Active diversity interaction: making choices

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Abstract

This paper describes a program designed to encourage interaction between minority and majority student groups in engineering. Multicultural engineering advocates at Kansas State University, a predominantly white institution, developed a program designed to increase communication and interaction between multicultural engineering students and the general engineering student population. This program, *Making Choices*, was presented to Introduction to Engineering classes within different engineering disciplines to encourage students to engage in active diversity interaction. We defined active diversity interaction as seeking out opportunities and choosing to interact with students outside the groups in which they normally networked. During the activity, students interacted and discussed (1) underrepresented populations in engineering, (2) the need for diversity in engineering, (3) interaction opportunities, and (4) the benefits of diversity to all students. The presenters described research that has shown advantages gained from choosing diversity interactions in an academic setting, including physical and psychological health, cognitive growth, improved information transfer, and higher academic achievement. After the discussion, the students created graphs of the number of weekly interactions they had with persons of representative groups in the College of Engineering. For most students the graphs were curved showing that they had large numbers of interactions with just a few groups and small numbers of interactions with other groups. However, in the ideal engineering environment, the line should be nearly flat, showing similar numbers of interactions with all groups. A survey after the activity measured the affective responses of the students to the activity. Results of the survey indicated students tended to agree more with affective responses in the Organization category of Krathwohl's Affective Domain than with those in the Valuing category. We concluded that many students incorporated diversity interaction into their value systems but were unwilling to self-initiate diversity interactions. We believe this indicates a need for diversity interactions to be included in the engineering curricula in order to provide the benefits that researchers have attributed to interaction between diverse groups, including improved cognitive growth and academic achievement.

Introduction

This paper describes a program developed to create awareness of the benefits of interaction between diverse groups of students in the College of Engineering at Kansas State University, a predominantly white institution. The program, *Making Choices*, was presented to Introduction to Engineering classes within different engineering disciplines to encourage students to engage in *active diversity interaction*. We defined active diversity interaction as seeking out opportunities and choosing to interact with others outside the groups in which one normally networked. The educational philosophy of the authors is that diversity interaction benefits all students, but needs to be actively encouraged by the University. The learning strategy employed for the Making Choices program was group discussion/interaction, followed by a graphing activity created to address numbers of diversity interactions by the students. Descriptions of the Multicultural Engineering Program (MEP) and the summer bridge program, Multicultural Academic Program for Success (MAPS), are included.

Background

The Multicultural Engineering Program (MEP) at Kansas State University was created to establish learning communities, mentoring, and financial assistance for multiethnic students. A complimentary summer bridge program, Multicultural Academic Program for Success (MAPS), enhanced the program. In the summer before their freshman year, MAPS students participated in an orientation program followed by enrollment in a summer schedule composed of College Algebra or Chemistry I, a kinesiology course, and a university experience course for a total of five to six hours of classes. During the six-week summer session, MAPS students learned about the biofuel industry and developed engineering projects on biofuel topics. MAPS students were housed in university dormitories and supervised by engineering student mentors and MAPS administrators. Evenings were spent in study halls, mentored by university students. Additional activities included a high ropes challenge, cultural trips, community activities, and professional development. Field trips to an industry research facility and biofuels plant allowed students to make connections with sponsoring corporations. The program was funded by corporate partners and was free to the participants. During the fall semester, MAPS engineering students were mentored in the Multicultural Engineering Program, MEP. MEP students participated in an MEP orientation course and mentoring activities throughout the year, including career fair shadowing and talks by industry representatives. Since the institution of MAPS in 2007, the numbers of multiethnic students in MEP grew from 127 in 2006 to 216 in 2011, representing an increase of 70%.

Need for Diversity Interaction

As numbers of multiethnic engineering students increased, the program directors noticed that the multiethnic students formed close bonds and maintained active learning communities. While multiethnic students were mentored in leadership skills, a small percentage of them participated in student professional organizations outside MEP and design teams within the College. Research has indicated that participation in activities contributed to student retention and academic success.[5] The directors developed a program to create awareness of the Multicultural Engineering Program, show the benefits of interaction between diverse groups, and encourage diversity interaction. This program was developed for all groups, minority and majority, and was presented to first year Introduction to Engineering classes in three of eight engineering departments.

