What is important for female and minorities to achieve success in academia?

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ABSTRACT

Background: The attraction and retention of female and minorities to science, technology, engineering and mathematics (STEM) related academic careers have been a concern for many years. Today, it is still unclear what are the needs of this STEM minority population to encourage them to pursue and be retained in academic career paths.
Design/Method: In this study, senior undergraduate and graduate students, post-doctoral students and junior assistant professors were surveyed about topics that many studies have been reporting as essential for their success in academic careers. In this investigation, 123 attendees participated in surveys after a 1.5 day workshops held in three different institutions. The topics discussed and surveyed with the participants involved: Future Faculty Forum: What is Assistant Professorship?; Time management; Mastering the Science of College STEM Teaching; Culturally Responsive Teaching in STEM; Mentoring/career coaching; Graduate school 101; and Transitions: Being Proactive. Networking activities with the participants were also deployed, for example, round table and networking lunches (where all faculty and students in the college were invited to attend).
Results: The results of the surveys showed that females and males participants had different opinions on which topic was the most beneficial for their careers. Overall, female and minority participants were more concerned about time management and mentoring; while male participants were more interested on the topic "What is Assistant Professorship?".
Conclusions: This study indicates that different approaches are needed to attract and retain different genre and ethnicities in engineering and other STEM disciplines.

Keywords: female, minorities, academic career, African American, Hispanics

1. Introduction

There is a great need to educate highly capable science, technology, engineering and mathematics (STEM) undergraduate students and subsequently future STEM labor force (Ramalay, 2009). Yet, there are numerous studies showing that we are far from achieving this goal. This is because women and underrepresented minorities in STEM disciplines face several problems. The main issues described in the literature encompass reduced numbers of women obtaining doctoral degrees in particular STEM disciplines, unfavorable faculty search procedures for tenure-track positions, and insufficient or unavailable opportunities for career development in tenure and non-tenure track positions (Bilimoria, Joy, & Liang, 2008).

For instance, literature has shown, U.S. citizen women earned less than 15% engineering doctoral degrees between 1983 and 2016, which translated to about 1 in 10 Hispanic, American Indian, and Black women workers earning engineering doctoral degrees (Bilimoria, et al., 2008; Morella, 2016). In academia, women tenure-track faculty in engineering accounts for just about 15.2 percent, with Hispanic and African-American faculty members being just 3.9 and 2.5 percent, respectively (Morella, 2016). Additionally, qualified female Ph.D. graduates may go unnoticeable to faculty search committees, whose makeup is deficient in gender diversity, does not include gender-blind screenings of applications, does not provide an impartial interview process and campus visit (Stewart, LaVaque-Manty, & Malley, 2004). Mason found that married women have even more difficulty in securing tenure track faculty positions than any PhD recipients (Mason, 2013).

Even after obtaining tenure-track faculty positions in STEM, these female faculty will endure various roadblocks to get tenured, promoted, and advance to leadership. For instance, in the top 50 U.S. institutions, the percentage of female full professors in STEM education ranges from 3% to 15% (Nelson, 2005). In fact, tenure-track women faculty in STEM areas often face isolation, have few or no mentors and role models, and are required to work more arduously than their male counterparts to become respected and gain credibility (Liang & Bilimoria, 2007; Rosser, 2004). The STEM environment for women is typically unfavorable for female faculty to occupy faculty leadership positions, such as vice presidencies, deans, and department chairs. Hence, it is common for tenure-track female faculty to report low job satisfaction compared to their male counterparts (Callister, 2006) and more likely to leave their academic positions (Valian, 2004).

These issues show that institutional changes are in great need to make great strides in attracting and retaining female and minorities in STEM careers (Carnes et al., 2012; Glass & Minnotte, 2010; Rosser & Chameau, 2006). Besides all this statistical information on the low success rate on promotion and retention of female and minorities in STEM careers, it is important to understand their needs early on in their careers, i.e. as graduate students, postdocs and assistant professors. In this study we focused on understanding the needs of different underrepresented minorities (i.e., in terms of ethnicity and gender) as well as the topics that they feel that are the most relevant for their success in academic careers.

