DIFFERENCES IN CHEMICAL ENGINEERING STUDENT-FACULTY INTERACTIONS BY STUDENT AGE AND EXPERIENCE AT A LARGE, PUBLIC, RESEARCH UNIVERSITY

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Efforts to improve the engineering workforce include research to understand and support student diversity. One important aspect of student difference that is often overlooked is student age. Adult students, those age 25 and older, are an increasingly prevalent group of students in institutions of higher education. The National Center for Education Statistics projects that the rate of increase of students over the age of 25 will outpace the rate for traditionally aged students through 2023.[1] Recent work analyzing the Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD) database of 209,737 engineering students found that nontraditional students, many of whom are adult students, made up 10% of the undergraduate engineering population from 1988 to 2002.[2] This shift makes it important for instructors, administrators, and researchers to understand and promote positive outcomes for adult students.

Adult undergraduate students have been demonstrated to enhance the learning for all students, through their high level of engagement with active learning.[3] They also are a rich source of lived experience, and many adult students in engineering have engineering-related work and project experience that can enrich classroom discussions and provide teamwork and management skills.[4] This paper focuses specifically on student-faculty interactions among experienced adult and inexperienced traditional chemical engineering students at a large, public, research university.

BACKGROUND

Prior research work by Kasworm and Pike has shown that adult students typically have fewer interactions with their peers and more interactions with faculty, compared to traditional-age students.[5] It is within the classroom that adults integrate academic concepts with their current (real world) knowledge structure to create holistic meaning. Using the classroom in such a way, adult students are able to maximize the little time they have to spend on campus. Prior work in our group has also found that adult engineering undergraduate students at three diverse institutions of higher education have complex relationships with their traditional-age peers, including both an identity of "otherness" and a sense of camaraderie.[6]

Student-faculty interaction is generally associated with positive outcomes for students, including college engagement and success. Several groups have also studied the impacts of student or faculty characteristics on student-faculty interactions,

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including Lundberg and Schreiner, who examined the influence of race and ethnicity on this relationship, and found that relationships with faculty are a strong predictor of success among students of color.[7] Wang and colleagues used faculty surveys to explore student-faculty interactions, and reported that female faculty and black or African faculty members reported higher levels of student-faculty interactions compared to male and white faculty members, respectively. They also found that faculty in health professions and arts and humanities had higher levels of interaction than in other disciplines, and that the competitiveness and Carnegie classification of the college or university correlated with student-faculty interaction levels. They found that a supportive college environment was important for student-faculty interactions.[8] These studies point to the importance of student-faculty interactions for student engagement and learning, and also reveal differences in interaction patterns based on personal characteristics and environmental contexts.

Prior work to examine the diversity of student demographics within chemical engineering has not focused on student age and experience in a significant way to date. However, the chemical engineering discipline is committed to promoting student diversity as broadly defined, and the lens on adult students in this study can support that aim.

METHODS

This study uses qualitative data drawn from semi-structured interviews with adult (25 years plus) undergraduates with prior engineering-related work experience and traditional-age (18-22 years) undergraduate chemical engineering students without engineering related work experience at a large, public, research university to ask: Are faculty-student relationships as described by students different for experienced adult students vs. students who are traditional in age and have no prior experience within chemical engineering?

This is part of a larger study to examine the experience and impacts of prior work experience on adult students (aged 25 plus), to reveal their ways of "doing" and "being" engineering students. The larger study recruited adult engineering students at three diverse institutions: large, public, research university; small, private, undergraduate university; and community college. Participants were recruited from all engineering disciplines and were required to have significant prior engineering-related work experience, such as work as a technician, a mechanic, or in manufacturing and assembly. The choice to focus on experienced adult students was situated in prior research that found a sample of 10 adult undergraduate students at a primarily undergraduate institution in the Northeast United States all had engineering-related work experience.[4] These engineering students typically were influenced in their choice to study engineering based on their exposure to the field of engineering work. We find this to be an important difference that may influence the way nontraditional adult students may perceive themselves, approach their roles as engineering students, and persist in engineering coursework. To clarify the difference in experience and age between the two groups in this investigation, we use the terms "experienced adult" to mean a student who is 25 years or older and has engineering-related work experience, and "inexperienced, traditional-age student" to mean a student who is 18-22 years of age and does not have a history of engineering-related work experience. We acknowledge that traditional-age students may have a great deal of experience in other domains, and do not wish for the term "inexperienced" to be over-interpreted in its use here.