Purpose of the Study

Studies have been conducted to determine the effect of diversity interaction on campus climate, individual students, learning, and academic achievement.[6, 7, 13] Researchers determined that diversity interactions were beneficial to students, and some called for diversity in the curriculum.[6, 7, 13] We wanted to determine the attitudes and interests of engineering students in diversity interaction. Our primary purpose was to determine the immediate affective impact on the students. We wanted to know if this topic interested students and where it fit within their interests and values.

Research Questions

1. What is the affective impact of the Making Choices program on engineering students?
2. What are the affective responses of engineering students toward diversity interaction?

Literature Review

Research indicated that diversity interaction enhanced personal and academic growth and influenced student motivation and intellectual engagement.[6, 7, 13] Erikson concluded that college students benefitted from the opportunity to interact and experiment with different social ideas and values.[3] Yet, most student interactions are with people like themselves. The tendency to engage with others of the same age, gender and race, termed homophily, is common within most social and academic settings.[15] Research suggested that while communication may be easier within homophilous interactions, communication in heterophilous interactions may be more effective in transmission of new information.[9] Gurin et al. reported that interaction among diverse groups was supportive of cognitive growth and academic achievement.[6] They suggested that colleges and universities should provide informal opportunities for diversity interaction on the basis that such interactions stimulated active thinking and cognitive growth.[6] Drawing on the work of Piaget, Gurin et al. concluded that interaction among diverse peers created the relational disequilibrium that fostered cognitive growth.[6] According to Piaget, new ideas, circumstances, and surroundings enhanced cognitive growth by creating discrepancies and discontinuities.[14] This process, which Piaget termed disequilibrium, stimulated active thinking, seeking new information, and processing.[14] American students often have their first significant diversity interactions in the university environment. An institution that promotes authentic communication between diverse students creates a positive environment for "active thinking and intellectual engagement" (p. 19).[6]

Maslow's Hierarchy of Needs is a familiar concept in education; basic needs must be fulfilled before higher level needs, and learning is more effective when basic needs such as food, shelter, and safety are met.[10] Maslow also developed the concept of *growth-choices*.[12] Growth-choices were choices that required moving outside one's comfort zone, getting to know persons outside one's normal group, and trying new and unfamiliar experiences and activities.[11,12] According to Maslow, persons who actively sought growth-choices benefitted from those opportunities through improved psychological and physical health.[11, 12] Characteristics of a healthy person included openness to experience and improved cognition.[11,12] Fishbein and Azjen emphasized the need for interaction experiences in their Expectancy-Value Model.[4] According to Fishbein and Azjen, attitudes were one's positive or negative evaluation of others based on beliefs, where beliefs resulted from the knowledge that a one had about others.[4] Providing genuine interaction allowed students to gather accurate, representative knowledge about their peers.[4]

Conceptual Framework

The conceptual framework for this study included Nelson Laird's position that positive interactions among diverse college students improved "academic self-confidence, social agency, and critical thinking disposition" (p. 385).[13] Nelson Laird determined that college students benefitted from informal interactional diversity and classroom diversity.[13] Informal interactional

diversity referred to social incidental interactions between diverse students such as in residence halls, while classroom diversity referred to curricular experiences that exposed students to new information and ideas about diversity.[13] Nelson Laird concluded that diversity should be a part of the academic curriculum, and opportunities for diversity interaction should be encouraged in the college environment.[13] Krathwohl's Affective Domain was used as an indicator of students' affective internalization of diversity interaction concepts.[8] Krathwohl defined the Affective Domain as responses, which indicated "a feeling tone, an emotion, or a degree of acceptance or rejection" (p. 7).[8] Krathwohl theorized that affective responses of subjects could be determined from statements and behavioral responses.[8] In this study, a diversity program presented the benefits of diversity interaction to engineering students. This study examined students' affective responses to the program in terms of Krathwohl's Affective Domain.

