

Towards Chemical Engineering Student Diversity: THE CASE OF INTERNATIONAL STUDENT EXPERIENCES AT TUSKEGEE UNIVERSITY

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Chemical engineering professionals play a major role in providing solutions to pertinent world problems, hence the need for educational institutions to ensure cultural competence of their students. This, in part, means the enrichment of student learning experiences through exposure to different ethnic backgrounds, cultures, and life experiences, as well as understanding international student experiences. Studies show that diversity in thought processes and perspectives on different subject areas creates more awareness and synergy towards innovative approaches to addressing problems. For example, Harvard University enrolls students from more than 125 countries and from every background. In the last two decades, the number of international students at Harvard has grown by more than two-thirds, so that today more than 20% of Harvard students are from outside the United States.^[1] It is the contention of the authors that the dynamism of culture and society at large requires enrollment equity regarding ethnicity, cultural background, and gender of students at colleges and universities. Suffice it to say that diversity in enrollment in such places of higher education in the United States is on the increase and will remain so for the foreseeable future. Such increase translates directly into diversity in the classroom and student experiences.

It is pertinent to bring to the fore that Tuskegee University is one of the nation's Historically Black Colleges and Universities (HBCUs). HBCUs are diverse even though such institutions are discussed as a category based on their historical racial makeup. According to the government's definition, black colleges, of which there are 103, are bound together by the fact that they were established prior to 1964 (the year of the Civil Rights Act) with the express purpose of educating African Americans.^[2] Henry and Closson^[3] posited that HBCUs were established during the time of "de jure segregation" in response to the educational needs of blacks and, as such, the institutions established a distinctive three-pronged mission, namely: developing (i) academic achievement, (ii) social

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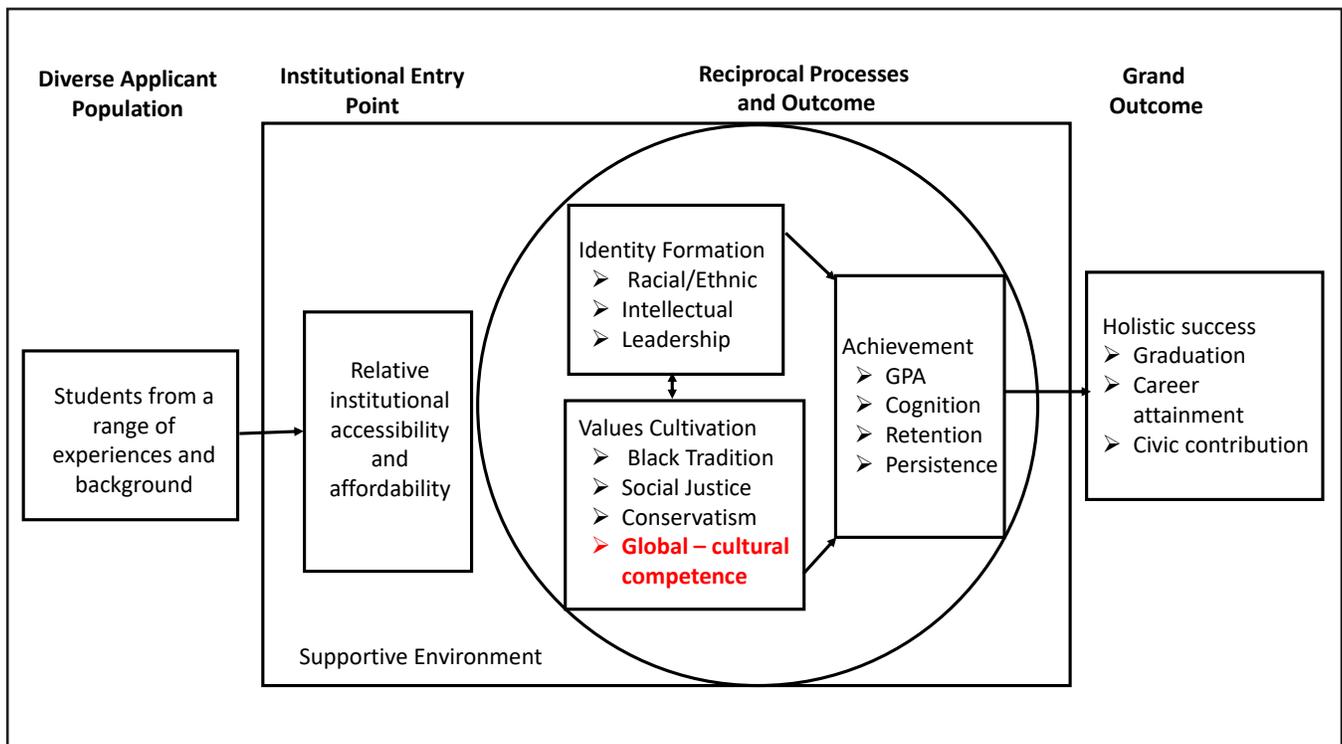