We collected data from up to 10 experienced adult students at each of the three sites, using semi-structured interview techniques as described by Seidman in *Interviewing as Qualitative Research*, third edition,[9] except that each participant was interviewed only one time, due to the demanding schedule of the adult-student demographic. Questions probed the experience, motivation, relationships, identity, and path to higher education of these students. The line of questions explored for the purpose of this paper were:

- *Are there any occasions in which you feel especially connected to your engineering student peers?*
- *Are there any occasions in which you feel especially disconnected from your engineering student peers?*
- *Are there any occasions in which you feel especially connected to your professors?*
- *Are there any occasions in which you feel especially disconnected from your professors?*
- *How similar or different do you feel to a "typical" engineering student at this institution?*

To ensure high-quality data collection, each researcher underwent at least 20 hours of training in human subject research, interviewing as qualitative research methods, and practice with the specific interview protocol. The interview question instrument was tested with at least five participants before use in collecting data for this study. The principal investigator reviewed the audio files and transcripts to ensure proper interview technique by the researchers.

We wished to draw comparisons between a group of experienced adult students and their inexperienced, traditional-age peers. For this study, we identified the chemical engineering department of the large, public-research institute (which we call "PUB" here) as the most appropriate context for this comparison. Of the 10 semi-structured interviews collected from all experienced adult engineering students at PUB, five of them happened to come from the chemical engineering program. Furthermore, there is a large pool of more than 300 traditional-age undergraduate students in the same department. To match the five experienced adult student interviews, we recruited five inexperienced, traditional-age students with no prior engineering work experience for the same semi-structured interview protocol. We sent an email through a department

Listserv to all undergraduate chemical engineering students, and selected the first five volunteers who qualified based on age (18-22 years), degree (enrolled in a chemical engineering B.S. program), and lack of significant engineering-related work experience (defined the same way as above).

The five experienced adult students highlighted in this study ranged in age from 28 years to 63 years. They were all full-time students, and three of them worked part-time. All five entered the university as transfer students. Two were married and one was in a domestic partnership, while the remaining two were single. Collectively, their prior work experience ranged from military to research consulting to information technology leadership.

For comparison, the five inexperienced, traditional-age students in this study ranged in age from 18 years to 22 years. They were all full-time students, and two worked part-time. Two entered the university as freshman, and the other three as transfer students. All of them were single, with no children in their care. Two of them had been employed as research assistants for more than six months but less than two years.

We acknowledge that a study size of five plus five is small. However, as Seidman explains, "the purpose of an in-depth interview study is to understand the experience of those who are interviewed, not to predict or control that experience" which he notes is a fundamental characteristic of a phenomenological approach to research. The aim in an interview study is to elicit enough detail that the researcher may see patterns among different individuals that are shaped by common experiences, or convey the complexities of the lives of those interviewed in such a way that it reveals connections with the readers' experiences.[10] We find that this sample of 10 students allows us to achieve these goals, by providing data around these students' experiences and approaches that have not previously been reported. We must keep the study size in mind as we seek to generalize the observed phenomena to other individuals and contexts.

The narratives were analyzed for themes and patterns of difference between experienced adult and inexperienced, traditional-age students. We used a method drawing from grounded emergent analysis with an "analytical spiral" approach as described previously by Plano Clark and Creswell[10] to analyze the fully transcribed interviews. The analytical spiral method acknowledges the nonlinear path of meaning-making when presented with qualitative data such as the semi-structured interviews in this study. This method begins with the raw data, moves through phases of probing and comparisons, and culminates in a visual model to represent the findings. Three trained researchers read all 10 transcripts and met to discuss emergent themes. We developed a set of codes appropriate to encompass the emergent themes, then individually assigned codes to passages from each transcript. Once we had completed this independently, we discussed again to modify and refine the code definitions and assignments to reach consensus.

