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## **Researching Diversity from Multiple, Diverse Perspectives**

### **Miss Avneet Hira, Purdue University, West Lafayette (College of Engineering)**

Avneet is a doctoral student in the School of Engineering Education at Purdue University. Her research interests include K-12 education and first year engineering in the light of the engineering design process, and inclusion of digital fabrication labs into classrooms. Her current work at the FACE lab is on the use of classroom Makerspaces for an interest-based framework of engineering design. She is also interested in cross-cultural work in engineering education to promote access and equity. She is an aerospace engineer, and is the present Vice President (Educational Content) of the Student Platform for Engineering Education Development (SPEED).

### **Ms. Chanel Beebe, Purdue University-Main Campus, West Lafayette (College of Engineering)**

Chanel Beebe is an Engineering Education Researcher at Purdue University where her work focusing on broadening participation in engineering and engineering thinking. Her passion lies in empowering communities to solve their own problems using creative pedagogies and engagement strategies. Her research looks at using the engineering design process to address social issues in a way that keeps the design process in the hands of communities that face the social problems.

### **Mr. James Holly Jr, Purdue University**

James Holly, Jr. is a Ph.D. Student in Engineering Education at Purdue University. He received a B.S. from Tuskegee University and a M.S. from Michigan State University, both in Mechanical Engineering. His research interest is exploring formal and informal K-12 engineering education learning contexts. Specifically, he is interested in how the engineering design process can be used to emphasize the humanistic side of engineering and investigating how engineering habits of mind can enhance pre-college students' learning abilities.

### **Mrs. Kayla Renee Maxey, Purdue University, West Lafayette (College of Engineering)**

Kayla is a doctoral student in the School of Engineering Education at Purdue University. Her research interest includes the influence of informal engineering learning experiences on diverse students' attitudes, beliefs, and perceptions of engineering, and the relationship between students' interests and the practices and cultures of engineering. Her current work at the FACE lab is on teaching strategies for K-12 STEM educators integrating engineering design and the development of engineering skills of K-12 learners.

### **Dr. Morgan M Hynes, Purdue University-Main Campus, West Lafayette (College of Engineering)**

Dr. Morgan Hynes is an Assistant Professor in the School of Engineering Education at Purdue University and Director of the FACE Lab research group at Purdue. In his research, Hynes explores the use of engineering to integrate academic subjects in K-12 classrooms. Specific research interests include design metacognition among learners of all ages; the knowledge base for teaching K-12 STEM through engineering; the relationships among the attitudes, beliefs, motivation, cognitive skills, and engineering skills of K-16 engineering learners; and teaching engineering.

## **Diverse Researchers Researching Diversity**

*I am a black man currently studying as a fourth-year doctoral student in an Engineering Education Program. I am a community-engaged scholar operating from a critical research perspective, primarily focused on out-of-school educational experiences for black youth.*

*I am a woman with a multiracial heritage descending from Indigenous tribes in the United States, enslaved ancestors from Africa and the Caribbean, and European immigrants. I live within the intersections of life as an athlete, engineer, researcher, and mom. These intersections that I navigate daily are at the core of my research interests.*

*I am an American woman of African Descent with deep roots in Detroit and Native Cultures. I am an artist by passion and industrial engineer by trade. I conduct research on and within the cultures I am a part of (Marginalized peoples, engineers, artists and entrepreneurs).*

*I am straight, white male who completed a Mechanical Engineering degree. Having participated in engineering education as a member of the dominant culture, I saw opportunities where we could change the culture and be more inclusive and welcoming of diverse perspectives and people.*

*I am an Indian woman who is living abroad. Having moved between several social groups, cities, and countries since I was a child, I know what it is like to feel like an outsider. With my work, I strive to empower people to find home wherever they find themselves.*

In this paper we present autoethnographic work as a culmination of our personal narratives, to answer the pivotal question of how researchers from diverse backgrounds conduct research in issues pertaining to diversity in engineering education. Excerpts from these narratives that begin uncovering our identities and positionality are presented above. This work is situated in the understanding that research in diversity, the intentions behind it, the conceptualization of diversity and the people conducting it, are not identical.