Figure 1. Framework of an HBCU-based educational approach for black student success. (Source: Arroyo, A.T.^[8] with permission. © 2014 Society for the Teaching of Psychology)

support and (iii) service to the black community and society at large. Henry and Closson (2010)^[3] also intimated that at the heart of the role of HBCUs is the elevating of the psyche of blacks from an enslaved segregated mentality to that of a black identity and conscious empowerment to confront societal injustice and create cultural awareness in the community. However, HBCUs currently enroll socioeconomically and racially diverse students including a significant number of African-American students enrolled in higher education. Thus, HBCUs make a significant contribution towards the United States' target of 60 percent of citizenry ages 24-65 obtaining a bachelor's degree by the year 2025.^[4] In fact, HBCUs have always been diverse in their student and faculty makeup unless forbidden by law, and some of the pioneering students and faculty at HBCUs were white students. Further, HBCU faculties are some of the most diverse in the nation, boasting, on average, 60% black and 40% non-black faculties.^[5-7] Diversity at HBCUs also extends beyond racial and ethnic categories. Undoubtedly, the black population at HBCUs is not monolithic because there are black students who are either first-generation or naturalized citizens (who may have come to the United States long before attaining college age), or internationals. The first-generation students constitute those who were born in the United States to black immigrant parents whereas the internationals belong to the group that came to the United States for college education. The members of each of these groups have different levels of assimilation and

experiences that manifests in the classroom. The uniqueness of HBCUs' training or education is embedded in the holistic approach that admitted students receive. This comprehensive education combines three points of convergence namely: supportive environment; improved academic achievement, as well as identity formation; and values cultivation. These three points of convergence are vividly described by Arroyo and represented schematically in Figure 1. According to Arroyo^[8] "Achievement represents traditional cognitive measures associated with higher education, identity signifies areas of formation of self-concept related to race, intellect, and leadership, and values connects to the unique blend of conservatism and progressivism that defines the traditional African American ethic." For example, at Tuskegee University part of the mission statement reads that "We stress the relationship between education and employment, between what students learn and the changing needs of a global workforce." In that regard, a modification of the Arroyo model under values cultivation to capture global-cultural competence is relevant to our mission and included here. A cultural competence is achievable in a multicultural classroom.

In a UCLA Faculty Development and Training document, Garibay^[9] contends that engaging in issues of diversity in the classroom is critical and a first step toward creating a welcoming classroom environment for diverse students. It is important to indicate that such a welcoming classroom environment enables student engagement and instructor enthusiasm for

very successful academic work. Further, the observation by Garibay^[9] is consistent with the American Association of Colleges and Universities (AAC&U) initiative that partly describes paying attention to the cultural differences that learners bring to the educational experience that enhance the educational enterprise, and a welcoming community that engages all its diversity in the service of student and organizational learning.^[10] It is interesting to note that researchers have reported that students at liberal arts colleges have more frequent experiences with diversity than do their peers at other types of institutions.^[11,12] In the view of the authors, this may be because many liberal arts colleges have policies and practices designed to prepare their students for a diverse democracy. The authors concluded that what ultimately really matters is what students encounter

in their studies that reflects a range of human experiences and that students are encouraged and supported to interact with others in ways that help them think and respond in novel, more complex ways to contemporary circumstances. Thus, ensuring that students gain valuable experiences with diversity during college is not a matter of resources or location, but a matter of institutional will. A more pluralistic view, expressed by Hurtado and Ruiz,^[13] is that college is an ideal environment for students to encounter diversity in racial or ethnic differences, and where they can build awareness and appreciation of such differences, and learn how to treat others as equals and with dignity. Additionally, the realization of the benefits of diversity on campuses can be enhanced for the students through the provision of co-curricular experiences that enable them to interact with others from different backgrounds, perspectives, and beliefs.

