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Teaching to Develop Perspective, Skills, Confidence, and Identity as Problem-Solving Engineers

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Cover Page Footnote

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Teaching to Develop Perspective, Skills, Confidence, and Identity as Problem-Solving Engineers

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Abstract

The "core" of an engineering degree program typically comprises the concepts, equations, and technical skills needed, as well as their practical application to common problems of the profession. This core is then divided into the "content" that must be covered in each course. It is widely recognized, however, that successful individuals do not thrive as professionals on content alone. Thus, there is significant and increasing emphasis across higher education to "educate the whole person." These efforts aim to develop "deep" qualities like grit, critical thinking, perseverance, learning from failure, valuing diversity, teamwork, leadership, curiosity, recognizing opportunity, creating value, and acting ethically and sustainably. Assessment is crucial as educators seeking to continuously improve our pedagogical practices and as researchers motivated to generate evidence of efficacy. In this manuscript, I describe specific efforts, tools, and modules aimed at developing an inclusive and entrepreneurial mindset in engineering students, as well as practices for fostering an inclusive learning environment. Finally, I reflect on the value of qualitative and quantitative approaches in assessing the development of "deep" qualities in students.

Keywords: Inclusion, emotional intelligence, critical thinking, entrepreneurial mindset, qualitative research, pedagogy

Introduction

Education is a dynamic process that must continuously adapt to remain relevant in the face of societal, technological, and workforce changes. For example, the ubiquitous use of the internet may be affecting our cognition (Firth et al. 2019), and the use of evolving electronic media technologies impacts the habits and practices and perhaps even the intelligence of developing youth (Sauce et al. 2022). These effects and others contribute to what may be seen as generational characteristics. Conversely, technological advances continually evolve industry, automating and obsoleting some tasks while creating new practices and professions. As such, it is essential for educators to be open to new ideas and to continuously develop their skills. In my case, I did not follow a seamless path from student to teacher, choosing initially to pursue a career as a federal scientist in a government laboratory. However, while hiring and managing researchers for my own lab and projects, I came to need candidates more able to solve problems independently and preform their assignments with a mindset for innovation. That need and a growing entrepreneurial desire to translate my research into commercial products and services, spurred my return to academia as a professor.

As I entered the classroom as a teacher, I realized that the mode and practices of teaching had changed significantly since I had last been a student. PowerPoints (Chen and Lin 2008; Witherby and Tauber 2019) have replaced the overhead projector, and online learning systems have raised the expectations of students for course materials, packaging, and organization, shifting much of what was once student responsibilities to expectations for the professor (Schaefer et al. 2013). A significant disconnect between my expectations and those of my students impeded my ability to construct and communicate information in a relatable way and therefore teach

effectively. Still, I could not abandon my core teaching philosophy: The most important thing I can help develop in students is the ability and confidence to do hard things they've never done before. This requires students to ask (Rothstein, Santana, and Puriefoy 2011) and answer their own questions and persevere through frustration. This is difficult by design but can be too much (Day 1982) when combined with poor teaching practices. These experiences led me to seek professional development opportunities to improve my teaching. Through these activities, I developed my own modules and practices implementing what I learned.

I developed *two* collections of practices and modules for *two* courses I teach as part of two professional development programs with different goals. The two courses are "Introduction to Bioengineering" and "Biomedical Engineering I". These courses have both my most diverse student enrollment and allow for more independent exploration of the material due to being taught to juniors, seniors, and graduate students at both 400 and 500 levels. Despite the multiple dualities stated, I believe there is significant overlap in the desired outcomes, changing student mindset and fostering an inclusive learning environment. I worked to make the two goals complementary components of a cohesive approach to teaching in which students develop their perspective, skills, confidence, and identity as innovative, problem-solving engineers.

In this article, I will describe the basis of my motivation and training, which set the course for the development of these practices, with the hope that other STEM educators may identify similar experiences if they exist and find aid in my example. I then describe each of the five modules/practices and how to use them. These are Student Cards and Tool Cards, student team formation approaches, and the inclusive aspects of rubrics and peer grading. I will present and discuss the results from a student survey. Finally, I reflect on the impact of these results as part of the narrative bookends, sharing my evolving philosophy of teaching. While I hope readers may appreciate and apply the specific modules presented in their own courses, I hope

the narrative serves as a reassuring example for struggling new teachers.