Though we know there exist different conceptions of “diversity,” the focus of this work is to unpack the ways we describe and operationalize diversity. Simultaneously, we acknowledge that our experiences and the meaning we make of them are constructed and influenced by our cultural background. The following are our accounts of our positionality, the work we do, and the lessons we have learned along the way.

### **James Holly, Jr.**

I am a black man currently studying as a fourth-year doctoral student in the School of Engineering Education at Purdue University. I have Bachelor of Science (Tuskegee University) and Master of Science (Michigan State University) degrees in Mechanical Engineering. I am a community-engaged scholar operating from a critical research perspective, primarily focused on out-of-school educational experiences for black youth. I consider the work I do as efforts towards the prosperity of black youth. This means researching and teaching in a manner that

illuminates manifestations of antiblackness in American society (past and present), while simultaneously affirming the racial/cultural identity and intellectual capabilities of black youth. Racism is entrenched in American history and has led to continuous racial disparities across wealth/poverty, housing, education, and health dimensions among others, where black Americans can be found at or near the bottom of every measure. Therefore, I devote my scholarship and service to educating black youth with the intention of equipping them to identify and constructively challenge the structural inequalities and prevailing injustices that exists in society. My pedagogy is most prominently influenced by the works of Paulo Freire, Rev. Dr. Martin Luther King, Jr., and Gloria Ladson-Billings, though many other scholars, activists, and lesser-known individuals have shaped my motivation to attend to the needs of black youth, particularly those in impoverished urban communities.

I was born and bred in Detroit, Michigan, an urban metropolis once known for its automotive and musical innovation, and more recently known for high crime rates and deteriorating public schools. Notwithstanding, for me Detroit generates a sense of pride. There is great decay coexisting with great beauty, vulnerable and neglected people crossing paths with successful leaders of various sectors. This reality has given me a sobering perspective of the severity of disregard for certain populations in our nation; furthermore, I witnessed many in my community labor to alleviate the condition of those suffering, which is the aspiration I now embody. While many reference Detroit for its glory days of being the Motor City and Motown, I woefully reflect on the atrocities that led to the racial unrest in 1943, and the deindustrialization that precipitated the racial tumult during the summer of 1967. Both events are inconspicuous aspects of Detroit's past, that have direct connections to bringing about its current state. I do what I do because unfortunately Detroit is not an anomaly in regard to other predominantly black urban cities. True democracy depends on individuals collectively toiling to secure justice and equitable living conditions for these resource-forsaken communities.

I consider diversity to be a synonym for difference or variety, appearing in characterizations of opinion, religion, race, or any other classification of something or someone. Given the history of monolithic representations of black Americans, part of my work is exposing black youth (and others) to the diversity present among the lived experiences of black citizens. As an engineering educator and researcher, this elucidation of black life is crucial to authentically answering ongoing calls for broadening participation in engineering. I advocate for stakeholders in engineering to acknowledge the historic exclusion of blacks in engineering, and examine the resulting culture that has contributed to our underrepresentation in the field. Until then, I don't think the systematically excluded can be fully included.

## **Kayla R. Maxey**

I am a woman with a multicultural heritage descending from Indigenous tribes in the United States, enslaved ancestors from Africa and the Caribbean, and European immigrants. I live within the cultural intersections and the other intersections of life as a former collegiate athlete, an engineer, a researcher, wife, and mom. These intersections that I navigate daily are at the foundation of my research interests around how identities are developed and negotiated especially in hegemonic spaces like engineering. After working on global research and

development engineering teams, I can think of many situations during my journey where my identity was shaped, times where I negotiated identities to meet professional goals, and other moments where my identity was refined. As a member of non-dominant cultures, these experiences motivate me to focus my research on historically underrepresented communities in engineering to understand how members of these communities experience the discipline and how those experiences impacts their identification with the profession. By understanding these intersections, I believe we can create cultural shifts within the engineering profession that promotes acculturation vs. assimilation in order for the profession to create the greatest future societal impact.