There are, however, contrary views about cultural diversity in the classroom. For example Alsubaie,^[14] in agreeing that classrooms are becoming increasingly multicultural, contends that differences between cultures in communication or interpersonal contacts of students in the multicultural classroom give rise to issues such as low academic performance, longer time to adjust to new cultures, and problems with self-trust (Figure 2).

While there is scarcity of literature on the challenges of the multicultural classroom, some studies also show that there are many levels at which learning styles differ from country to country. For example, Witsel^[15] argues that there are natural ways in which the style of teaching and learning at a “home” country would influence the study skills that the students would have developed, and that would determine the way in which they handle study skills expected of them in a westernized educational setting. The suggested differences in educational styles are listed below:

- *Relationship of lecturer-student (formal vs. informal, big*

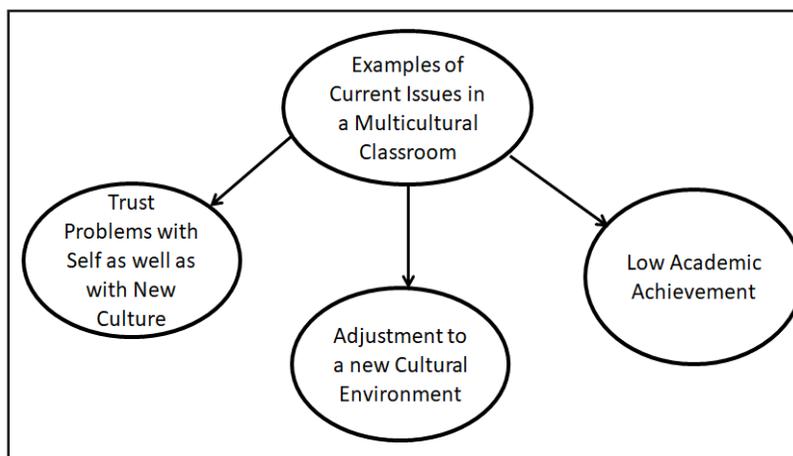


Figure 2. Example of current issues in the multicultural classroom. (Source: Alsubaie^[14] with permission. © <www.iiste.org>)

vs. small power difference);

- *Interaction in class (not done vs. questions and critical answers are expected);*
- *Relations between students (harmony in the group vs. individual performance);*
- *Time (being on time is not relevant vs. being on time is important);*
- *Regulation of learning process (mainly by lecturer vs. mainly by students);*
- *Aim of learning (emphasis on theory vs. emphasis on understanding and application); and*
- *Uses of technical resources/media (limited vs. much).*

Although these challenges may exist, there is strong evidence that diversity is very important in that a diverse student body benefits teaching and research by increasing creativity, innovation, and problem solving.^[16,17]

At Tuskegee University, the Department of Chemical Engineering recruits international students from different parts of the world with the aim of diversifying the overall learning experience of the students. Represented continents include Asia and Africa with the majority of the students hailing from the Persian Gulf Region. The incorporation of these students into the program is providing a platform for interaction between different cultures and harnessing the synergy therein for an exciting learning experience. In designing this work, we focus on the origin of the student, experiences with the cultural transition, any challenges with English language as the medium of instruction, and other important issues within the context of the student learning experience. Therefore, our aim is to: (i) understand how the issues of multicultural classroom—namely adjustment to new culture, trust with self and new culture—may influence or affect the student learning experience with consequences in perceived low academic

achievement; and (ii) formulate intervening strategies to address shortcomings.

METHODOLOGY

Due to the relatively small population of international students in the Department of Chemical Engineering, a focus-group approach was adopted to collect relevant information for analysis. Focus group discussion questions were designed based on the challenges of multicultural classroom raised through the work done by Alsubaie.^[14] To recruit participants, we utilized a purposeful sampling approach. Our goal was to select and reach out to international students in the Department of Chemical Engineering. Using email addresses, we sent email invitations, which included a description of the study, an informed consent form, and a request to participate. Due to the small population size, we decided to combine the survey with a focus-group discussion. A survey questionnaire developed in Google Forms was then sent to prospective participants, to which eight individuals responded. However, only four attended the focus-group discussion. All participants were international students from mainly two geographical regions of the world. At the focus-group discussion, all participants were given the opportunity to address every single question asked, as well as any follow-up questions. The discussion session was audiotaped with the permission of participants. Relevant parts of the discussion are captured here. In selecting which sections of the discussion to publish, the authors carefully chose portions that protected the identities of our students who participated in this study. The results of this preliminary study are summarized in Figures 3A and 3B (following pages).