2. Methods

In this study, three workshops were organized at three different Universities, namely, The University of Akron (UA), Mississippi State University (MSU) and University of Houston (UH). These Universities were selected because they have different underrepresented student and faculty demographics (Hispanic and African American) and they were located near other institutions that

were also invited to participate in the workshop, e.g. Rice University, Texas Southern University (a historically black institution), Case Western Reserve University, Cleveland State University, and Youngstown State University.

At UA, the student population is like most mid-sized state institutions (see Table 1). MSU and UH were also selected to participate since they are primary minority serving institutions. MSU has 19% of African American graduate and undergraduate students and UH has an undergraduate Hispanic population of 29%. Interestingly, the faculty demographics are quite similar at each institution. More detailed information on the demographics of these institutions can be found in Table 1. The goal of this study was to get the most diverse female and male minorities, as well as female non-minority populations to understand the needs for different underrepresented minority groups in relation to their perceived needs to succeed in STEM academic careers.

Table 1. Number of engineering faculty, graduate student and undergraduate student demographics at each institution participating in this study

		Total	Women	African American	Hispanic	Pacific Islander
University Akron (UA)	Faculty	92	12	0	1	0
	Graduate students	361	84	1	3	1
	Undergrad	3889	778	194	116	2
University Houston (UH)	Faculty	109	15	1	2	0
	Graduate students	948	265	24	32	2
	Undergrad	2294	826	138	620	6
Mississippi State (MSU)	Faculty	157	23	5	3	2
	Graduate students	590	123	34	27	8
	Undergrad	2932	527	320	29	0

At each institution, workshops of 1.5 days were held. The workshops targeted participants from different academic levels in Engineering, i.e. senior undergraduate and graduate students, post-docs, and early career Assistant Professors. At the University of Akron, there were 35 participants; while at the University of Houston and Mississippi State University, there were 55 and 33 participants, respectively. This investigation involved performing surveys about different topics believed to be important to help students and assistant professors achieving success in pursuing STEM academic careers. The topics discussed and surveyed were: Future Faculty Forum: What is Assistant Professorship?; Time management; Mastering the Science of College STEM Teaching; Culturally Responsive Teaching in STEM; Mentoring/career coaching; Graduate school 101; Transitions: Being Proactive. We also had networking activities with the participants, i.e. round table and networking lunches (where all faculty and students in the college were invited to attend). These networking activities were also assessed for the perceived impact of these activities in their careers. In this study, 69 workshop participants from UA, MSU and UH were surveyed. The results from these surveys were analyzed using IBM SPSS Statistics for Windows (IBM Corp., 2013, Armonk NY, version 22.0.) (I. Corp, Released 2013.). The correlations were assigned using the "frequencies command" and "crosstabs command" using the descriptive statistics method (Babbie, 2013). The graphs were plotted using OriginPro 8.5 (OriginLab Corp., 2010, Northhampton, MA) (O. Corp, 2010).

3. Results and Discussion

3.1.Demographics of the Participants

The overall attendee population was quite balanced in terms of gender, although we had slightly more female attendees in the three workshops combined. Additionally, the number of minorities attending all three workshops, both female and male, were quite high, around 25% (Figure 1). The most abundant ethnicity across-the three workshops was Caucasian followed by Asians, for both female and male workshop attendees. Overall, we achieved our goal to get a very diverse population attending the workshops.