FINDINGS

Our analysis revealed differences in the ways inexperienced, traditional-age students and experienced adult students in this university department context perceived and approached instructor relationships.

In this study, experienced adult students are less intimidated by professors than inexperienced, traditional-age students

When asked an open-ended question about connections to faculty members, four of the five inexperienced, traditional-age students in this study responded that they were intimidated by professors, embarrassed to ask questions, or found it difficult to approach their professors. Many inexperienced, traditional-age participants in this study emphasized throughout their interview the competitive nature of the academic climate, a factor that made them feel insecure, anxious, and worried about being perceived as below average by their peers and professors. As a result of this environment, many felt they would rather engage with their peers and the graduate teaching assistants than directly with professors, whether in office hours or by asking questions in class. Illustrative quotes used below indicate participant ID numbers. (Letter "T" code suffix is used to indicate an inexperienced, traditional-age student. Experienced adult students have no suffix letter.)

> *"So when we, all the students were growing up, you were taught that there are no such things as stupid questions, but there are questions that are really stupid, and I don't want to ask them. I'd rather ask them to a [teaching assistant] rather than a professor. It's really intimidating because of how accomplished they are and what they have done and you're in there asking stupid questions that you should know. So it's kind of embarrassing."-PUB103T*

> *"...when I ask questions I really need to think first. Really think hard. Is it, more like, not like I need to think how to solve this problem, instead I need to think, is it a clever question or a stupid question? Is it this question that will make people laugh or is this question will make people roll their eyes?" -PUB119T*

In contrast, experienced adult students in this study are not intimidated by professors, and are not embarrassed to seek help from faculty members. None of the five experienced adult participants said that they were intimidated or embarrassed to ask questions, although one did note that it can take courage to seek help.

> *"...I think this is probably something that comes with maturity, is that, there's nothing wrong with asking for help. And I'm not intimidated, like some of the students are, by the professors. And so, I will walk into a professor's office and ask for some help when I need it, and I will go to office hours and that naturally leads to some sort of an exchange." -PUB 014*

> *"It's probably like in class...I ask a lot of questions whereas I feel like a lot of my peers don't because they are scared*

of being embarrassed in class? Whereas I'm too old, I've been embarrassed too many times in my life, I don't care anymore" -PUB 108

Indeed, experienced adult participants noted that while they themselves are not intimidated by professors, they have noticed that many of their younger peers struggle with this, which they see as a missed opportunity.

"And I think in that regard I have an advantage over some of the younger students. I know some of my classmates have expressed being intimidated even by [teaching assistants]. I feel sorry that they do, because they're just people. And they're eager. They're good people and they're there to help you." -PUB 014

We find that this difference expresses itself in better help-seeking behaviors, such as office hours attendance and question-asking, among experienced adult students in this study. The trend also seems to extend to graduate teaching assistants, with some inexperienced, traditional-age students in this study being sensitive to this age or status difference as well.

Inexperienced, traditional-age students in this study often refer to the competitive nature of college as one of the reasons they don't feel comfortable asking questions. Experienced adult student participants rarely mention the competitive climate, and when they do it is in a more positive way. And it doesn't hinder them from getting as much out of faculty and graduate student interactions as they can.

Similarities in age and associated life experience contribute to interactions

Some experienced adult students in this study feel that age gives them an advantage when it comes to asking for help or talking to professors. This is especially true of the experienced adult students who don't blend in, because they are visibly older. They have an easier time connecting with professors, and asking questions in class. These adult students' experience in the workplace may impact their willingness to ask questions and make themselves vulnerable. Because some experienced adult students are a similar age to their instructors, there may be opportunities to connect to cultural references, life and family experiences, and other points of commonality that neither the instructor nor the adult student share with traditional-age students. Our interviews with experienced adult students show that these students appreciate this opportunity for connection. Some professors will also actively engage in conversations with the older adult students and take an interest in their stories. This is also something the experienced adult students in this study take advantage of to be able to connect with professors.