Development

The first collection of modules I created focused on developing an entrepreneurial mindset (EM) and was the product of an Engineering Unleashed (EU) Fellowship (Engineering Unleashed, n.d.). That fellowship arose from earlier participation in an EU National Workshop (Engineering Unleashed Faculty Development National Workshops n.d.) on "Integrating Curriculum with Entrepreneurial Mindset" (ICE). Engineering Unleashed is a program sponsored by the Kern Entrepreneurial Engineering Network (KEEN). The primary thrust is distilled into "The Framework" for Entrepreneurial Minded Learning (EML), which works with the three C's: curiosity, connections, and creating value. The program arises from recognition in the industry, aligning with my own experience, that students had not developed the mindset needed to solve real-world problems and to innovate while doing so. Therefore, besides developing these modules to recognize opportunities and create value, I proposed a quantitative assessment of the efficacy of the modules.

Apart from my gains in EML, however, I still struggled to foster a supportive rapport with my students, one built on encouragement and trust. Student evaluations of (my) teaching (SETs) revealed that things I had said in class, such as "Come on! You're engineers, aren't you?" had stopped some students from asking any more questions the rest of the semester. Eventually, I came to understand my own uniqueness, and this recognition was the beginning of a change in my expectations for my students. Understanding one's self, as well as the students, is crucial to teaching inclusively (Dewsbury 2020); self-awareness increases your ability to have empathy and can bring to light personal strengths and privileges that you wrongly attribute to everyone. When the University of Dayton School of Engineering announced the "Teach All Learners" program in Summer 2022, I jumped at the opportunity to participate in the inaugural cohort.

There, my fellow UD instructors and I learned about inclusive teaching practices and the value of qualitative assessment in developing and improving pedagogical practices. I had never considered the importance of qualitative research in teaching, as quantitative analysis tends to be the predominant approach in STEM research. With "evidence-based' practices in mind, I assumed evidence meant statistically significant, numerical differences, a belief that not only made "evidence" more challenging to achieve, but also discounted the actual words and sentences my students were writing to communicate with me.

Practices

Tool Card

The Tool Card ("Tool Cards | Engineering Unleashed" n.d.) is a set of weekly assignments I implemented in my Biomedical Engineering course. Students were asked to identify a "tool" and create a slide briefly describing several key aspects of the tool. The "tool" can be a fundamental law of physics, a biological phenomenon, a scientific instrument, a biomedical device, a manufacturing technique, or an experimental approach. It need not be limited to just these, however. The key aspects are: how it works, what it's used for, advantages and disadvantages/limitations, a journal article citation, and a quality image. Students can pull these from the lecture, the reading, or their own independent search (which frequently happens). The assignment also supports their group course project, a biomedical research proposal. By mid-semester, a team of four should have 32 tools to work with to achieve their aims. The deep skill Tool Cards aim to develop in students the ability to *see* (i.e., think about) all of these things (some of which aren't even tangible objects) as tools in their "toolbox" as an engineer. In the KEEN framework, this is the "Connections" C. As part of an inclusive practice, I select one or two "choice" Tool Cards to showcase each week, awarding the Tool Card grade a bonus point. This allows students to understand what good

tools look like and can boost the feeling of accomplishment and belonging for creators of choice cards. It also led to Student Cards.

Student Card

The Student Card is assigned the first week. Like Tool Cards, students create a slide about themselves, identifying their preferred name and pronouns, their favorite class or subject, why they are taking the class, academic or engineering strengths, major and year of graduation, post-graduation plans, something about themselves that they think contributes to the way they approach engineering, and an extracurricular personal fact. They also should upload a recent photo or representative graphic. The Student Card arose from my struggle to learn names quickly enough to make students feel welcome. It grew into a way to increase students' feeling of belonging in the course and bolster their identity as engineers. It has helped with the former, but I have yet to assess its impact on the latter, but I plan to. I also use it to assist in organizing teams for group assignments.

Teaming

Team exercises like design projects are presumed to lead to the development of teamwork skills. Diverse teams have been shown to be more creative (Hundschell et al. 2022) and divergent in their thinking, leading to better solutions and increased productivity. Without support, however, this is often not the case, and diversity can lead to conflict. Diversity is not one-dimensional; it exists at both surface and deeper levels (Harrison et al. 2002), which should also be taken into account. As such, there is no single best way to form student teams. Various approaches have benefits and disadvantages; even an emphasis on diversity may require varied methods.