Active Diversity Program

The Director of the Multicultural Engineering Program and the Retention Coordinator created the active diversity program, called Making Choices. As multicultural engineering advocates, the directors determined that a need existed to foster interaction between diverse groups. The program, Making Choices, introduced the concept of *active diversity interaction* to engineering students. Active diversity interaction was defined as seeking out opportunities and choosing to interact with students outside the groups in which they normally networked. Making Choices was designed to (1) develop awareness of underrepresented groups in the College of Engineering, (2) explain the need for diversity in the engineering field, (3) develop awareness of the number of daily diversity interactions experienced by engineering students, and (4) identify the benefits of diversity interaction. The program was presented to Introduction to Engineering classes containing a mixture of minority, multiethnic, women, and majority white male students. Students participated in interactive discussions and a graphing activity of diversity interactions.

Presentation

The program began with introductions of the three presenters, the Assistant Dean for Retention Diversity, and Inclusion, the Multicultural Engineering Program Director and the Retention Coordinator. Each presenter described her role in the College of Engineering and included a fun fact about herself. Students were then asked to introduce themselves to three people around them and include their own fun fact. The presenters described the Multicultural Engineering Program (MEP) and the Women in Engineering (WiE) program, along with Scholars Assisting Scholars (SAS), a tutoring program administered by the Retention Coordinator.

Collaborative Discussion

The presenters explained that underrepresented students in engineering included women, African American, Native American, and Hispanic students. Students in the audience were asked to discuss with those around them the need for MEP, and share those answers with the rest of the audience. The MEP Director, female, Native American, and mathematician; and the Assistant Dean, female and professional engineer, shared their perceptions of being Native American and female in their engineering and mathematics classes and about talking to large groups when few in the audience were like themselves. Students were asked to discuss with each other the need for

support programs such as MEP and WiE. After volunteers shared their group's responses, the MEP Director discussed benefits of having diverse groups represented in engineering, including improvements in communication, safety, and health considerations.