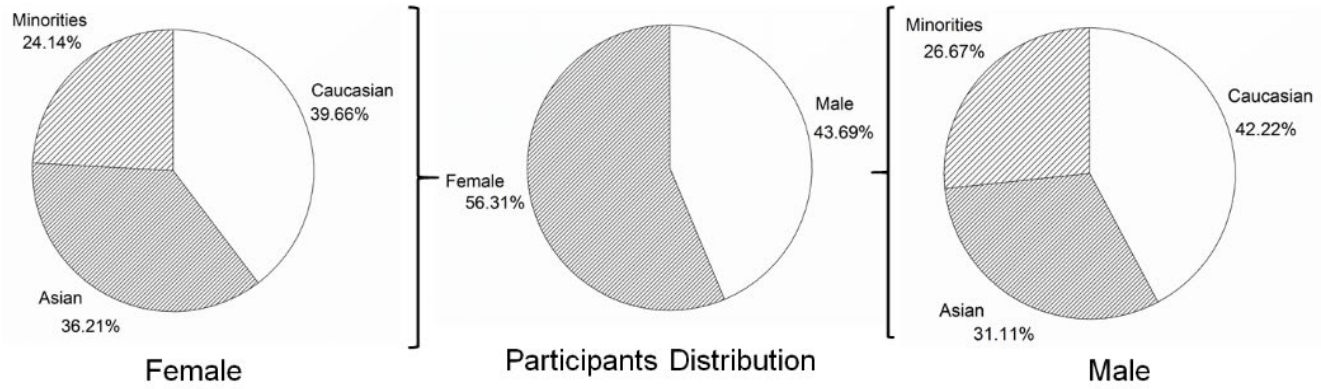

Figure 1. Demographics of the population attending the three workshops

Among the ethnic minorities participating in the workshops, African Americans, followed by Hispanics were the most represented with 42.31% and 34.64%, respectively (Figure 2). As expected, based on the population demographics at MSU and UH (Table 1), the number of African American participants were the highest at the MSU workshop; while the Hispanic population were mostly from the workshop attendees at UH, which is a Hispanic Serving Institution.

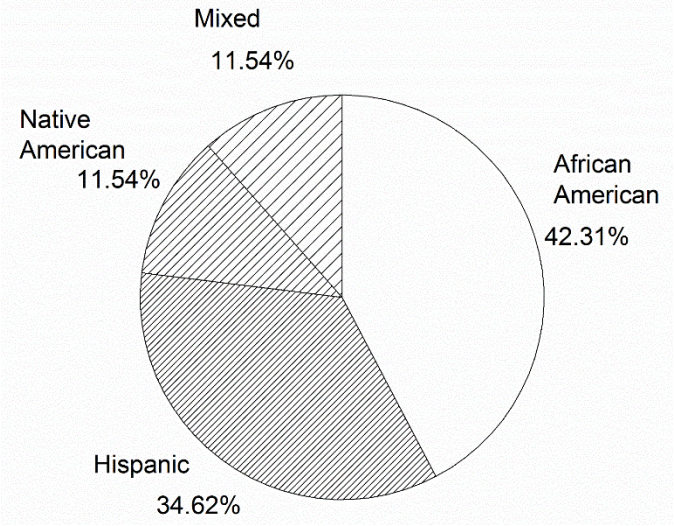

Figure 2. Distribution of minorities attending the three workshops.

The level of education of the attendees was also very diverse, and was comprised of senior undergraduate, M.S. and Ph.D. students as well as Post-docs and early career Assistant Professors (Figure 3). The most abundant category attending the workshop was M.S. and Ph.D. students, followed by the Postdocs/Assistant Professors category and Undergraduate students, for both male and female attendees. Interestingly, we had slightly more female Postdocs and Assistant professors attending the workshops than male.