As part of my inclusive teaching practices, I employed various grouping systems throughout the semester, including random self-selection by major and graduate or undergraduate status and by "strength"/performance. Grouping strategies also included diversifying or aligning the strengths and interests based on the Student Cards and a

"passion finding" exercise inspired by an Engineering Unleashed Card (Goehler 2019). Briefly, I believe using various team selection strategies throughout the semester may offer the opportunity to learn different teamwork skills and minimize, rather than repeat, any adverse effects of a particular strategy. This, again, is an area I plan to seek more qualitative feedback on.

Peer Grading

Peer grading or peer assessment is suggested to have several benefits (Luo, Robinson, and Park 2014), the least of which is the reduced time spent grading by the instructor. I will admit that this was one of the advantages I sought at first. However, my experience with engineering students at the University of Dayton has been that they are incredibly lenient in scoring their peers. This may be due to a reluctance to be critical toward their peers (Falchikov 1995), unspoken collusion, or simply minimizing time and effort spent on coursework where they can. As an instructor, it renders peer grading relatively useless as an actual form of assessment, and I use the peer grade more as a participation grade. However, it should be mentioned that more effective approaches have been demonstrated (García-Martínez et al. 2019). For example, I sometimes employ ordinal grading (Engineering Unleashed Faculty Development National Workshops), or rank grading, to improve distinction.

Despite challenges with peer grading validity, it has other significant benefits. It has been shown to improve student understanding of engineering design concepts when used in team-based engineering design courses. It has also been shown to improve writing (Yalch, Vitale, and Kevin Ford 2019); specifically, it improves the reviewer's writing (Lundstrom and Baker 2009). I posit that these specific applications succeed because they are part of creative exercises in which no "correct" answer exists. The greatest value of peer grading is exposing students to each other's work so that they can put their work in context and learn from each other. Peer grading allows the instructor to show the students each other's work, which

helps normalize expectations in ways that rubrics cannot. Rubrics are required, however, for peer grading and provide a similar, if perhaps lesser, effect.

Rubrics

Grading rubrics can reduce the time and mental effort required to grade assignments while supporting consistency and fairness. Provided to students ahead of time, rubrics add transparency regarding what is expected of them. Done correctly, they provide accessible benchmarks for students to evaluate their work. For these reasons, nearly all teachers use rubrics consistently. Thus, the rubric is one inclusive pedagogical technique many teachers already use, even if they are unaware of its impact on inclusivity (Ragupathi and Lee 2020). Rubrics reduce inconsistency and bias in grading and normalize performance expectations among students from different backgrounds. Rubrics may not even be used to grade; instructional rubrics (Andrade 2000) may be provided to guide the process and communicate (Sundeen 2014) the learning goals.

Methods

Inclusive teaching practices were partly assessed using the "University of Dayton Common Academic Program–Diversity & Social Justice Learning Assessment" referred to as UDCAP-DSJLA. This instrument was designed to assess student engagement in diversity and social justice learning in the University's Common Academic Program Diversity and Social Justice (DSJ) courses ("University of Dayton Institutional Learning Goals (ILGs)/Diversity Assessment" n.d.). While it probes the impact of individual course activities, it is not focused on inclusion. I made the survey available to students in two sections of Introduction to Bioengineering, CME 490 and CME 590, which is not a DSJ course, in the final week of the semester. More direct qualitative data was derived from written reflection assignments following the bioethics lectures, debates, and discussions. However, these assignments were administered without

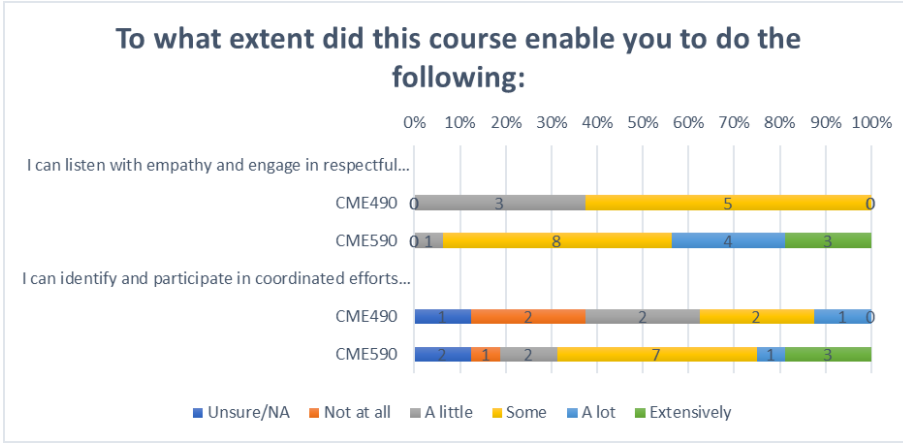

Figure 1. Stacked histogram of both class sections to Question 1.6 and 1.7 with the number of responses overlaid onto the bars.

prior intent or approval for use in a published study and are not reported here.

