

Improving Support of Welding Technology Students: Examining Experiences and Perceptions of Welding Technology Students through Survey Results

Ms. Alexandria Williams, University of Michigan

Alexandria Williams is a Master's student in the Engineering Education Research Bridge to Doctorate Program at The University of Michigan. Her research interests focus on leveraging machine learning to create adaptive, inclusive, and personalized learning environments that address the diverse needs of underrepresented minority (URM) students and other marginalized learners in higher education. Alexandria holds a Bachelor's degree in Computer Science from Alcorn State University.

Ms. Amber Green, University of Michigan

Amber Green is a PhD student in Engineering Education Research and Robotics at the University of Michigan. Her research interests include robotics student self-efficacy, robotics students' perceptions of instructional robotics practices and self-efficacy boosting instructional practices. Amber received a Bachelor's of Science in Engineering from the department of Electrical and Computer Engineering at The Ohio State University.

Vibhavari Vempala, University of Michigan

Dr. Vibhavari Vempala is a Research Fellow in the Department of Industrial and Operations Engineering at the University of Michigan. She works with Dr. Joi-Lynn Mondisa to study mentoring and the career and professional development experiences of engineering students. Dr. Vempala received a PhD in Engineering Education Research from the University of Michigan in 2025 and hold a MS and BS in Biomedical Engineering.

Dr. Joi-Lynn Mondisa, University of Michigan

Joi Mondisa is an Associate Professor in the Industrial & Operations Engineering Department and Graduate Program Director of the Engineering Education Research Program at the University of Michigan. Her research focuses on mentoring practices, programs, and experiences as well as professional development in STEM. Prior to her graduate studies, Dr. Mondisa spent 10 years working as a professional in manufacturing, operations, technical sales, and publishing. During that time, she also taught engineering technology courses at Triton College in River Grove, Illinois, for seven years. She earned a B.S. in General Engineering from the University of Illinois at Urbana-Champaign, an M.B.A. from Governors State University, an M.S. in Industrial Engineering, and a Ph.D. in Engineering Education from Purdue University.

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Background

Welding is an essential component of many industries and serves as a foundational technology in modern society. Welding is considered foundational to our society because there are many roles within the industry that require human capability and cannot be replaced by automation [1]. Despite being an important field, there is a shortage of qualified welders in the welding workforce [2]. Many factors influence this demand for skilled welding personnel. Factors include needing skilled and qualified welding teachers [3], programs and classrooms equipped with proper technology and resources [2], and an understanding of students' experiences [4]. The need to increase students' interest in welding is imperative now more than ever because a large number of current welders are close to retiring. Given this, the American Welding Society expects that there will be approximately 200,000 more welding jobs than available workers [5]. Welding programs typically range from two year associate degree or short-term certificate programs at community colleges to some four-year welding technology degrees. Previous research indicates student success in occupational programs or certificates at two-year colleges is influenced by students' characteristics and experiences in college and local environments [6]. Research also indicates that the academic and personal experiences of welding technology (WT) students are sparsely examined in the literature [4]. Therefore, we must examine the characteristics, experiences, and perceptions of WT students to better understand and identify ways to support their matriculation and retention in welding. In this work, we examine these experiences and perceptions through survey findings that are part of a larger collaborative research study conducted by faculty, administrators, and researchers from two community colleges and two universities in Southeast Michigan. The larger study focuses on WT students, faculty, administrators, and industry employers across Southeast Michigan. Its goal is to create substantiated and effective strategies that help support WT students to enter welding careers, and reduce the demand gap for welding professionals. The research question guiding the work presented in this paper is: What are the academic and personal experiences of students in WT?

Methodology

In this paper, we present findings from the survey data of students who are enrolled in a WT program or taking a welding class. The broader study's goal is to create practical strategies for improving instruction, program design, and career pathways, ultimately enhancing the welding workforce pipeline in the region.