"I think at some point almost every professor I've had has said something to me of the nature of 'so, what's your story. Why are you here? What are you doing here?' Not in a derogatory way, but just, you know, 'what's going on? This is really unusual. We don't really see someone your age here.' So, that sort of opens up a little bit of a dialogue" -UB 014

"...with professors often I feel bit more commonality. Just because I, as opposed to...I expect my peers, I approach them not as like big intimidating people, I just see them as a person just doing their job. And to me, being a student is a, my, job and so I can't do my job without clarification from them sometimes and so if I got to go get that then I just go get it, it's fine. … they don't intimidate me… when I do approach professors, I don't approach them necessarily as student to teacher. I approach them respectfully but I approach them as, almost as a peer in my demeanor at least, and that's just because they don't intimidate me…." -PUB108

Inexperienced, traditional-age students in this study have also noted that it is easier to connect to professors who are younger and thus are more culturally similar to themselves. They perceive these professors as less intimidating and more relatable.

"I find that the younger the professor, the easier it is to connect with them, the easier it is to talk to them. They are a lot more laid back, a lot more relaxed." -PUB103T

We also found commonality among the students in some factors that influence student-faculty interactions and relationships.

Large class sizes make it more challenging to forge meaningful student-faculty mentoring relationships

All five inexperienced, traditional-age participants stated that they believed large class sizes at PUB to be a primary hindrance to forming meaningful relationships with professors. Students who entered the university via transfer from smaller colleges in particular mentioned that the classroom dynamic in a large class is completely different from that of a smaller, more intimate class where the professor knows every name. In larger classes traditional-age students feel they are just a number and most professors will make little to no effort to get to know them or personally monitor their progress.

"I think it's very hard as [PUB] students, public school students, to become connected towards their professors, but that's just because our class sizes are so large." -PUB020T

"The chemE classes here are like 200 students, 150 students. There are not too many one-on-one times. I would really prefer a smaller class, that's just how I learn better, that's just how I grow. I really would like to know my professors better, but just because I am in a class of 200 students, 150 students, it's really hard to do that. At community college, the professors knew who you are, they knew your name, they knew how well you were doing in the class, they would check up on you. That was really nice to know that the professors actually cared, rather than here, it's just come to class to get a grade and professors don't even know your name." -PUB103T

Despite the large class size and their perception that professors often seem distant, inexperienced, traditional-age students in this study largely agree that professors are willing to help students and talk with them about topics unrelated to

coursework (particularly their own research). Inexperienced, traditional-age students agree that it is largely up to the student to take the initiative to reach out for help.

> *"I feel like in general over here, most of the professors I know, given the opportunity, if they could clone themselves and produce like a hundred of themselves and help every student, they probably would... But the thing is they are not willing to go out of their way to help you, you have to go out of your way to come and approach them." -PUB117T*

Experienced adult chemical engineering students in this study also feel that size of a class plays a factor in being able to connect with professors. These experienced adult students agree that it can be more difficult (albeit not impossible) to forge connections with professors in large classes.

> *"Yeah, I think that plays a big role, the class size. The way that I would find myself approaching professors would be to start with the office hours. That would be like the beginning. Then from there, start talking a little bit more. But the office hours are just so crowded that it doesn't make it possible to make that relationship. As in community college I could go to office hours and be the only one there. Or just right after class I could ask one question about, 'professor what do you do in your job that you have?' And just right there that would start a whole story and relationship. That's how I see that. And that, it doesn't seem to work like there here, I can't do that here." -PUB109*

While some experienced adult engineering students in this study feel that large class sizes make it difficult to engage with professors, they seem to agree that professors do try to be available, and that making a connection is definitely possible if the student goes to office hours and makes use of other opportunities presented to them. However, some students report that due to scheduling constraints, they are unable to effectively engage with professors by going to office hours.