Results

While the UDCAP-DSJLA revealed significant DSJ engagement for a non-DSJ course, only the data pertinent to the inclusive practices described here will be reported. Question one asked students, "To what extent did this course enable you to do the following?" with sub-question activities 6 and 7 addressing experiences related to groups and pertinent to inclusive practices discussed above.

The quantitative results shown in Figure 1 indicate a majority of students were able to "listen with empathy and engage in respectful dialogue with people from diverse backgrounds and experiences to build mutual understanding around systems of injustice" (Q1.6). They could also "identify and participate in coordinated efforts with multiple cultural groups to build equitable communities for all cultures and identities" (Q1.7). The graduate level (CME 590) showed significantly more engagement than the undergraduate (CME 490). This is likely due to the greater diversity of the class.

The qualitative responses from Question 4 of the UDCAP-DSJLA, "Please briefly describe one classroom experience that most impacted

your diversity and social justice learning in this course" from the CME 590 class support this supposition. To illustrate, here are two direct passages from these responses:

> One example that impacted my education in diversity and social justice was actually working with multiple students of other ethnicities than me. It was very interesting to work with people so different than me with other undergraduate experiences and see what they could bring to a problem or topic in discussion. It was very eye-opening and educational and helped me to develop my skills of teamwork and openness too.
>
> Group experiences. Divided into groups for 3-4 assignments. It improves our social skills and competitiveness.

Reflection and Recommendations

While some statistically significant results related to the EML modules were obtained (though unreported), most of the investigated elements did not undergo a statistically significant change. Limited statistical power is to be expected, as even a classroom that superficially exhibits low diversity and uniform phenotype will comprise individuals with different cumulative experiences, interests, abilities, and perspectives, especially when investigating something as amorphous as mindset. As instructors, it doesn't take long to realize that different course sections can vary significantly within the same semester and even more so from year to year. This point is exemplified by increased discrepancies due to COVID-19 (Rosario-Moore et al. 2023). Achieving statistically significant discretion can be a real challenge for those teaching courses with less than thirty students.

Moreover, as a teacher, the quantitative results gave me little guidance on what specific modules were effective and why. Finally, the close-ended nature of questions that yield a number on a Likert

scale or a binary choice can bias responses, inadvertently or not (Rasmussen Reports n.d.). To give students agency in their education and a sense of belonging and to advocate for the subsequent class, they should be allowed more than a numeric response to a close-ended question.

In contrast, the qualitative information from student reflection essays, gathered as part of my inclusive teaching practices, richly illustrated a significant impact on student perspectives of the impact of diversity on team dynamics and its importance in considering the equitable outcomes of technological innovations. In addition, the open-ended reflections provided a space for some students to express strongly felt needs for continued improvement in engineering students' skills to discuss power and intersectionality.

Together, these results have drastically changed my perspective on qualitative research in education and my future plans for assessment. As an early career educator with most of my professional experience in STEM research and none in pedagogy, I gave little consideration to qualitative research. During my first attempts at educational research, I believed that any legitimate proof of the effectiveness of a method required statistical significance, and I missed opportunities for richer feedback. This piece is humbly written for early career educators like myself, as the power and legitimacy of qualitative research are well-known and have been for some time.

Qualitative approaches to research in education are, in a way, a descendant of the qualitative approaches used by anthropologists and sociologists dating back to the 1800s. Franz Boas was one of the first social scientists to try qualitative and inductive approaches to understanding other cultures. Boas' work was strikingly different than biased ethnographies of "primitive" cultures that had existed before. So, it should not be surprising that qualitative approaches may be suited to, or even required in, the scholarship of inclusive education. Qualitative approaches have been recognized as legitimate research methods since at least the early 1980s. By the early aughts, Hatch published "Doing Qualitative Work in Research Settings" (Lundstrom

and Baker 2009), the seminal book on qualitative research in education. It is the original source of the ideas in this paragraph and a book I highly suggest as a starting point for qualitative research.