Measures

A survey with items adapted from the Community College Survey of Student Engagement (CCSSE) [7] was used to collect data from students who are enrolled in a WT program or taking

a welding class. The survey contained 14 Likert-scale questions, 5 multiple choice questions and 14 binary questions to assess students' experiences in three different constructs. The constructs are *student engagement* which includes 14 questions, *academic experiences* which includes seven questions, and *external demands* which includes 13 questions. These items were either directly from or slightly modified from the CCSSE survey instrument and were rated on a 5-point Likert scale (e.g., 1=Never to 5=Very Often). Additionally, the survey collected demographics and background information such as gender, age, relationship status, number of children a student may have, race, GPA, intended degree, college attending and years enrolled in their program. The results reported in this paper only include survey questions that received at least one response. Questions with zero respondents are not included in the results analysis.

Recruitment and Data Collection

After receiving institutional review board (IRB) approval, the third and fourth authors on the project shared a recruitment email with research team members who are welding instructors. The instructors then distributed the recruitment email to their contacts and the WT students within their networks to encourage survey participation. The recruitment email included a brief description of the study, nature of participation, and eligibility. The email also included a copy of the informed consent form and emphasized that participation is optional. Students who met the eligibility criteria and were interested in participating could do so by clicking on a Qualtrics link which took them to the survey and started the informed consent process. Participants who completed the survey were compensated with a \$20 gift card and data collection was halted when additional outreach resulted in no new responses.

Data Analysis

Before cleaning the data, the team received a total of 155 survey responses. After careful review, a total of 43 responses were excluded due to missing information (n=24), duplicate student responses (n=15), or nonsensical answers (n=1). Of the remaining 112 surveys, we retained responses if the survey progress status indicated 100%, marking full completion of the survey and if the participant received financial compensation for their participation. Our analysis included a total of 109 responses. The responses to multiple choice questions were averaged showing their central value and binary and Likert questions are mathematically conveyed through percentages, expressing their fraction of the whole.

Results and Discussion

The data collected from the welding technology student survey gives an overview of the personal characteristics and the academic and personal experiences of students enrolled across a few Southeast Michigan institutions. Table 1 provides a summary of the surveyed welding students' personal characteristics, including their gender, age, relationship status, race/ethnicity, parental status, and degree program enrollment.

Table 1: Demographics and background information of students in welding programs.

		Number	Percentage
Gender identity	Male	88	81.48%
	Female	20	18.52%
Age	18-25	87	79.82%
	26-30	8	7.34%
	31-35	5	4.59%
	35+	9	8.08%
Relationship Status	Single	97	88.99%
	Married or equivalent	12	11.01%
How many children live in your household the majority of the time?	0	68	62.39%
	1	11	10.09%
	2+	30	27.52%
Race	White/Non-Hispanic	87	79.82%
	American Indian/Alaska Native, White/ Non-Hispanic	8	7.34%
	Hispanic	3	2.75%
	Asian or Asian American	4	3.67%
	Black or African American	6	5.50%
	Middle Eastern or North African	1	0.0917%
Do you identify as Hispanic or Latino?	Yes, Mexican American/Chicano	2	1.83%
	Yes, Central American	1	0.92%
	No	106	97.25%
Current GPA (on a 4.0 scale)	2.0 - 3.0	19	17.43%
	3.0 - 4.0	77	70.64%
Degree program	Associate's	30	27.52%
	Bachelor's	44	40.37%
	Certificate	20	18.35%
	Non-Applicable	10	9.17%
	Other	5	4.59%
Enrollment Duration	Less than a year	30	27.78%
	A year	25	23.15%
	Two years	19	17.59%
	Three years	17	15.74%
	Four or more years	17	15.75%

The data shows that the majority of respondents are male (81.48%), between 18–25 years old (79.82%), and single (88.99%), with most (62.39%) having no children. White/Non-Hispanic students make up the largest racial group (79.82%) with most students pursuing bachelor's (40.37%) or associate's degrees (27.52%), and the majority having been enrolled for two years or less (68.52%). Collectively, this sample represents a relatively young, career-focused population balancing education with employment and personal responsibilities. Welding has traditionally been seen as a skilled trade often tied to certificate or associate's degree programs. However, over 40% of participants in the survey reported being enrolled in a bachelor's degree program. A large number of students in bachelor's programs may reflect a growing demand in the industry for advanced technical knowledge. It could also reflect that the institutions in the survey sample are schools that offer more bachelor-level programs, possibly influencing the pool of responses.