As indicated earlier, the focus-group discussion questions were based on the three thrust areas resulting from the Alsubaie^[14] work. The discussion questions were categorized into three groups and are detailed below:

(a) Trust Problems

- (i) *Did you experience any kind of struggle trying to fit into the new culture and education system?*
- (ii) *Did you harbor or experience any fear of being wrong or misunderstood in class?*

(b) Adjustment to new cultural environment

- (i) *What was the hardest experience during your adjustment period to a new cultural environment?*
 1. *Social interaction?*
 2. *New teaching methods or styles?*
 3. *Use of unfamiliar technology?*
- (ii) *What do you think would have made your learning experience better or easier (for example, a TA for every single course you took)?*

(c) Academic achievement/performance

- (i) *Do you think your GPA is a true reflection of your academic ability or you could have done better?*

College is an ideal environment for students to encounter diversity in racial or ethnic differences, and where they can build awareness and appreciation of such differences, and learn how to treat others as equals and with dignity. Additionally, the realization of the benefits of diversity on campuses can be enhanced for the students through the provision of co-curricular experiences that enable them to interact with others from different backgrounds, perspectives, and beliefs.

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- (ii) *To what extent do you think the lack of knowledge of technology hampered your learning experience?*
 - (iii) *To what extent has language hampered your learning experience?*
 - (iv) *Do you think that cultural difference affected your social interaction ability, for example, your participation in study teams, thereby putting at a disadvantage in your learning experience?*

RESULTS AND DISCUSSION

In order to investigate the concerns of multicultural classroom issues, both survey (using Google Forms) and focus group discussion instruments were used. It is important to emphasize that the subjects of this investigation are the international student population in the Department of Chemical Engineering at Tuskegee University. Hence, the use of both survey and focus group instruments is to somewhat compensate for the small sample size. In all, eight international students representing roughly 10 percent of the total chemical engineering student population at Tuskegee University participated in the survey and focus-group discussion. It is worth mentioning that the undergraduate international student population in the department has seen improvement over the last decade rising from zero to the current number. It is also for this reason that the department recognizes the need to understand international students' experiences.

