and it's still rigid.

In any way, pathways need to be seen as a combination of factors that end up drawing people towards STEM. They aren't all required to ensure success, and any combination of pathways can happen. Rather, they need to be seen in individual contexts and need to allow space for constraints, opportunities, and affordances on a system-level.

Key Terms

- STEM Pipeline: This metaphor implies that to go from 8th grade and end up in a STEM career, there is one inlet into a STEM career, one outlet, and one direction of flow through a pipeline that gets progressively smaller as it has leaks where people who entered the pipeline miss benchmarks and end up not making it into a STEM career.
- Supply side model: The STEM pipeline is seen as such, meaning that it is believed the more people enter this pipeline, the more will come out at the end of it and enter into a STEM career field.
- Pipeline benchmarks: The steps a person needs to take or the things a person needs to accomplish to make it from the beginning of the STEM pipeline to the end. These benchmarks include taking algebra by the time they attend middle school and having taken (a) calculus course(s) by the end of high school, graduating high school, attending college and majoring in a science, and eventually entering a STEM career.
- Four-composite typology: a model that allows a more nuanced and flexible look at how people end up in STEM careers, indicated by academic credentials, (early) interest in STEM, both, or neither. This typology emphasizes individual agency.