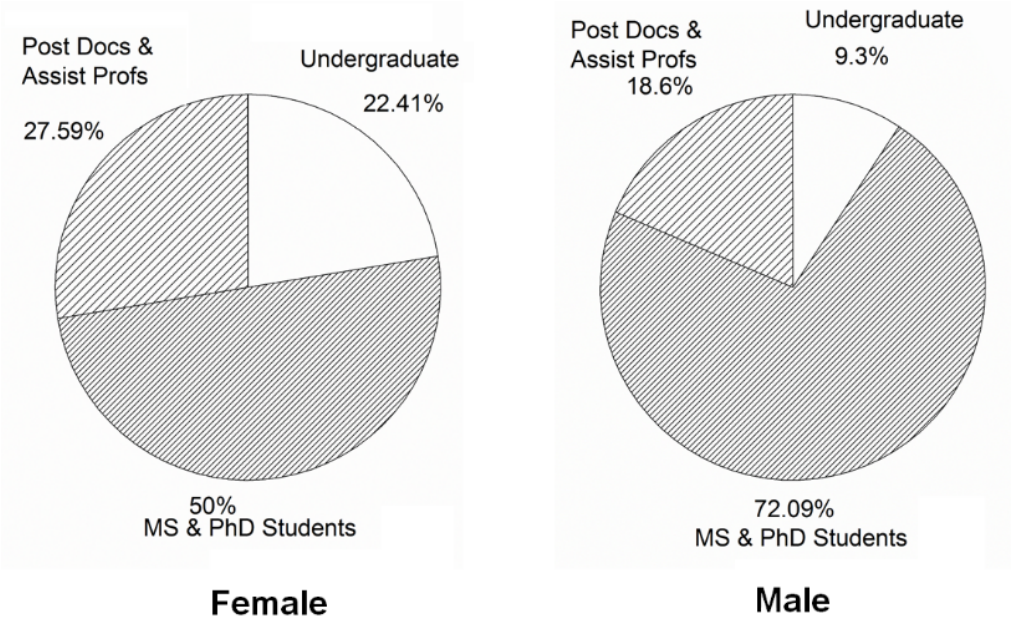

Figure 3. Education level of participants divided into two categories: Female and Male

3.2.Topics discussed with the Participants

The topics discussed in the workshops were based on issues faced by underrepresented female and minority graduate students, post-docs and faculty in engineering (Concannon & Barrow, 2012; Kokkelenberg & Sinha, 2010; Wilson, Iyengar, Pang, Warner, & Luces, 2012). The main goal was to present and discuss with the participants issues and solutions in the academic life to attract and retain them in academic careers. This workshop also provided tools to the participants to mentor/coach others to pursue careers in academia. Below is the summary of what each topic discussed in the workshop consisted of:

Graduate school 101: This topic mainly focused on senior undergraduate students and Assistant Professors willing to mentor undergraduates in academic career paths. The goal of this section was to provide guidance on the criteria for selection of potential graduate programs and advisors as well as the difference between full-time and part-time programs. In this section, we also described graduate school applications, the importance, and the best approaches to prepare personal statements, obtain reference letters, and succeed in the GRE exam. We also provided guidance on types of funding available spanning from the differences among Fellowships, research sponsored projects, University sponsored stipends (Teaching or Graduate Assistantships), and stand-alone tuition waivers.

What is Assistant Professorship?: This section covered different aspects on how to be successful in academic job searches and the requirements for tenure and promotion in US institutions. We also discussed about teaching, research, and service as a faculty member. In the research aspect, we presented the funding agencies and funding opportunities for engineering faculty, guidelines for writing winning proposals, publishing and dissemination of research and studies. In teaching: we explained how to prepare a syllabus and organize a lecture. In service: we presented the typical University expectations for tenure and promotion.

Time management: This topic covered multiple approaches to managing time ranging from on-line calendars, day planners, and personal assistants; to 'do it yourself' books. In this session we also emphasized that the best approach would differ for each person. This topic provided examples and discussions on different approaches for time management. Topics discussed included: balance coursework or career and personal life, teaching assistant activities and research for the dissertation or thesis, balance multiple projects and mentorship of students, and meet the requirements for research, teaching and service for tenure and promotion.