Beyond that, I suggest beginning the approval process of your Institutional Review Board (IRB) so that you may use qualitative data that may have been previously overlooked as publishable if not meaningful, as you most likely will not be able to do so retroactively. In the meantime, make use of reflection assignments to improve your teaching. Besides developing metacognition (Wismath, Orr, and Good 2014), reinforcing and expanding learning, and developing self-efficacy (Karaoglan-Yilmaz et al. 2023), they perfectly complement inclusive teaching and learning. While grading reflection assignments, you will learn about your students and the effect of your course modules and practices and provide an open channel for them to communicate with you. Besides, a "qualitative exploration phase" is a common practice to develop a more effective quantitative instrument.

In closing, I believe that if one can be a more inclusive teacher, one can be a more effective teacher. Although you may already be using inclusive teaching practices, self-reflection (Dewsbury 2020) can help you to identify and amplify these practices and relate to your students better. Therefore, I encourage new teachers to use student reflections as an inclusive practice, a way to obtain fruitful feedback to improve their teaching, and as a qualitative approach to educational research.

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References

Andrade, Heidi Goodrich. 2000. "Using Rubrics to Promote Thinking and Learning." *Educational Leadership* 57 (5): 13. http://libproxy.udayton.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=3270122&site=ehost-live.

Brunhaver, Samantha R, Jennifer M Bekki, and Adam R Carberry. 2018. "Development of the Engineering Student Entrepreneurial Mindset Assessment (ESEMA)," 12.

Chen, Jennjou, and Tsui-Fang Lin. 2008. "Does Downloading PowerPoint Slides Before the Lecture Lead to Better Student Achievement?" *International Review of Economics Education* 7 (2): 9–18. https://doi.org/10.1016/S1477-3880 (15)30092-X.

Day, H. I. 1982. "Curiosity and the Interested Explorer." *Performance & Instruction* 21 (4): 19–22. https://doi.org/10.1002/pfi.4170210410.

Dewsbury, Bryan M. 2020. "Deep Teaching in a College STEM Classroom." *Cultural Studies of Science Education* 15 (1): 169–91. https://doi.org/10.1007/s11422-018-9891-z.

Engineering Unleashed. "Home | Engineering Unleashed." n.d. Accessed June 25, 2023. https://engineeringunleashed.com/content/home.

Engineering Unleashed Faculty Development. "Engineering Unleashed Faculty Development National Workshops." n.d. Accessed June 25, 2023. https://engineeringunleashed.com/content/faculty-development-national-workshops.

Falchikov, Nancy. 1995. “Peer Feedback Marking: Developing Peer Assessment.” *Innovations in Education and Training International* 32 (2): 175–87. https://doi.org/10.1080/1355800950320212.

Firth, Joseph, John Torous, Brendon Stubbs, Josh A. Firth, Genevieve Z. Steiner, Lee Smith, Mario Alvarez-Jimenez, et al. 2019. “The 'Online Brain': How the Internet May Be Changing Our Cognition.” *World Psychiatry* 18 (2): 119–29. https://doi.org/10.1002/wps.20617.

García-Martínez, Carlos, Rebeca Cerezo, Manuel Bermúdez, and Cristóbal Romero. 2019. “Improving Essay Peer Grading Accuracy in Massive Open Online Courses Using Personalized Weights from Student's Engagement and Performance.” *Journal of Computer Assisted Learning* 35 (1): 110–20. https://doi.org/10.1111/jcal.12316.

Goehler, Craig. 2019. “Discovering Passion for Bioengineering | Engineering Unleashed.” Card. Engineering Unleashed. August 16, 2019. https://engineeringunleashed.com/card/1521.

Harrison, David A., Kenneth H. Price, Joanne H. Gavin, and Anna T. Florey. 2002. “Time, Teams, and Task Performance: Changing Effects of Surface- and Deep-Level Diversity on Group Functioning.” *The Academy of Management Journal* 45 (5): 1029–45. https://doi.org/10.2307/3069328.

Hundschell, Andreas, Stefan Razinskas, Julia Backmann, and Martin Hoegl. 2022. “The Effects of Diversity on Creativity: A Literature Review and Synthesis.” *Applied Psychology* 71 (4): 1598–1634. https://doi.org/10.1111/apps.12365.

James, Thomas, Craig Downing, and Diane Evans. 2017. “Comparison of Two Survey Instruments for the Assessment of Entrepreneurial Mindset.” In *2017 ASEE Annual Conference & Exposition Proceedings*, 28057. Columbus, Ohio: ASEE Conferences. https://doi.org/10/gnzcxq.