My research assistantship works on a project to broaden the context in which engineering is introduced to students to increase participation by aligning the context to the personal interests of students. Within the context of this project, I am evaluating how the integration of teamwork within engineering influences whose contributions matter. Through this lens, I am able to explore how peer interactions in the context of engineering influences perceptions, attitudes, motivations, and beliefs toward the profession.

In addition to this project, I am working on a curricular project to improve the accessibility of quality engineering curriculum in informal learning spaces. This multifaceted project includes projects around curriculum evaluation to promote multiculturalism and representation of non-dominant communities, as well as, professional development opportunities for informal educators. This project is essential to the conversation of broadening participation because one cannot become what they cannot see. Therefore, this project seeks to shift the historical narrative about engineering to include and celebrate the historically hidden faces of the profession.

Each project tackles “diversity” differently with a focus on how to create or refine cultures that values and respects the contributions of populations not historically represented. Because each project uses the term “diversity” differently it is imperative as a researcher to define the problem under evaluation and how the evaluation empowers the community of interests. I believe that the relationship between research and diverse communities significantly shapes how the world interacts with members of these communities.

Therefore, it is equally important to include perspective of the populations of interests within the research projects to prevent recreating the status quo. Through including the participants viewpoint within the research project, researchers are able to evaluate their positionality and unintentional biases they may bring into a project. As researchers focused on diversity, this is essential to our work, to ensure the research we conduct does not continue to marginalize community despite our well intentions.

Because we are indoctrinated with binaries within US culture, I believe as researchers we should challenge the boundaries of the conversation and keep ourselves and colleagues accountable for the conversations we lead in our circles of influence.

**Chanel Beebe**

I am an American woman of African Descent with deep roots in Detroit and Native Cultures. I am an artist by passion and industrial engineer by trade. I conduct research on and within the cultures I am a part of including: marginalized peoples, engineers, artists and entrepreneurs.

My background motivates my research questions because participation in marginalized groups has resulted in experiences of personal and shared needs for resources and representation in socially powerful professions. The diversity of the needs experienced in these spaces have led me to take a constructivist view of the world because I have had to acknowledge that circumstance deeply influences the way meaning is developed.

My research assistantship unpacks the experiences of African American undergraduate engineers at a predominantly white institution. The context of this research sits tangential to conversations about diversity because it focuses on how a *lack* of diversity is experienced by those who find themselves unique in an otherwise homogeneous space. Though this project is funded by diversity initiatives, my research questions the experience from the perspective of students who *bring* “diversity” into predominantly white spaces. Through this lens I can understand what a lack of racial diversity means to those whose existence provides the very little of it that is found in their university spaces.

My dissertation research, on the other hand, looks at using the engineering design process for social problems in a way that prioritizes the autonomy and guidance of the community groups that experience the social problems. Within this space, diversity of perspective and priority encounters diversity of social power. Engineers working in these spaces, be they of a racial minority or not, come into the space with a certain level of social power that may or may not be shared by the community partners. This sort of “diversity” confounds the experience for all parties involved and forces me to take a dynamic lens in my research approach. I must both be sensitive to the values and needs of the community groups while simultaneously giving the engineers the chance to contribute to the problem space authentically.

My involvement in both of these spaces has pushed me to conceive of “diversity” as a deeply nuanced topic that depends on both context and the social power at play. As a result of these experiences, I am less inclined to enter conversations about “diversity” in isolation. In fact, I find most conversations around the topic to be both reductionist and problematic as they often forgo the very complex nature of the socio-cultural histories that have generated the “need for diversity” in certain settings. Additionally, I am resistant to conversations about “diversity and inclusion” because they often posit “diversity and inclusion” to be useful due to their ability to strengthen the quality of industry specific products and seldom ever seek to address the needs of the populations that they claim to want to “include.” In a sense, both terms have come to trigger thoughts of exploitation and feigned assimilation to serve the needs of a dominant culture who seeks to appease and pacify with trendy buzz words while simultaneously maintaining traditions of social distance that have historically and systematically disenfranchised certain groups.