> *"You know, there are classes, most of the lecture classes, unless you actually engage the professor, you're not gonna know. So, yeah, sometimes you'll go to office hours and talk to your professor, but… I mean there are some classes where you're actually presenting to your professors and you get to know them a little more on a personal basis and so I think it always comes down to the size of the class. I mean, it's difficult for a professor to get to know everyone in like a 400-person lecture. But if you're in a small seminar or if you're in a small lab class, you know, you have that opportunity. I think it's valuable, just feeling comfortable interacting with your professor. It's a big deal. We're not here to just check these boxes off on a list and then that's it. You know, part of the value of coming to [PUB], for instance, is to maximize the resources available and professors are a huge resource. But, that being said, with all the time constraints I have, sometimes I can't go to office hours because I'm doing something else. So, yeah, the opportunities are there. I just personally have not … made [the] most of these opportunities. Just because I chose to put in my time elsewhere." -PUB 010*

Teaching style and quality impact student-faculty interactions

Inexperienced, traditional-age students in this study mentioned that they were much more likely to feel comfortable personally approaching professors if they connected to their teaching style. During class students form opinions about the professor based on her or his organizational level and level of preparedness. Professors who were disorganized, made simple mistakes during lecture, and seemed to answer questions poorly were seen as people who were unable to help the student progress academically. These professors were thus not seen as an effective resource and inexperienced, traditional-age students report their lack of inclination to attempt to forge connection. However, professors who are knowledgeable and prepared and offer encouraging words to students are greatly appreciated and are very effective at encouraging productive class dialogue.

> *"I guess through teaching and hearing from other people, you kind of get a sense of how the professor, like, works? And from there you subconsciously form an opinion, like is this professor, like, someone who I think can help me? Because there are professors who might not have a teaching style that you like and then you won't want to approach them for help." -PUB118T*

> *"I love my [class number] professor, since I'm more willing to ask questions since he's super knowledgeable though it's his first time teaching it. I feel very encouraged by his words and sometimes … says 'oh, you did a great job!' It means a lot to me, it means like, oh I'm actually learning this subject, and not just reading of a book, knowing the surface." -PUB119T*

Teaching style or quality did not come out as much in the interviews with experienced adult students in this study, so this may be a less important factor among experienced adult students. Nevertheless, one experienced adult student did comment that an inability of a professor to connect with the novice experience can promote a feeling of being disconnected.

> *"I would have to say that, in the lecture halls themselves, during the teaching experience, there's no question that all the professors that I've had are brilliant in their fields. I wouldn't say that they all recognize what's necessary at any given point to transfer that brilliance to their students. And, some of them are so in the upper stratosphere of intelligence that it's listening to somebody speaking another language at times. And then, yeah, I do feel disconnected. … But, uhm, sometimes, yeah, I feel totally disconnected because some of these people have been doing this stuff for so long they just don't realize how hard it is for somebody who's coming in and hasn't been doing it for 20-30 years." -PUB014*

Faculty engagement in reaching out to students and being available contributes positively across age groups

Some students, both traditional-age and adult, described examples of faculty as being engaged in extracurricular activities,

hosting welcoming office hours to go beyond homework material, and similar.

> *"So in [course number], [faculty name] was teaching, and then, I actually got the chance to get lunch with her through AIChE, they had a student-professor lunch program, or something you sign up for. So I got lunch with [professor] and then she was really, really nice. She, we had a more special connection just because, like, she also helped me find research. And then I'm actually taking another one of her classes right now, partly because she's teaching it and I wanted to, kind of like, learn from her a little bit more? So we have a much deeper than normal professor student connection."-PUB118T*