Mastering the Science of College STEM Teaching: This topic offered the opportunity to examine and explore research-based teaching strategies and best practices that positively impact student learning. Workshop attendees were introduced to diverse aspects of teaching and adult learning tools. Resources were provided to the participants aiming to aid them to develop effective materials for their lectures to build conceptual understand of course content as well as designing unique learning experiences. Additionally, they were introduced to learning theories, instructional strategies, and methods for assessing student learning. Specific activities in this section included: preparing a statement able to describe their beliefs about learning and teaching; obtaining familiarity with the material content for the anticipated course; understanding the different teaching and learning styles. Participants also worked in groups to analyze teaching case studies and/or video clips depicting effective teaching approaches.

Culturally Responsive Teaching in STEM: In this section we discussed the importance of students' socio-culture; mechanisms to become leaders of acceptance and changes; and embrace teaching and learning methods that support critical thinking and multiple approaches for problem solving. Attendees were able to investigate and understand approaches for culturally responsive teaching to develop a roadmap to reproduce these skills in classroom settings.

Mentoring: In this section, we discussed the importance of mentors in academic and professional settings for success in any career path. In this workshop we also discussed the role of mentees for making the relationship as productive as possible. Successes and challenges between mentor and mentee relationships and possible ways to overcome issues were also discussed.

Transitions and Being Proactive: This session contained specialized topics for underrepresented groups in STEM, besides addressing certain inquiries and concerns from the attendees, some points discussed in this session were: a) Transition of specific target groups from graduate studies to faculty positions; b) The significance and methods used to becoming proactive. For example, we explained the tools used to join a research group without having to wait for a formal invitation; and c) approaches to deal with micro-aggressions and racism.

Round Table/Network lunch discussions: Aimed to i) address specific issues of the participants and provide possible solutions that workshop attendees may face as they move through their academic career and ii) expand their networking. Although the previous workshop sessions were specifically designed to address areas that the participants would encounter in their career, this section aimed to answer specific questions and discuss issues that they typically can face in the academic environment. Finally, the lunch allowed all the participants to network with different

faculty members from each University by performing a “speed date” type of interaction during lunch.

3.3. Perceptions of attendees about the most beneficial topics for a successful academic career

The data obtained in the workshop were analyzed to determine what important topics underrepresented females and ethnic groups perceived as helpful to succeed in academic careers. As shown in figure 4, women felt that the networking lunch was extremely valuable. The large numbers of females across all three workshops made the environment feel safe for most of the female participants and allowed them to talk more freely and discuss their issues and concerns.