My work advocates for traditionally underrepresented voices by prioritizing their concerns and priorities. By letting them dictate the research and design processes occurring in

my work, I allow them to have input on the types of conversations and interventions we experience together. By allowing them to become partners in my work, I make myself vulnerable to their reality. This vulnerability allows me to share a bit of the social power and capital that comes with being a researcher by requiring me to replace my own goals of ultimate novelty and extraordinary impact with goals of shared satisfaction and utility of the work we have done together. In a sense, by refusing to essentialize the diversity present in our interactions, I am able to experience the complicated identities present in these settings and give them space to flourish and design in ways that serve their needs and desires.

When it comes to issues that affect “small” groups of people, the question of how the issues of the smaller groups relate to the larger group will always arise (and usually arise first). The task for the researcher then becomes establishing the needs of the smaller group as valuable *independently* of the needs larger group. Though connections to the issues of the larger group may exist, it is important for issues of the smaller group to be valued inherently. Otherwise, critical issues of the smaller group may go ignored for lack of relevance to the larger group (perpetuating the initial marginalization)

Issues of diversity are different from issues of inclusion. Issues of diversity and inclusion are theoretically and practically different from issues of race relations, representation and oppression.

The function of America’s international and domestic prowess has been to confound issues of race and class. The function of a researcher who has experienced marginalization via both race and class is to both unpack and intertwine these issues in a way that reflects the complicated history and future of marginalized peoples.

## **Morgan M. Hynes**

I am an Assistant Professor in Engineering Education focusing on pre-college engineering education. I am a straight, cisgender, white male who completed a Mechanical Engineering Bachelor’s degree and a Ph.D. in Engineering Education from a department of education. In my graduate and post-graduate research work, I worked in many different pre-college engineering contexts/settings and was inspired by the solutions young students had for complex problems. However, I was dismayed with the underrepresentation of women and people of color pursuing engineering. Having participated in engineering education as a member of the dominant culture, I saw opportunities where we could change the culture and be more inclusive and welcoming of diverse perspectives and people, especially those underrepresented in engineering. I position myself in my research as a member of the dominant engineering culture who is a champion for change to create a more inclusive engineering culture. From my perspective, I believe the onus of transforming engineering culture to be more inclusive is really on the members of the dominant culture, and do not believe we are stepping up in a big enough way to create the change that is necessary.

I work on projects focusing on how broadening the contexts of engineering activities can broaden the appeal to diverse people. I work on emphasizing the humanistic aspects of engineering in activities I develop and test with students from Kindergarten through college.

My NSF CAREER project focuses on understanding how broader, more social contexts for engineering design activities can better appeal to grades 5-9 students' personal interests. In this context, I think about diversity in three distinct ways--the diversity of engineering, the diversity of solutions, and the diversity of people. The diversity of engineering relates to the diverse projects, fields, and domains engineers work on or in. My goal is to highlight to young students that engineers do much more than build bridges, buildings, and cars. The diversity of solutions relates to the idea that any problem will have multiple possible solutions and that each one brings its own unique benefits and tradeoffs. I want students to understand that engineering problems, unlike how mathematics or science is traditionally presented in the K-12 classroom, do not often have single, right answers. Lastly, the diversity of people relates to moving engineering undergraduate education and the profession to be more representative of the national population. With this intention, I aim to engage diverse groups of young students and conduct research to see how the activities may better appeal to students along the lines of gender and race/ethnicity, in particular.

A college level project I am currently working on focuses specifically on documenting the experiences of African American students studying engineering at a Predominately White Institution (PWI). The project is associated with a larger project aimed at transforming the culture of an engineering department to be a more welcoming and inclusive environment for African American students.

The biggest lesson I have learned in my work is that each person is individual and unique. While it is helpful to think about large groups of people underrepresented in engineering (e.g., women, African Americans, Hispanic/Latinx, Native Americans, etc.) and how you can better serve them as larger groups, I have learned that each person has their own beliefs, values, ideas, perspectives, knowledge and abilities and that an engineering education must adapt to each individual to make the most impact for that student. That being said, I do believe you need to move back and forth between the individual and group. Listening to individual's stories is impactful for understanding how something (e.g., an intervention, experience, etc.) really influences one's lived experience. I believe it can be a slippery slope to start to generalize data from individuals across groups based on gender or race/ethnicity; however, when coupled with the individual's story/data we as researchers and educators can be motivated to try new change that may make a difference. Additionally, I believe this kind of work is strengthened when you have multiple, diverse perspectives looking at and interpreting data and then communicating the findings.