Student Engagement

The questions related to student engagement surveyed on a scale of one to five (1 = Never, 5 = Very Often) how often students had the following experiences: engaged in serious conversations with students who differ from you, received prompt feedback from instructors on your performance, come to class without completing readings or assignments, skipped class, worked with instructors on activities other than coursework, and discussed career plans with an instructor or supervisor. Students rated "*How often have you received prompt feedback from instructors on your performance?*" with the highest average rating of 4.04, indicating meaningful engagement with instructors. The least rated question was "*How often have you skipped class?*" with an average of 1.49, corresponding to "Never". The remaining experiences received average ratings of 3.71 for discussing career plans with an instructor or advisor, 3.12 for engaging in serious conversations with students who differ from you, 2.84 for working with instructors on activities other than coursework, and 2.13 for coming to class without completing readings or assignments. Overall, these ratings indicate a student population relatively engaged in coursework and having meaningful interactions with instructors about their performance and career plans.

Additional questions examined student engagement regarding how much time students spend preparing for class (studying, reading, writing, rehearsing, doing homework, etc.) and participating in college-sponsored activities (organizations, campus publications, student government, intramural sports, etc.). Forty seven percent of respondents indicated spending 1 - 5 hours in a typical 7-day week preparing for class. Eighty seven percent of respondents spend the same amount of time participating in college-sponsored activities. Most of the respondents selected the lowest option for these set of engagement questions, which might not necessarily indicate disengagement; rather it may reflect a focus on quality of time spent rather than the quantity of time. Further, the results might also indicate that students have limited time to engage in coursework and college sponsored activities due to external demands (discussed below).

The final portion of this section identifies issues that may cause students to withdraw from the class or the college. The five issues include: working full-time, caring for dependents, being academically unprepared, lack of finances, and transferring to a 4-year college or

university, rated on a scale of one to five (1 = Never, 5= Very Often). Of the listed potential issues, lack of finances received the highest average rating with 2.72. Being academically unprepared received the lowest average rating with 1.76. The remaining averages are as follows: 2.53 for working full time, 2.28 for caring for dependents and 1.83 for transferring to a 4-year college or university.

Academic Experiences

To understand students' academic experiences, we asked students to rate how often their coursework encouraged the following mental activities: making judgements about the value or soundness of information, arguments or methods, applying theories or concepts to practical problems or in a new situation, and using information you have read or heard to perform a new skill. On average students rated using information you have read or heard to perform a new skill the highest at 3.93. Applying theories or concepts to practical problems or in new situations received a 3.82 and making judgements about value or soundness of information at 3.16.

Additionally, participants were surveyed about the emphasized activities in their coursework as well as their participation in remedial coursework and experiential learning activities. Nearly half of the students (47.71%) reported that they participated in internships, field experiences, co-ops, or clinical assignments, reflecting a moderate level of hands-on industry involvement. Similarly, a significant number of students (48.62%, 40.37%, 57.14%) have taken developmental or remedial courses in math, reading, and writing, indicating that many require additional academic support before or during their welding program studies. Overall these findings suggest that the student body includes both well-prepared individuals and those building foundational academic skills. A summary of the participants' responses related to their academic experiences are included in Table 2 below.

Table 2: Academic experiences

Which of the following have you done, or are currently doing at this college?			
		Number	Percentage
Internship, field experience, co-op experience, or clinical assignment	Yes	52	47.71%
	No	56	51.38%
Developmental/remedial math course	Yes	53	48.62%
	No	55	50.46%
Developmental/remedial reading course	Yes	44	40.37%
	No	64	58.72%
Developmental/remedial writing course	Yes	62	57.14%
	No	46	42.59%

External Demands

To understand the external demands of welding technology students, survey questions focused on the hours students spent working for pay, providing care for dependents, and commuting to and from classes (Table 3). About thirty nine percent (38.54%) of students reported working more than 20 hours per week and a similar percent of students (37.61%) reported dedicating only 1-5 hours per week working for pay, which indicates a mix of students who work full time as well as students who only work 1-5 hours per week enrolled in welding classes. Similarly, a majority of students spend only about 1-5 hours per week providing care for dependents (75%) and commuting to class (83.02%). These findings suggest that the participants' relatively young age and single status may be influencing their strong focus on career development which is further discussed below.