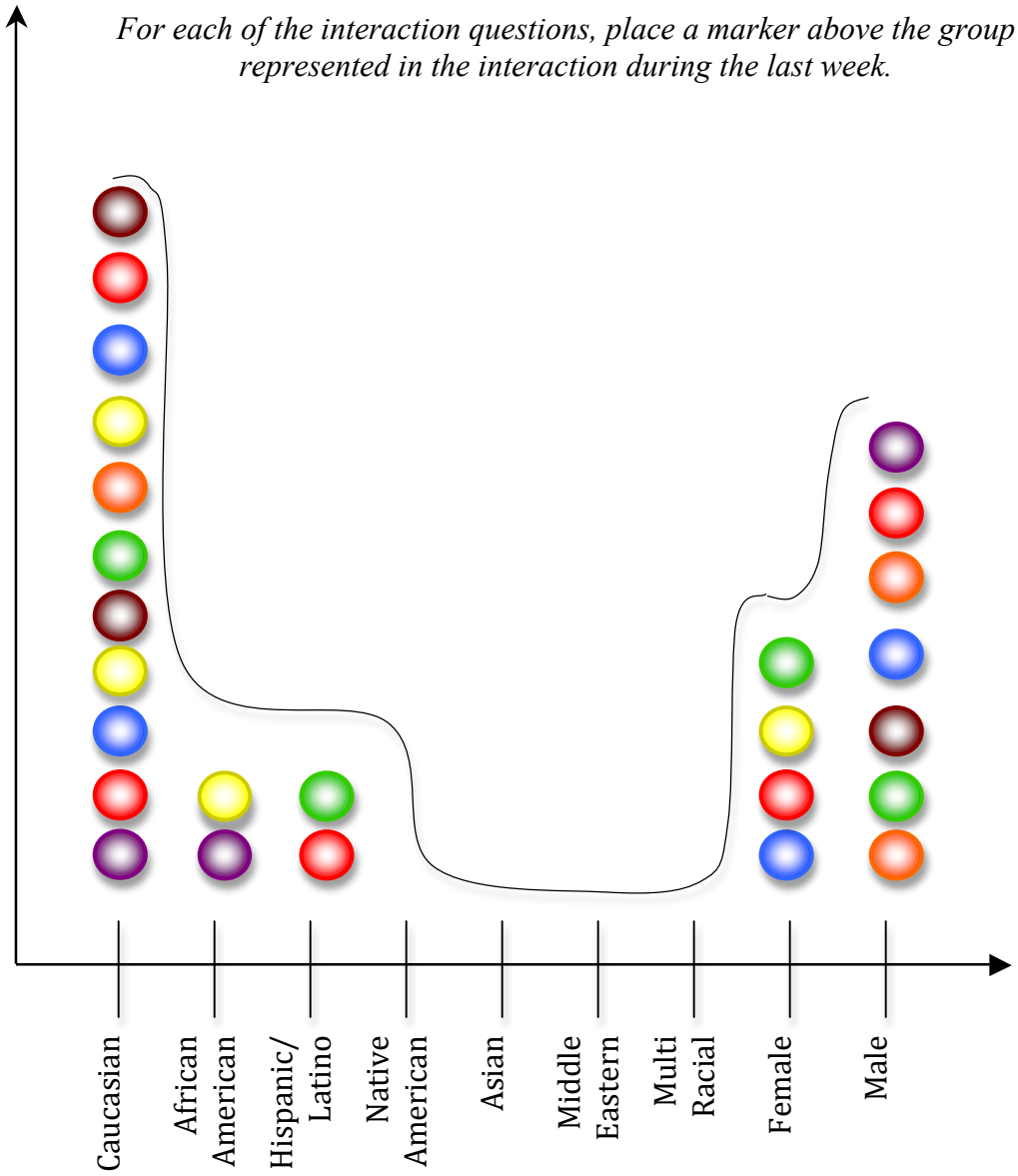
Diversity Interaction Self-Assessment Graph

Students were reminded that while they normally interacted with people that they were familiar and comfortable with, actively seeking opportunities for interaction with diverse groups was a choice that they could make. This type of interaction was defined as active diversity interaction. The presenters described opportunities for active diversity interaction including sitting by someone in class or participating in a design team or professional organization. A list of interaction questions representing types of opportunities was presented (Appendix 1), and students were given the Diversity Interaction Self-Assessment Graph with types of groups on the horizontal axis (Appendix 2). Students were given candy to use as markers representing each interaction with a person of a representative group in the last seven days. The markers developed a bar graph showing the most common groups that each student interacted with. After students graphed their interactions using candy markers, they were directed to draw a curve connecting the top of each column, forming a line graph of the total interactions with each representative group. The typical line graph of interactions for most students was curved showing large numbers of interactions with a student's normal group and few with other groups. A sample Self-Assessment graph is shown in Figure 1. After students completed their graphs, the MEP Director explained that in the ideal world, a student's graph of interactions should be nearly flat showing similar numbers of interactions among all groups.

Benefits of Diversity Interaction

After the graphing activity, the Assistant Dean presented benefits of diversity interaction to the students. Research has indicated that diversity interaction improved the following: (1) psychological and physical health, (2) cognitive growth and academic achievement, (3) creativity and problem solving ability, and (4) critical thinking and intellectual engagement.[6, 7, 13] Research on diversity interaction and the resulting conclusions about the benefits were presented to the students. Discussion of research on the benefits of diversity interaction began with an introduction to Maslow's concept of growth-choices. By a show of hands, most students indicated familiarity with Maslow's Hierarchy of needs. The presenters discussed Maslow's concept of growth-choices and developed this concept within the context of active diversity interaction, explaining that choosing to initiate interaction with persons outside one's normal group could be considered a growth-choice.[11, 12] After explaining Piaget's theory of disequilibrium and cognitive growth, the presenters discussed active diversity interaction in terms of new ideas and circumstances resulting in potential opportunities for active learning.[14] The authors also presented conclusions by Lieu and Duff and Nelson Laird, that informal interactional diversity improved numerous learning dimensions including creativity, problem solving, critical thinking, information transfer and academic achievement.[9, 13]