### **Avneet Hira**

I am an Indian woman who is living abroad. I am an Aerospace engineer by training and currently pursuing a Ph.D. in engineering education. I love making things. One of the highlights of my undergraduate years was making and flying remote controlled aero models and other contraptions. My experiences working in the aeromodelling lab during my undergraduate years and then my experiences pursuing a Master's degree in Aerospace engineering made me realize that I often found myself pretending to be someone who I am not. I believe I most often did this

to feel accepted within a community of people and to be able to work with them. This included lying about the TV shows I watched, music I listened to, my hobbies, and then also not speaking up against and often playing along with masculine banter that was often sexist, racist, and definitely uncalled for.

Outside of my experiences in engineering education, I have lived in multiple cities, changed schools often, and have often been called “the new kid in class.” I remember having to introduce myself in class to strangers every couple of years and hoping to have a shiny enough lunchbox for others to want to sit with me. Along the way, I met several friends and mentors whom I have found comfort in confiding in, have supported me as I have asked uncomfortable and hard questions of myself and systems around me, and have championed by beliefs, passions, and craziness. These and several other experiences have made me realize the importance of camaraderie and community to ask, answer, solve, and sometimes just sit with issues of systematic disenfranchisement, especially issues that relate to the politics of knowledge production, attainment, and dissemination.

In addition to being reflective about how my everyday practices can offend, hurt, and make little of others’ stories and trying to be better every day, my outward facing professional life comprises research and service in line with the same. For the past three years, I was working as a research assistant on a research project that aimed at broadening participation in engineering in K-12 settings.

With my Ph.D. dissertation which is focused on the educational potential of Makerspaces, I research them as potential spaces for individualized learning where everyone’s interests, motivations, and skill sets are valued. Makerspaces as of now in the United States mostly conjure up images of racial, gender, and economic privilege. Activities and participants often ascribe to values associated with masculine nature, dominant racial groups, and equipment housed in these spaces is often too expensive for low SES populations to procure. With my work, I challenge this rhetoric of who gets to Make and whose knowledge is considered valuable in a Makerspace environment.

I am involved with a global non-profit organization that elevates and acts upon student voice affecting change in engineering education. We, students from diverse cultural, racial, and national backgrounds affect change in engineering and its education by generating and providing opinion at historically academy-benefitting national and international venues. My current role in the organization is of advocacy and empowerment. I support conversations between students, faculty members, deans, and industry professionals, to tilt the system which should be but I believe currently is not set up to serve the interests of students. I also work with several friends, colleagues, mentors, from all over the world on specific projects/forums which are in line with making engineering and more broadly the world a better place to live in.

One of the biggest lessons that I’ve learned is that you have to look inwardly as much, if not more than what you look outwardly to make any change happen. More often than not we and our actions are part of the problem. With most issues being systemic, usually, we are part of the system which is the problem and conforming to the system leads to confirmation of the adversities that come along with the system.



I've also learned quite a few lessons related to people, community, and being true to the change you want to see in the world. People are mostly good, and assuming best intentions works more often than I previously thought. Everyone has their agenda, and it might not speak very easily to yours, but that is ok. However, if you do believe in your agenda, you should continue taking steps in its direction. Community and camaraderie with individuals pursuing similar agendas are possibly the most significant supports I have had in doing my work.

### **Concluding remarks**

With these narratives, we begin to unpack our stories about conducting research with diverse populations. The running themes through our narratives are that of intention and differences. The reasons we do the work we do, and the changes we want to see in the world are not the same. This paper is our attempt to highlight some of the complexities and intricacies of work that is often indexed together as "Diversity Research" by the academy. By sharing our stories we seek to spark conversations about what it means for diverse researchers to research diversity. This work is situated in the understanding that research in diversity, the intentions behind it, the conceptualization of diversity and the people conducting it, are not identical.