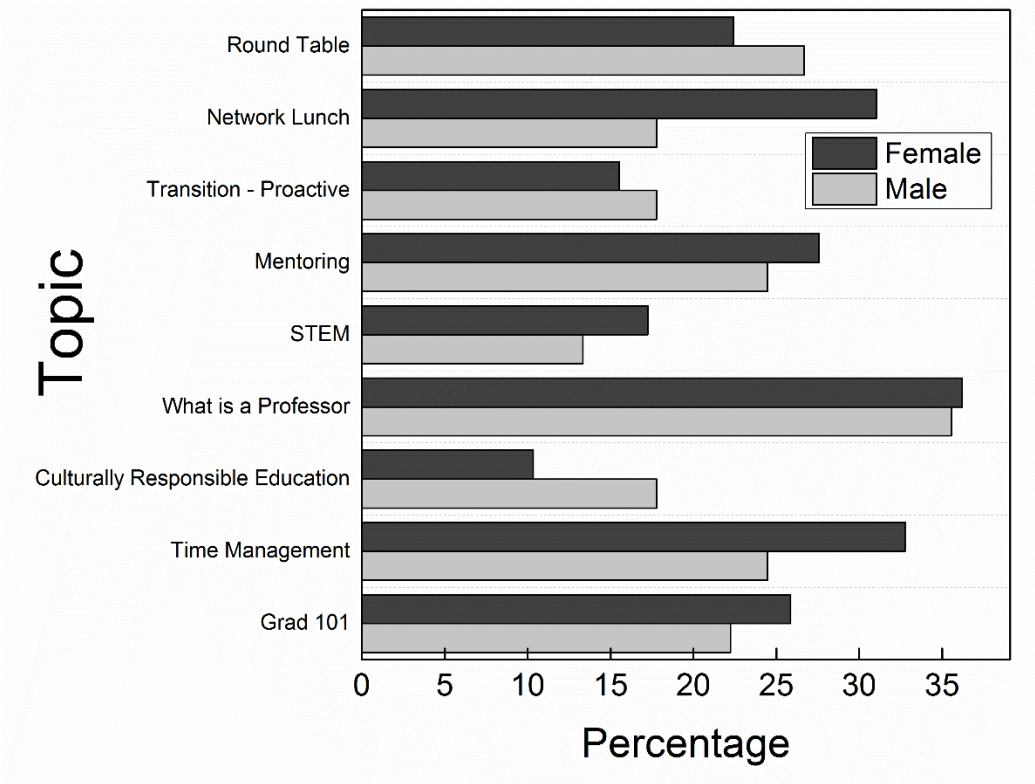

Figure 4. The most beneficial topics perceived by female and male participants.

Time management and mentoring were also very important topics for the female participants. Many participants expressed difficulty in effectively managing their time to be productive, i.e. write papers, proposals, perform research. This was more pronounced in women since some of the attendees already had families, and had increased demands associated with managing work and family. This issue is well known, as previously presented by Suitor and colleagues (Suitor, Mecom, & Feld, 2001). In their study, 673 faculty members from a certain University participated in a survey to understand the connection between scholarly productivity and family duties in female and male faculty members. The study determined that female professors bear more domestic chores than the male professors. This is even more true when they

have children and are married. This labor division discrepancy between male and female academics translated into decreased research productivity for women in tenure-track positions.

Mentoring was also considered very important to the female attendees, they recognized the need to receive and even being able to provide proper mentorship to peers and students. The role of mentorship to have a successful career was also acknowledged by the attendees, especially by the junior female faculty participants. Many women participants pointed out the lack of mentorship. In fact, research has shown that women junior faculty typically do not participate on formal mentoring programs or are more likely not to find mentors on their own (Kosoko-Lasaki, Sonnino, & Voytko, 2006). Hence, there is clearly a need in academia for more mentoring programs that focus specifically on women junior faculty.

Both genders were very interested in the topic "What is Assistant Professorship?", since the participants were able to get the "big picture" of life as an assistant professor and demystify some misconceptions about what takes to be successful as an Assistant Professor (Figure 4). The participants found the guidance on the expectations for tenure and promotion, as well as, suggestions on how to look for funding sources and prepare proposals to be extremely valuable topics. These topics have been of a large concern for many early career faculty members and even graduate and postdoctoral students, since over the years getting funded has become more difficult and in some cases have been shown to be gender biased (Ginther, Schaffer, & Schnell, 2011; Rosser & Chameau, 2006).

In the case of topics considered more relevant to ethnic minorities (regardless of gender), we noticed that female minorities showed similar interest on the network activities (i.e. round table and network lunch) and on the topics: mentoring, transition-proactive and What is assistant professorship (Figure 5). Time management was considered to be one of the most beneficial topics for female minorities. Female Asians, on the other hand, were more interested in the mentoring topic, while Caucasians were interested in "what is assistant professorship." Clearly, these results show that different ethnicities seem to have different needs and perceptions of what they feel important for their success in academic careers.