Figure 1. Sample Diversity Interaction Self-Assessment Graph



Personal Challenge

Students were given a list of organizations and opportunities for active diversity interaction. The presentation concluded with a challenge to the participants to do something different by interacting with other students outside their normal groups. Students were urged to learn about themselves and about others by stepping outside their normal routine and making growth-choices in the form of active diversity interactions.

Assessment

Following the presentation, students were asked to respond to the program in a survey. We chose to assess the affective impact of the presentation using Krathwohl's Affective Domain.[8] Researchers have suggested that affect must be present for any cognitive learning to occur, and many researchers believe that accessing the Affective Domain in students is critical to cognitive development.[1, 2] In the Taxonomy of the Affective Domain, Krathwohl classified human reaction and responses to educational content.[8] The taxonomy organized emotions, feelings, and values toward a topic in terms of categories, subcategories, and behavioral responses. The categories were Receiving, Responding, Valuing, Organization, and Characterization by a Value.[8]

Taxonomy of the Affective Domain

Krathwohl's Taxonomy of the Affective Domain was created to provide a common terminology for educational researchers.[8] The intent was to create a frame of reference for researchers to use in defining, classifying, and measuring human affective behavior.[8] Difficulty in measuring affective responses in research stemmed from the variety of meanings for terms commonly associated with affective behavior such as *interest, appreciation, and value*.[8] These terms encompassed a wide variety of meanings and therefore were not useful in assessing affective responses. For example human responses associated with appreciation could indicate a general interest or a strong commitment. Krathwohl defined his affective categories, Receiving, Responding, Valuing, Organization, and Characterization by a Value, within a continuum of internalization.[8] Table 1 shows the categories and subcategories of the Affective Domain. The Receiving category represents the lowest level of internalization and the Characterization by Value or Value Complex category represents the highest.[8] At the lowest level of internalization, a student was aware and responsive to a topic. At mid-levels of internalization, the student was willing to respond and organize a concept into her value structure. At the highest level, the student incorporated a concept into her world view.[8]

Participants

Eighty-three undergraduate engineering students in Introduction to Engineering classes participated in the program. Introduction to Engineering is a first year introductory class for freshmen and new students in the College. The survey was administered in paper form immediately after the presentation. Participation in the survey was voluntary and anonymous. Ethics approval was obtained through the Istitutional Review Board of the University. Sixty-five students (n=65) responded to the survey for a response rate of 78%.

Survey

We developed our survey of students' affective responses based on statement format suggested by Krathwohl.[8] In *Taxonomy of Educational Objectives Handbook II: Affective Domain,* Krathwohl presented assessment statements representative of each category of his Affective Domain.[8] Our survey consisted of nine statements representing Categories 1 through 4 of Krathwohl's Affective Domain. Educators and students established survey validity with analysis and interpretive responses. Survey participants were asked to indicate the degree of agreement or

disagreement to statements in the survey using a five-point Lickert Scale in which 1=strongly disagree and 5=strongly agree. Table 2 shows the statements in the survey and their category within Krathwohl's Affective Domain, along with survey results.