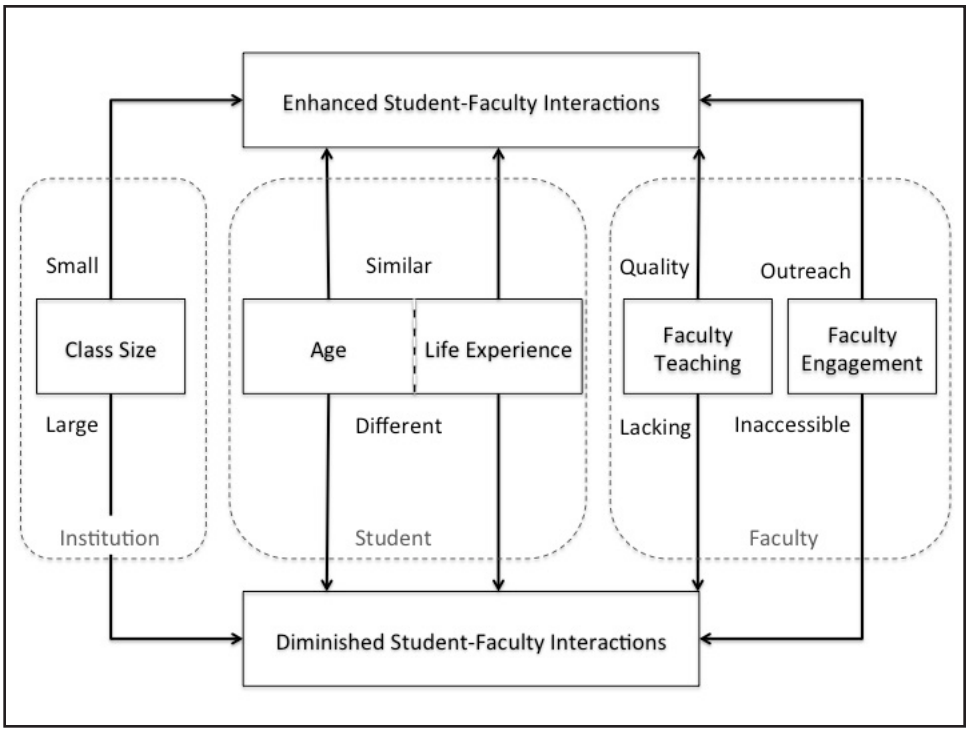

Figure 1. *Quality of student-faculty interactions as a function of characteristics of institution, students, and faculty, as described by students.*

We organize the summary of these interview findings in Figure 1 to show the factors that can enhance or diminish student-faculty interactions. Some of these factors depend directly on student age and experience, and are found as differences between experienced adult and inexperienced traditional-age chemical engineering students in this context. Other factors are not directly related to student age and experience differences, but we acknowledge that age and life experience may temper the extent to which these factors influence student-faculty interactions. We organize them in the following categories, shown by the dotted lines:

Institution Characteristics:

Class size

The class size is a function of institutional context, and many of the students, both experienced adult and inexperienced traditional-aged, interviewed for this study cited class size as an important factor, with smaller class sizes promoting student-faculty interactions.

Student Characteristics:

Age

Students of both age groups, adult and traditional, cited similarities in age between themselves and the faculty members as a factor that promoted connection. Age in this case is related to cultural touchpoints, patterns of interpersonal interaction, and other commonalities.

Life Experience

Experienced adult students point to similarities in life experience with faculty members as promoting their connections. Experienced adult students in this study draw on their own experience in the workplace as a model for constructive working relationships with senior colleagues. Inexperienced, traditional-age students also point to differences in life experiences and achievements as contributing to their feelings of being intimidated by faculty.

We show a linkage between these two student characteristics, because these may develop concurrently, and we did not decouple these factors in our study.

Faculty Characteristics:

Faculty Teaching

The perceived quality and style of faculty teaching is an area that can enhance student connections with professors, by driving students to make the effort to forge mentoring relationships with faculty whose teaching resonates with them.

Faculty Engagement

Faculty members who make themselves available to students for more than reviewing homework sets are described enthusiastically by students as sources of connection and important professional relationships. This can include sharing a meal with students, participating in student-faculty events, or hosting drop-in style office hours.

An important outcome from this broad research project is to promote awareness among engineering faculty and administrators that experienced adult engineering students are present

in our classrooms. This means expanding our perception of who among us might be a student to include students in their 40s, 50s, and 60s+ who get mistaken as parents or staff on campus, and an awareness that late 20s and 30-something students who "pass" as traditional age students may have relevant experiences and skills that we can draw on, and other aspects of non-traditionality such as family commitments.

LIMITATIONS

When we consider the scope and limitations of this study, it is important to acknowledge the context of the large, public, research institute and the demographics of the students at the site. Many of the participants interviewed for this study, both traditional-age and adult, entered the university as transfer students. Transfer students make up a large fraction of students at this university, and their collective experience is likely different from freshman admits in many ways.