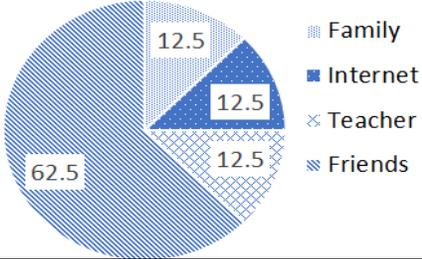
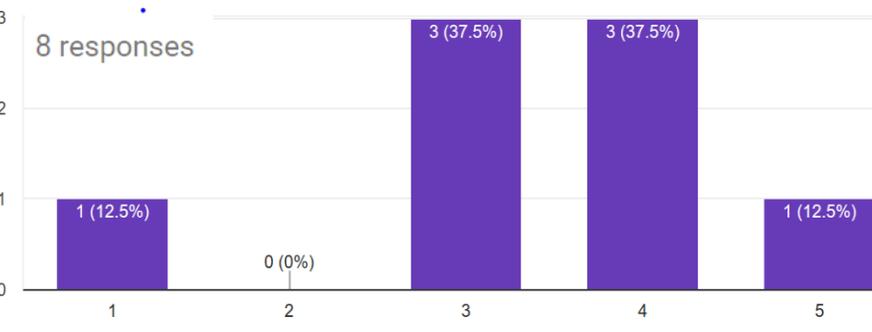
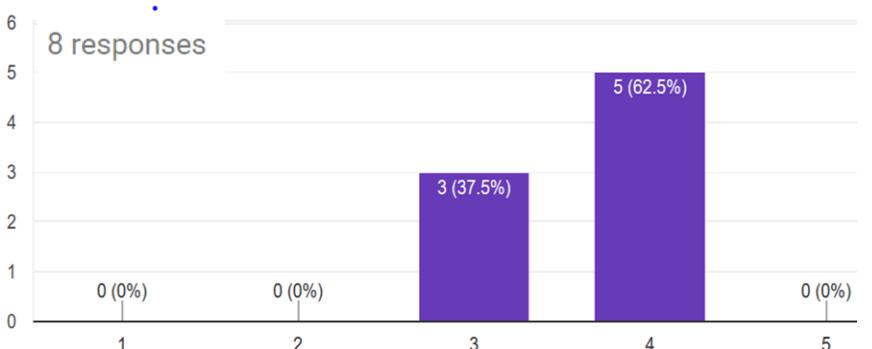
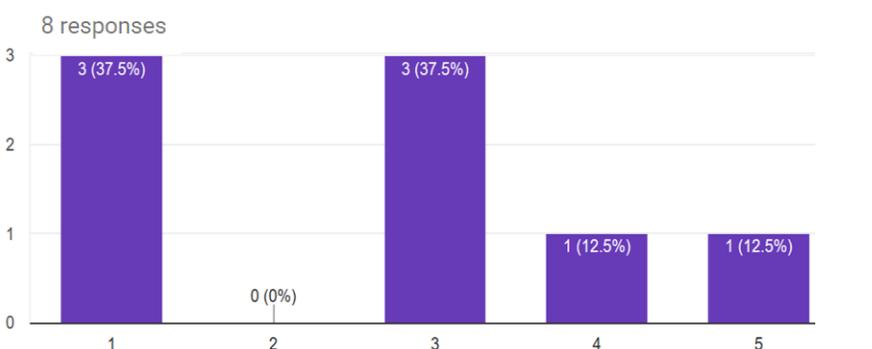
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The medium of instruction at Tuskegee University is English Language. On a scale 1-5, please indicate the extent to which this is a hindrance to your study goal? (1 means Not at ALL, 5 means Very Difficult)	<p>8 responses</p>  <table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3</td> <td>37.5%</td> </tr> <tr> <td>2</td> <td>0</td> <td>0%</td> </tr> <tr> <td>3</td> <td>3</td> <td>37.5%</td> </tr> <tr> <td>4</td> <td>1</td> <td>12.5%</td> </tr> <tr> <td>5</td> <td>1</td> <td>12.5%</td> </tr> </tbody> </table>	Rating	Count	Percentage	1	3	37.5%	2	0	0%	3	3	37.5%	4	1	12.5%	5	1	12.5%
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Figure 3A. Summary of student response to questionnaire (part 1).

The students also responded to how they heard about the chemical engineering program at Tuskegee University and 65% indicated from friends. This could be an indication that international alums are giving positive feedback about the department. On the hot button issue of English as a second

language (ESL), only 1 (~12%) indicated that the English language is a challenge as far as his/her studies are concerned. In addition to the information provided in Figures 3A and 3B, the focus group discussion offered students the opportunity to address specific issues of the multicultural classroom relevant