Karaoglan-Yilmaz, Fatma Gizem, Ahmet Berk Ustun, Ke Zhang, and Ramazan Yilmaz. 2023. “Metacognitive Awareness, Reflective Thinking, Problem Solving, and Community of Inquiry as

Predictors of Academic Self-Efficacy in Blended Learning: A Correlational Study." *Turkish Online Journal of Distance Education* 24 (1): 20–36. https://doi.org/10.17718/tojde.989874.

Li, Cheryl, Ronald Harichandran, Maria-Isabel Carnasciali, Nadiye Erdil, and Jean Nocito-Gobel. 2016. "Development of an Instrument to Measure the Entrepreneurial Mindset of Engineering Students." In *2016 ASEE Annual Conference & Exposition Proceedings*, 26819. New Orleans, Louisiana: ASEE Conferences. https://doi.org/10/gnzczb.

Lundstrom, Kristi, and Wendy Baker. 2009. "To Give Is Better than to Receive: The Benefits of Peer Review to the Reviewer's Own Writing." *Journal of Second Language Writing* 18 (1): 30–43. https://doi.org/10.1016/j.jslw.2008.06.002.

Luo, Heng, Anthony Robinson, and Jae-Young Park. 2014. "Peer Grading in a MOOC: Reliability, Validity, and Perceived Effects." *Online Learning Journal* 18 (2). https://doi.org/10.24059/olj.v18i2.429.

Ragupathi, Kiruthika, and Adrian Lee. 2020. "Beyond Fairness and Consistency in Grading: The Role of Rubrics in Higher Education." In *Diversity and Inclusion in Global Higher Education: Lessons from Across Asia*, edited by Catherine Shea Sanger and Nancy W. Gleason, 73–95. Singapore: Springer. https://doi.org/10.1007/978-981-15-1628-3_3.

Rasmussen Reports. "Questions - Okay To Be White - February 13-15, 2023 - Rasmussen Reports®." n.d. Accessed March 2, 2023. https://www.rasmussenreports.com/public_content/lifestyle/questions/january_2023/questions_okay_to_be_white_february_13_15_2023.

Rosario-Moore, Alexios, Kara E. Graham, Svetlana Mitric, and Gabriela Avila. 2023. "Shocks to the System: COVID-19's Perceived Interference With the Academic Performance and Plans of University Undergraduates." *Journal of College Student Retention: Research, Theory & Practice*, March,

15210251231156420. https://doi.org/10.1177/15210251231156420.
Rothstein, Dan, Luz Santana, and Wendy D. Puriefoy. 2011. *Make Just One Change: Teach Students to Ask Their Own Questions*. Cambridge, Mass: Harvard Education Press.
Sauce, Bruno, Magnus Liebherr, Nicholas Judd, and Torkel Klingberg. 2022. "The Impact of Digital Media on Children's Intelligence While Controlling for Genetic Differences in Cognition and Socioeconomic Background." *Scientific Reports* 12 (1): 7720. https://doi.org/10.1038/s41598-022-11341-2.
Schaefer, Thomas, Marguerite Barta, William Whitley, and Margie Stogsdill. 2013. "The 'You Owe Me!' Mentality: A Student Entitlement Perception Paradox." *Journal of Learning in Higher Education* 9 (1): 79–91. https://eric.ed.gov/?id=EJ1144111.
Sundeen, Todd H. 2014. "Instructional Rubrics: Effects of Presentation Options on Writing Quality." *Assessing Writing* 21 (July): 74–88. https://doi.org/10.1016/j.asw.2014.03.003.
"Tool Cards | Engineering Unleashed." n.d. Accessed June 25, 2023. https://engineeringunleashed.com/card/3673.
"University of Dayton Institutional Learning Goals (ILGs)/Diversity Assessment." n.d. Accessed June 27, 2023. https://udayton.edu/provost/ilg/diversity/assessment.php.
Wismath, Shelly, Doug Orr, and Brandon Good. 2014. "Metacognition: Student Reflections on Problem Solving." *Journal on Excellence in College Teaching* 25 (2): 69–90. http://libproxy.udayton.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=98323041&site=eds-live.
Witherby, Amber E., and Sarah K. Tauber. 2019. "The Current Status of Students' Note-Taking: Why and How Do Students Take Notes?" *Journal of Applied Research in Memory and Cognition* 8 (2): 139–53. https://doi.org/10.1016/j.jarmac.2019.04.002.
Yalch, Matthew M., Erika M. Vitale, and J. Kevin Ford. 2019. "Benefits of Peer Review on Students' Writing." *Psychology*

Learning & Teaching 18 (3): 317–25.
https://doi.org/10.1177/1475725719835070.