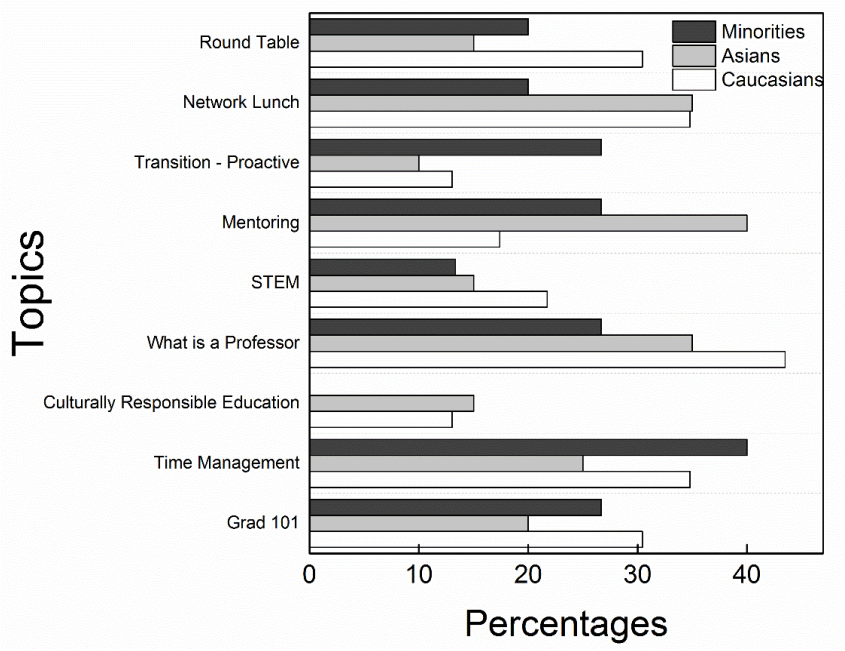

Figure 5. The most beneficial topics perceived by female minorities attending the workshops.

In the case of the male participants, all male attendees (from the different ethnicities) were interested in the topic "What is assistant professorship". Asian males, were also extremely interested in the "Mentoring" topic. Male Caucasians and minorities seemed to have almost the same interest in all topics presented in the workshop (Figure 6).

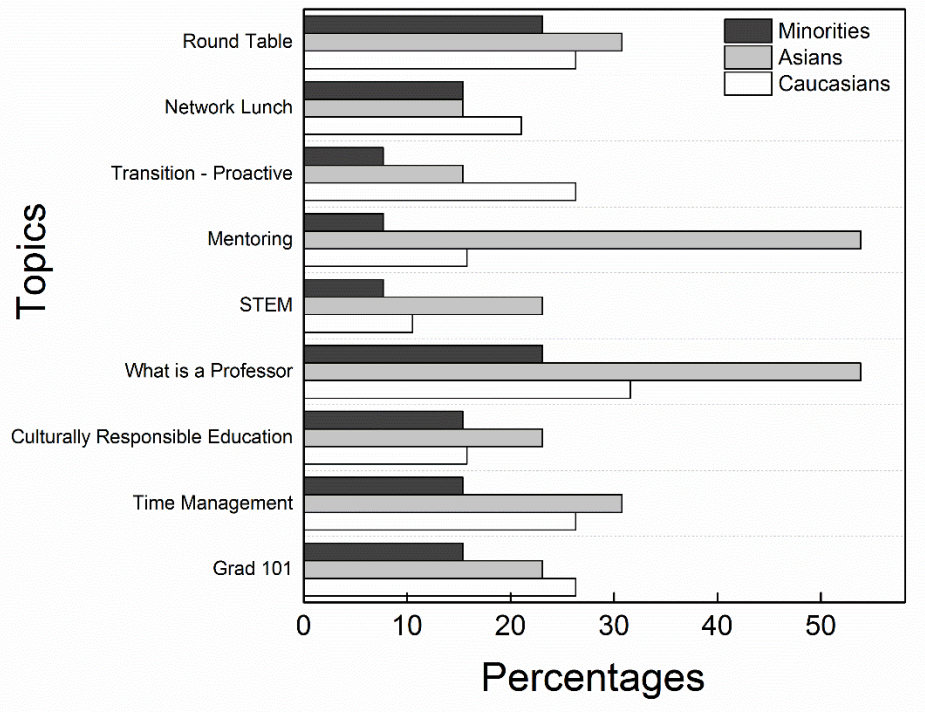

Figure 6. The most beneficial topics perceived by male minorities attending the workshops.