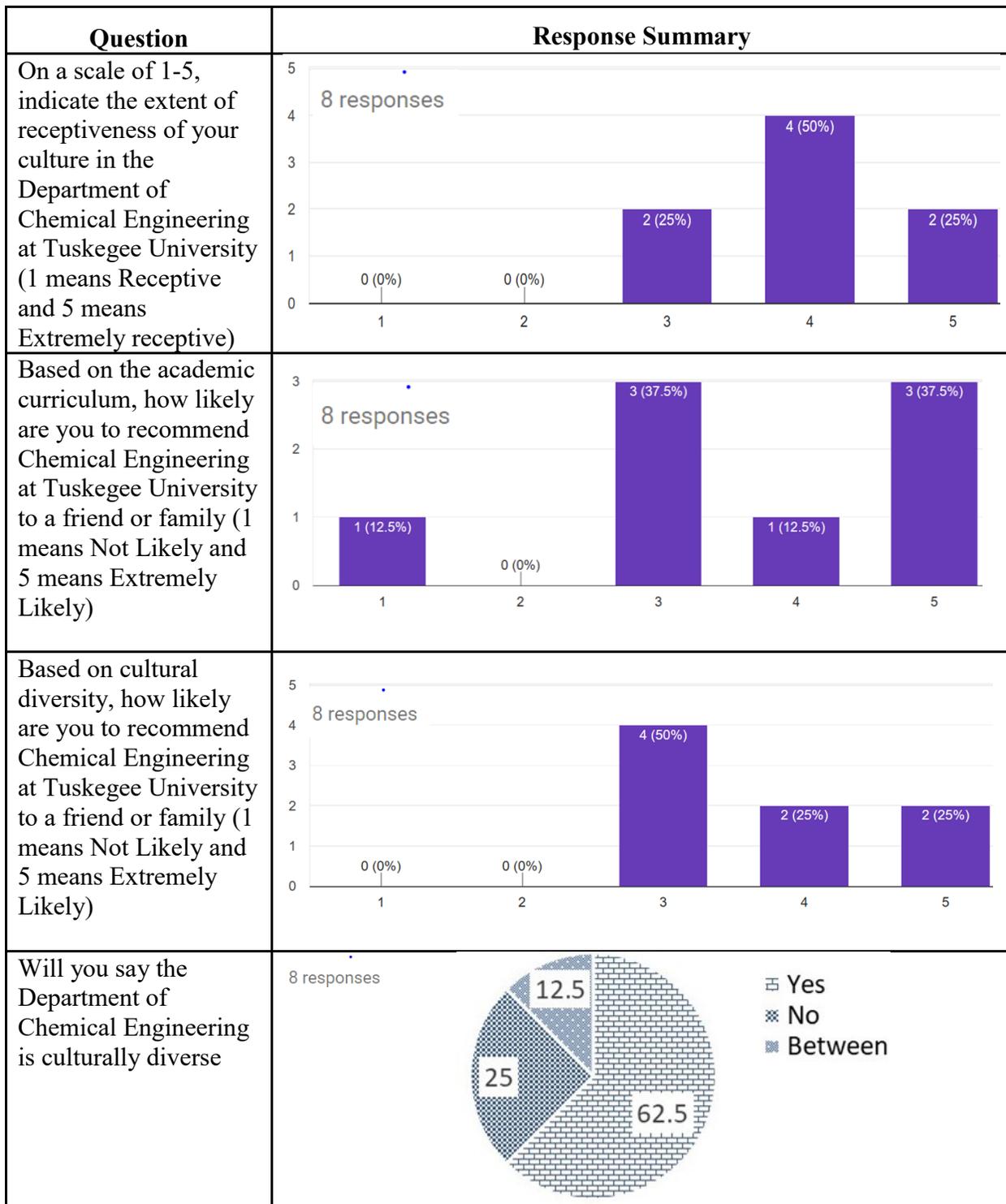


Figure 3B. Summary of student response to questionnaire (part 2).

to their academic progress and/or success in the chemical engineering program. Given that the black race in the department is not homogeneous due to the inclusion of first-generation and international blacks, and that the department currently recruits from the Persian Gulf, it is imperative that for purposes of quality control and student learning outcomes, the voices of students are heard and concerns expressed are addressed in the management policies. The students' responses are captured and categorized into three headings according to the current issues of multicultural classroom.^[14]

Trust Problems. All the respondents expressed concerns about self-trust especially in the first semester of their study. It is important also to indicate that the level of this concern as well as the duration of overcoming these challenges varied for different students. The direct expression of the students is captured below.

“Okay, in terms of the class setup, I’d say one of the biggest struggles I went through is the feeling of being part of the group and the program. Umm, because there was this first impression of feeling that things are being done differently, and I was different; I spoke differently. I definitely have a thick accent coming straight from Africa with a British type of English language. For example, on the first day of class during the self-introduction I couldn’t hear/understand a lot of my colleagues and when it was my turn, I had to repeat myself several times for them to understand me. Also, sometimes in class I’d ask a question and everyone would be like ‘Uh [student name], we didn’t understand you.’ Those were some of the preliminary challenges that I encountered. In fact, both professors and students had difficulty understanding me. When you say entertained the fear, I think I didn’t have a choice. The fear was inherent. The fear of being misunderstood or saying the wrong things. I’d say by the end of the first semester, I got over much of this fear.”

“I didn’t have the fear of being wrong but rather what people thought about my accent. I thought people would say my accent was funny and that somehow limited my interaction and participation in class because I didn’t really want to be perceived as a stranger. Again, for me, the language barrier was more of the content than accent. Growing up at home, I become familiar with the American accent through watching TV shows. However, how they construct their sentences was quite different for me and I had to learn. I didn’t have any challenge understanding the lectures in class. This is in part due the diversity in race and culture of the faculty in the department and so I didn’t have any difficulty in terms of understanding the content of lectures.”