The large size typical of some classes at PUB, and the associated competition for resources including faculty attention, certainly entered into the conversation during the semi-structured interviews. The findings here then may be especially applicable to other large universities or large departments, especially those that may be perceived as competitive. While the data we collected from students from other institutions and majors were not directly presented in the analysis here, we note that the theme of seeing faculty as approachable resources and learning peers, without intimidation, was common in interviews of experienced adult students at the other data collection sites and other majors at this site.

Furthermore, this study was designed to learn more about the sub-group of adult undergraduate engineering students who have significant prior engineering-related work experience, by comparison with traditional-age students who entered our program directly from high school and did not experience the role of engineering-related industry worker. The study was not designed to separate the impacts of age from the impacts of experience in these groups of students. In that way, we may consider the impacts of age and experience to be confounded in this study. Adult students without engineering-related work experience are not represented here, nor are students who may be within the traditional age range who have significant engineering-related work experience. We did not explore the impacts of internships or co-op experiences in this study.

CONCLUSIONS

Supporting the diversity of students in engineering programs can begin with awareness of the various perspectives of diverse students in our programs. These results give a window into the approach and thinking of experienced adult undergraduate engineering students, an important but often overlooked part of our engineering classrooms.

A major takeaway from this study finds applicability with all students in all contexts: There is learning power in vulnerability. Adult learners know this, and their intentionality and life experience give them the power to push past differences in age or status when seeking understanding, so they are unafraid to ask professors and graduate students questions to aid their learning. Traditional-age students in chemical engineering programs should be encouraged to embrace the vulnerability that comes with asking questions. Faculty members can encourage students to think critically about what they are learning, and to take opportunities to reflect and ask thoughtful questions. The results also harmonize with previous work on student-faculty interactions in other contexts to show that similarities between faculty and students can be powerful for initiating student-faculty relationships.[7,8] This also suggests that faculty can enhance this opportunity by seeking and expressing similarities with their students, such as sharing their own backgrounds, philosophies, and interests.

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REFERENCES

1. Snyder, T.D., and S.A. Dillow, *Digest of Education Statistics 2013* (NCES 2015-11). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education (2015)
2. Bushey-McNeil, J., M.W. Ohland, and R.A. Long, "Nontraditional Student Access and Success in Engineering," *Proceedings of the 2014 American Society of Engineering Education Annual Conference*, Indianapolis, IN (2014)
3. Darkenwald, G.G., and R.J. Novak, "Classroom Age Composition and Academic Achievement in College," *Adult Education Quarterly*, **47**(2), 108 (1997)
4. Ciston, D., M-I. Carnasciali, V. Zelenak, M. Hollis, "Adult Undergraduate Engineering Student Experience," *American Society for Engineering Education National Conference* (2012)
5 Kasworm, C.E. and G.R. Pike, "Adult Undergraduate Students: Evaluating the Appropriateness of a Traditional Model of Academic Performance," *Research in Higher Education*, **35**(6), 689 (1994)
6. Mikel, T.K., F.Q. Hoang, E. Okada, P.S.H. Kim, A. Rodriguez, M-I. Carnasciali, and S. Ciston, "A Multi-Institutional Study of the Relationships Between Nontraditional and Traditional Undergraduate Engineering Students," *American Society of Engineering Education Pacific Southwest Section Meeting* (2016)
7. Lundberg, C.A., and L.A. Schreiner, "Quality and frequency of Faculty-Student Interaction as Predictors of Learning: An Analysis by Student Race/Ethnicity," *J. College Student Development*, **45**(5), 549 (2004)
8. Wang, R., A. BrckaLorenz, and Y.-C. Chiang, "What Characteristics Predict Student- Faculty Interaction and Important Relationships with Effective Educational Practice," *Annual Meeting of American Educational Research Association* (2015)
9. Seidman, I., *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*, New York: Teachers College Press (2006)
10. Plano Clark, V.L. and J.W. Creswell, editors, *The Mixed Methods Reader*, Thousand Oaks, California: Sage Publications (2008) ❐