Statements 1, 2, and 4 represented the Receiving and Responding categories of the Affective Domain. These statements represented students' awareness of diverse groups on campus and recognition of opportunities for active diversity interactions. Statements 3, 5, and 6 represented the Valuing category of the Affective Domain. Statements in the Valuing category were further classified within subcategories. According to Krathwohl, the Valuing category of the taxonomy was a transition from cooperation and satisfaction in learning to the realization that a topic had worth.[8] Within the Valuing category, behavior transitioned from examination and recognition of value to a willingness to act on beliefs and values. In Sub Category 3.1 Acceptance of a Value, behavioral responses indicated acceptance of the worth or value of a topic and increasing interest in participation. In Sub Category 3.2 Preference for a Value, a learner actively participated in the interest or activity that she considered valuable. In Sub Category 3.3 Commitment, the learner expressed commitment to the area of interest. Behavioral responses included advocating a cause and spending time and energy discussing it with others.[8] Statements 7, 8, and 9 represented Category 4, Organization. Krathwohl considered Organization to be the recognition by the learner of multiple relevant values and the need for a value system with a recognizable hierarchy.[8] The learner engaged in higher level thought processes about values and was able to defend choices and recognize the basis of her commitment to an idea. In Sub Category 4.1 Conceptualization of a Value, the learner achieved the ability to consider values in the abstract and therefore exhibited consideration and comparative judgment. In Sub Category 4.2 Organization of a Value System, the learner created order within a complex set of values. Behavioral responses included the ability to form judgments about societal concerns and appreciation of the impact of those values on oneself and others. Krathwohl considered behavioral responses for Category 5 to be representative of a person's world view after years of experience and consideration of values.[8] We considered Category 5 responses to be beyond the scope of this exercise and did not develop representative statements.

Results

The results of the survey of engineering students' affective responses to the Making Choices program are shown in Table 2. Statements 1, 2 and 4 represented Categories 1 and 2, Receiving and Responding, of Krathwohl's Affective Domain. For statement 1, 58% of respondents agreed or strongly agreed with the statement, and the mean of the responses was 3.60. In statement 2, 52% agreed or strongly agreed with the statement with a mean of 3.54. In statement 4, 84% agreed or strongly agreed with the statement resulting in a mean of 4.08. Responses to statements 1, 2, and 4 indicated students in the class were aware and understood diversity in the college. Responses to statement 4 indicated that 84% of students responded favorably to opportunities for diversity interaction.

Statements 3, 5, and 6 represented Category 3, Valuing, of Krathwohl's Affective Domain. Mean values for the responses were 3.82 for statement 3, 3.55 for statement 5, and 3.14 for statement 6. While 75% of students indicated they agreed or strongly agreed to plan to increase their level of diversity interaction (statement 3), 55% of students indicated they agreed or strongly agreed that

they were interested in finding opportunities (statement 5), and only 42% agreed or strongly agreed that they planned to talk to others about opportunities for diversity interaction (statement 6).

Statements 7, 8, and 9 represented Category 4, Organization, with mean scores of 3.72, 3.80, and 3.89, respectively. Sixty-one percent of students agreed or strongly agreed that diversity interaction can have a lasting impact on their lives (statement 7). Sixty-four percent agreed or strongly agreed that diversity interaction could help them become a more successful engineer (statement 8), and 73% indicated they agreed or strongly agreed with the need to engage in diversity interaction (statement 9).

Conclusion

The survey indicated that a majority of students responded favorably to diversity interaction and had internalized the concept of diversity interaction at the Organization level. Students were able to incorporate this concept into their value system and recognize benefits to themselves and society. However, a lower percentage of students agreed or strongly agreed with statements in the Valuing category. Students had conceptualized and organized diversity interaction into their value systems and were willing to increase their level of diversity interaction but did not actively plan to seek such opportunities. Krathwohl indicated that it was possible for Conceptualization (Category 4.1) and Organization (Category 4.2) to be experienced by a learner before Preference (Category 3.2) and Commitment (Category 3.3).[8] In this study, students understood the value of the concept but were unwilling or unready to make the growth-choices that would provide the benefits of the experience. We believe this indicates a need to provide opportunities for diversity interaction among engineering students. As suggested by other researchers, we believe that diversity interaction should be a part of the curriculum. Appropriately designed activities in which opportunities are provided for interaction between diverse groups can lead to experiences that fulfill the potential for improvements in academic achievement, cognitive growth, and critical thinking.[6, 7, 13] As the numbers of multicultural students in the College of Engineering at Kansas State University continue to increase, support programs can be used to encourage diversity interaction activities in all settings, including within the curriculum.