“To be honest with you, they help us a lot. Especially the people in the admissions office. They’re fantastic. I didn’t have any problem with self-trust. I think the difficulty is the English language. I complete high school before coming here. I made TOEFL through an online program at Auburn University. The biggest challenge is understanding what I say or what the teacher says.”

“No, I never had any difficulty with problems of self-trust. I contribute in class as much as I can and if I get corrected because I might have given a wrong answer, I appreciate it because for me it’s part of the learning process.”

Adjustment to new Cultural Environment. As seen in the data, 50% representing four out of eight respondents rated their cultural adjustment or acceptability at 4 out of 5. This is an indication of some degree of challenge with the cultural transition. Some of the direct experiences are captured below.

“In terms of adjustment to new culture, I really would say the hardest for me was social balance and getting to fit in. Particularly, learning to work in teams with people who thought differently, and learning to get into a conversation even if it was just about classwork or current affairs, or things that will make me bond better to feel like I’m part of the system. I think that take me a while. I had to go through a lot acquaintance and learn to pick what type of conversation and with whom. For me, that was a milestone and looking back from where I am today to where to where I had come from, I think it had been one my greatest achievement here. I have made friends and have study teams that I could share my knowledge with and exchange perspectives that expose my mind a whole lot to the American culture. The use of technology was also a challenge. I was exposed slightly to the use of computers in the final year of high school. I initially had difficulty with simply use of Microsoft Office applications for basic word processing. In terms of technology, I was way behind the rest of my American colleagues. For example. I had to learn how to type faster.

“I’m a graduating senior of chemical engineering. Yeah, in terms of culture the American system is very different from that home. There are couple here and there that I encountered. For example, in my first semester I struggle with what food to eat. Then I also had difficulty with way people communicate, not necessarily with the accent but the kind of slangs that is used sometimes. For me, I’m extremely introverted and shy and wouldn’t go out of my way to talk to people. I guess that affected me in relation interacting with my colleagues. I feel like if I were a little bit outgoing, I probably wouldn’t have had to go through the experiences that I had. For example, my name is hard to pronounce and so that also became part of my challenges. Yes, if there is anything I have learned in addition to chemical engineering, it is social interaction. I believe the American society is built on one’s ability to interact and if you’re not interactive, you’re not really going to achieve much. I’ve learned that there is really nothing to be shy about and we must go out there and interact with people and network, especially for international students. You’ll be surprised to know how much people are willing to learn about you. Yes, I had some deficiency in the technology applications particularly in the area MS Office applications. I had to do a lot of catching up. I believe department well putting in place Software like Aspen Plus largely used by chemical engineering professionals and we have been trained on how to use such software. I will say social interaction was my hardest experience. I’ve learned that no man is island and I needed to work a lot on that part of me.”

“The teacher here, maybe they don’t understand what I say. That kind situation was my biggest problem. Sometimes they have to explain it to me. The students largely can understand what I say. I think Tuskegee University can also have an English Proficiency program to help those of us who came from systems where English language is not the medium of instruction. I think that the department can also organize some kind ice-breaking or socializing events for the students to facilitate social mixing. The technology here is just like at home. However, the major is the language. Also, at home we don’t have access to Facebook. When I came to America I got a Facebook account through which I can interact with our American friends. My hardest experience is with technology and that is because of the language. I’m easy-going and can easily make friends.

“I was 12 years when I came to the United States. I had the opportunity to visit home every year until I started college. My hardest transition was experienced in high school than here at Tuskegee. Also, Tuskegee University is a very diverse community and I don’t have any problem at all. French is my first language as there is no direct translation from French to English and so that was a bit of a problem. It was hard at first but with time it became easier. In terms of social interaction, I had no difficulty whatsoever. I feel like a lot of times the American students want to have international student friends. But the internationals are kind of scared to get out there. I think this kind of thing is a personal issue for different individuals, and such people may have to work on themselves. Yes, being the [leader of a campus organization] has help me in many ways. That’s how I met a lot of people, both internationals and American students, [Americans] just want to have experience with the international. I made a lot of friends in any other programs as well. My only challenge is the language and because of that I think the teaching style is most difficult challenge to overcome. For example, I had a hard time combining history and English classes with those of engineering. I like the way the professors go through problems in class. I like that a lot, that’s what helps me.”