Table 3. Hourly external demands of welding students

	Working for pay		Providing care for dependents		Commuting to class	
	Number	Percentage	Number	Percentage	Number	Percentage
1-5	41	37.61%	72	75%	88	83.02%
6 - 10	10	9.17%	12	12.5%	15	14.15%
11- 20	12	11.01%	6	6.25%	1	0.93%
21-30	13	11.93%	0	0%	1	0.93%
More than 30	29	26.61%	6	6.25%	1	0.93%

Students were also asked to select their reasons or goals for attending college (Table 4). The majority of respondents reported wanting to obtain job-related skills (99.02%) and self-improvement/personal enjoyment (91.26%). Furthermore, most indicated they do not plan to transfer to a 4-year college or institution (64.22%), but do want to obtain an associate's degree (67.33%) and complete a certificate program (70.59%). These responses suggest that students are primarily focused on gaining the knowledge, skills and official credentials needed for a career in welding technology. Additionally, given that many students in the survey (40.37%) were already enrolled in bachelor's programs, the findings related to student transfer intentions indicate that students in the survey might be primarily focused on completing the programs they are currently enrolled in and start a career in welding rather than pursue further education. Family influence was almost evenly split, with 51% reporting "No" and 48% reporting "Yes". This could be a reflection of a student population composed largely of young adults without significant family obligations. It may also indicate that many students do not have family members who are currently or were previously in the field to serve as role models. Additionally, it could reflect a shift in thinking in which students are prioritizing their own wants and needs when making educational and professional decisions.

Table 4. Reasons or goals for attending college.

	Number	Percentage
Obtain job related skills		
Yes	101	99.02%
No	1	0.98%
Self-improvement/personal enjoyment		
Yes	94	91.26%
No	9	8.74%
Update job related skills		
Yes	78	78.79%
No	21	21.21%
Complete a certificate program		
Yes	72	70.59%
No	30	29.41%
Obtain an associates degree		
Yes	68	67.33%
No	33	32.67%
Family influence		
Yes	48	48.98%
No	50	51.02%
Transfer to a 4-year college or university		
Yes	29	26.61%
No	70	64.22%
Change careers		
Yes	24	25%
No	72	75%

Implications and Conclusion

Welding technology is a major contributor to the technological advancement of our world. Southeast Michigan is still in need of support for WT workers because the number of students entering the WT workforce is insufficient to meet the demand. Investigating the experiences of WT students is essential for addressing the growing gap between the large numbers of those leaving the field and the relatively few entering or completing it. The data collected offers valuable insights into the experiences of welding students and how their personal circumstances may influence their educational outcomes. Based on the data, most welding students spend a limited amount of time, typically 1–5 hours per week, participating in college activities. This trend suggests that student engagement in extracurricular activities on campus is relatively low. Most students being single, working for pay, and only studying a few hours per week suggests that the student population may be highly focused on academics and work responsibilities, with limited time or interest in broader campus involvement. The low levels of student engagement and involvement also suggest that existing opportunities might not be fully

supporting the needs of the WT students in the study. Understanding the profile of current WT students provides a foundation for program suggestions that can attract and retain more students. Based on the findings, some recommendations for programs to support WT students include flexible, low-commitment opportunities for student engagement that align with students' lifestyles. For example, offering virtual events, short-term volunteer opportunities, or career-related student groups could promote meaningful involvement without demanding too much time. Understanding these participation trends can inform decision-making for institutions and educators when designing programs aimed at increasing student satisfaction by highlighting where support services (e.g., academic advising, tutoring, flexible class scheduling, financial assistance) may be most needed.

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