Future Research

We intend to expand the number of survey statements and continue to survey engineering students in order to confirm and refine results. We believe that a need exists for a longitudinal study of students' responses to active diversity over time. In addition, the longitudinal study could determine if programmed or curricular activities lead to self-initiation of diversity interaction. A study of students' affective responses to curricular and programmed diversity interaction activities could provide insight into the most effective activities.

Table 1. Categories of the Affective Domain

Category	Subcategories	Increasing Internalization
5.0 Characterization by Value or Value Complex	5.2 Characterization 5.1 Generalized Set	
4.0 Organization	4.2 Organization of a Value System 4.1 Conceptualization of a Value	
3.0 Valuing	3.3 Commitment 3.2 Preference for a Value 3.1 Acceptance of a Value	
2.0 Responding	2.3 Satisfaction in Response 2.2 Willingness to Respond 2.1 Acquiescence in Responding	
1.0 Receiving	1.3 Controlled or Selected Attention 1.2 Willingness to Receive 1.1 Awareness	

Adapted from Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1964). *Taxonomy of educational objectives: The classification of educational goals, Handbook II: Affective Domain.* New York: David McKay.

Table 2. Survey Statements, Affective Domain Categories, and Results

Statement of Affective Response[8]	Affective Category[8]	Likert Scale Values					Mean (SD)
		1	2	3	4	5	
1. I have noticed a difference in the numbers of students of color that I have encountered since leaving my high school and coming to the College of Engineering.	1 Receiving	7 11%	8 12%	12 18%	15 23%	23 35%	3.60 (1.37)
2. The Making Choices activity increased my awareness of underrepresented groups in the College of Engineering.	1 & 2 Receiving and Responding	4 6%	9 14%	15 23%	22 34%	15 23%	3.54 (1.17)
3. I plan to increase my level of diversity interaction in the College of Engineering.	3.1 Acceptance of a Value	2 3%	6 9%	8 12%	35 54%	14 21%	3.82 (0.98)
4. I believe that multiple opportunities exist for increasing diversity interaction in the College of Engineering.	2 Responding	0	0	10 15%	40 61%	15 23%	4.08 (0.62)
5. I am interested in finding opportunities for diversity interaction in the College of Engineering.	3.2 Preference for a Value	1 2%	10 15%	18 28 %	24 37%	12 18%	3.55 (1.02)
6. I plan to talk to other engineering students about opportunities for diversity interaction.	3. 3 Commitment	9 14%	11 17%	18 28%	16 25%	11 17%	3.14 (1.26)
7. I believe that diversity interaction can have a lasting impact on my life and the lives of others.	4.1 Conceptualiza-tion of a Value	2 3%	4 6%	19 29%	25 38%	15 23%	3.72 (0.99)
8. I believe that diversity interaction can help me to become a more successful engineer.	4.2 Organization of a Value System	2 3%	5 8%	17 26%	21 32%	20 31%	3.80 (1.06)
9. I recognize that I need to engage in diversity interaction as a part of my activities within the College of Engineering.	4.2 Organization of a Value System	1 1%	5 8%	12 18%	29 45%	18 28%	3.89 (0.95)

Five point Likert Scale values: 1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

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Appendix 1. Interaction Questions

1. Who did you have lunch with this week?
2. Who do you study with?
3. Who do you sit by in class?
4. Who have you had a phone conversation with?
5. What professors have you talked to?
6. Who do you go to church with?
7. Who do you play sports with?
8. Who was on your last project group?
9. Who have you recently met socially?
10. Who have you asked for help recently?
11. Who is in your student organization?
12. Who is your co-worker?
13. Who do you hang out with?
14. Who are your teaching assistants?

Appendix 2. Diversity Interaction Self-Assessment Graph

How many interactions have you had in the last week?

For each of the interaction questions, place a marker above the group represented in the interaction during the last week.