The educational level of the attendees also affected their interest for the different topics (Figure 7). For instance, Post-docs and Assistant Professors were highly interested in "Mentoring". "Time management" and the network activities were also considered very valuable for the Post-docs and Assistant Professors. The Ph.D. and M.S. students considered the topics "What is assistant professorship", "Time Management" as well as the networking activities the most beneficial. Undergraduates were very interested in the topics: "Grad 101", "Time management", "What is Professorship" and "Mentoring" because they experienced the most difficulties with these topics at their current educational level.

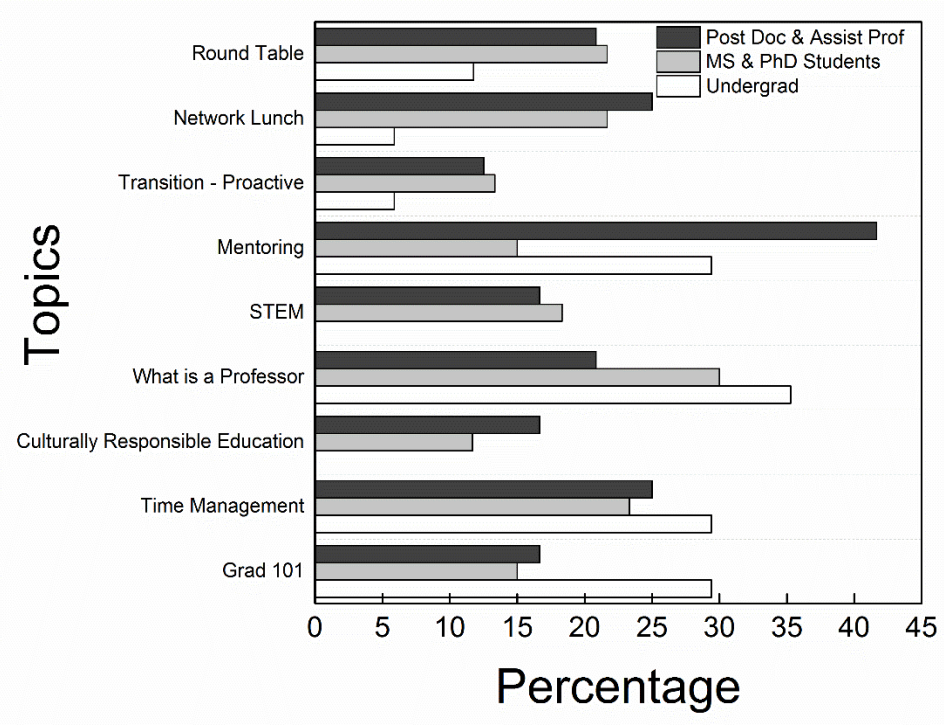

Figure 7. The most beneficial topics perceived by different educational levels

4. Conclusions and final remarks

In this study, we were successful in obtaining a balanced number of participants who were members of underrepresented minority populations, which allowed the investigation of the perception of different groups about what is needed to be successful in engineering academic careers. Generally, female participants were more concerned about time management and mentoring, while male participants were more interested on the topic "What is assistant professorship". Different educational levels and ethnicities also impacted the perception of participants on their needs to be successful in academic careers. Overall undergraduate and graduate students were more interested in 'what is professorship' and 'time management'; while professors and postdocs were more interested in 'mentoring' and networking activities. Ethnic minorities (especially females), on the other hand, had interests at similar level for different topics, which included mentoring, transition-proactive, What is assistant professorship and network activities. Hence, this study indicates that different approaches are needed to attract and retain different genre and ethnicities in engineering and other STEM disciplines. This study was posed as a pilot in an effort to obtain preliminary data on differences. Considering that we noticed differences, our future plans are to expand the study to include a longer time period for engagement as well as multiple modes of engagement. We will focus on addressing the topics of interest with female post docs and new assistant professors in an effort to strengthen the pipeline for those new in the academy and those planning to enter.

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expressed are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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