ACADEMIC ACHIEVEMENT/PERFORMANCE

“Oh yes! my I feel like I’ve been very trained and prepared for future challenges. My chemical engineering curriculum has been very fulfilling. I have been able to learn both theoretically in class and practically in the labs. I’ve been able to experience great internships which I got the opportunity right from Tuskegee University, putting me into different organizations and companies. I’ve been nurtured into a well-round leader and a chemical engineering professional who can apply the knowledge out there to make a difference.”

“I think the department is doing such a great job with respect to the training we’re getting from here. For example, in design classes, we are challenged in a way makes you feel like you learn something but the time you get through. I will give the department a thumb up for that. Yes, as far as the amount of knowledge I have is concerned I’ll, yes, I’ve been well trained. Does my GPA reflect my knowledge, I’ll

say no. I believe that I know much more than is reflected in my GPA, and that goes to the social interaction issue. I feel like I’m more intelligent than my GPA says.”

“I think we need TAs so that we can get more contact time. That will make life easier in terms the understanding the course materials. Yes, my stay here has been worthwhile. I’ll give myself 80% on that. Yes, I believe I’ve been well trained. The faculty have been extremely helpful to us.”

“Yes! I feel like I’m getting the right kind of training. For example, during the last spring break I had difficulties four of the chapters. It turned out the professor had something doing in office and came around every day. I used the opportunity to seek his help and I got over those challenges. So far so good. I definitely feel like my ability is expressed in my GPA. I also realized that when I put in more work it shows up in the grades.”

In summary, the focus-group discussion addressed different aspects of the student experiences with regards to challenges with self-trust, adjustment to new culture, and academic performance. While the students unanimously were of the opinion that their self-trust was never in doubt, they were, however, intimidated by their accent with which they spoke. Only one student representing 25 percent of the focus group participants came to the United States prior to high school age and for him, this type of transition was achieved earlier. In terms of transition into a new culture, the students unanimously reiterated that the hardest part was the communication barrier—the difficulty of understanding the language and being understood. This challenge manifested in areas such as their ability to participate in groups or as teammates. The students also agreed that the nurturing of the campus community (including their interactions with faculty and personnel of the admissions office) contributed tremendously to their transition. On academic performance, 50 percent of the students believed they are doing great and that their performance is a true reflection of their ability. On the contrary, the other 50 percent agreed that they have been well trained, even though their grades are not a true reflection of their academic ability. As much as the students agreed on the challenges observed by Alsubaie,^[14] they disagree that these challenges translate into low academic performance.

CONCLUSION

The student experiences shared not only provided evidence of challenges in the multicultural classroom, but also demonstrates that such experiences are unique and depend not only on the background but also on circumstances and personality. Even though all the students interviewed admitted to having some challenges due to their background, these challenges were overcome by the end of the first semester of the freshman year or the sophomore year. The diverse nature of the Department of Chemical Engineering is creating this culturally responsive teaching environment as a technique for improving

the student experiences and performance. Specifically, the department consists of faculty members with various origins such as West Africa, Southeast Asia, Middle East, Far East Asia, African American, and white American. In agreeing with Alsubaie that teachers who learn more about their students' backgrounds, cultures, and experiences will feel more capable and efficient in their work as teachers, we also believe that a more diverse faculty will be an asset in this endeavor. With Tuskegee University being an HBCU, learning outcomes are highly related to the supportive environment. The Department of Chemical Engineering is providing such an environment to enhance students' experiences. Our students learn and understand a variety of social traditions, foods, and cultures from our faculty members. We believe that these students are equipped to and can easily adapt to global assignments, since human relationship is more dominant than technical knowledge in a global economy. Tuskegee University is an HBCU. Thus, the lessons learned in this study have particular relevance to other HBCUs with engineering programs.

Additionally, there are some lessons learned that may apply in any institutional context although generalizations of these results is limited due to our small sample size. First, based on this study and others, word-of-mouth is important for growth in international enrollment. If students have a good experience, it spreads through their networks and appears to yield corresponding increases in enrollment when controlling for other variables. Second, belonging is particularly nuanced for international students with issue of accents, language barriers, and food choices cited. Institutions would benefit from dialogue with international students to understand how best to address these issues while remaining culturally sensitive, and our department is taking such steps to engage more. In this way, we would improve the classroom experiences of our students as echoed in the Alsubaie work.

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