Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #46911

A secondary data analysis of qualitative data to create survey items to measure undergraduate student researcher identity

Dr. Courtney June Faber, University at Buffalo, The State University of New York

Courtney Faber, Ph.D., is an Assistant Professor of Engineering Education at the University at Buffalo (UB). Prior to joining UB in August of 2023, she was a Research Associate Professor and Senior Lecturer in Engineering Fundamentals at the University of Tennessee, Knoxville. She was also the Director of the Fundamentals of Engineering and Computing Teaching in Higher Education Certificate Program. Her research focuses on empowering engineering education scholars to be more effective at impacting transformational change in engineering and developing educational experiences that consider epistemic thinking. She develops and uses innovative research methods that allow for deep investigations of constructs such as epistemic thinking, identity, and agency. Dr. Faber has a B.S. in Bioengineering and a Ph.D. in Engineering and Science Education from Clemson University and a M.S. in Biomedical Engineering from Cornell University. Among other awards for her research, she was awarded a National Science Foundation CAREER Award in 2022 to study epistemic negotiations on interdisciplinary engineering education research teams.

Dr. Danielle V. Lewis,

Dr. Danielle Vegas Lewis is currently the Postdoctoral Associate in Dr. Courtney Faber's ENLITE lab in the Department of Engineering Education at the University at Buffalo. Her research agenda aims to understand and disrupt the ways in which socially constructed identities allow for the reproduction of social inequality, with a focus on understanding the ways institutions of higher education and other social structures challenge or uphold hegemonic environments in which majority populations accumulate power that harms students underrepresented in certain contexts.

Kayleigh Merz, University at Buffalo, The State University of New York

Work in Progress: A secondary data analysis of qualitative data to create survey items to measure undergraduate student researcher identity

This Work-in-Progress empirical research paper documents the initial steps in the development of survey items to measure student researcher identity. Specifically, we focus on the secondary data analysis of qualitative data to develop items to measure the construct of interest, as it relates to researcher identity. Undergraduate research experiences (UREs) provide students with the opportunity to engage in authentic complex problem solving [1]. These experiences are considered high impact practices because they have been shown to increase student retention, engagement, and degree completion. Because of their impact on students, many institutions run undergraduate research experiences, encouraging both faculty and students to participate [2], [3]. The most common survey used to assess UREs is the "Undergraduate Research Student Self-Assessment (URSSA)" [4]. This survey includes items to capture details about students' experiences and measure students' 1) gains in thinking and working like a scientist, 2) personal gains related to research, and 3) gains in skills. However, this survey along with other evaluation efforts are not designed to measure how students see themselves as researchers or their perceptions of research and researchers and instead focus primarily on skill development [4]. Therefore, while the URSSA provides valuable information to those involved in undergraduate research, without the student's perceptions of the URE's impact on their sense of researcher identity, the degree to which they may benefit students remains unknown. In developing a clearer understanding of how students participating in UREs perceive their researcher identity, those involved in these experiences can better tailor engagement to enhance undergraduates' experiences.

Researchers who study UREs have explored some of the broader student outcomes in a variety of contexts (e.g., biomedical engineering, mechanical engineering, science) [5], [6], [7]. This work and other work has expanded the body of knowledge about students' experiences in undergraduate research beyond skill development and career aspirations. However, these studies have not resulted in changes to the survey instruments used to evaluate UREs and programs. The goal of our work is to develop a survey instrument to measure how engineering students with experience in research see themselves as researchers – their researcher identity. We conceptualize researcher identity as a type of role identity with four dimensions – interest, performance, competence, and recognition [8], [9], [10]. Although the final survey will include all four constructs, this work-in-progress paper focuses exclusively on the construct of interest. Additionally, we describe our process to draft survey items through our integration of interview data, identity theory, and other surveys designed to measure specific role identities (e.g., engineering and physics) [9], [10].

While there is substantial literature that defines the overall scale development process, this literature does not provide researchers with specific examples of how to draft survey items from a combination of theory and interview data (for exceptions, see [11]). In fact, in a systematic review of 371 articles on studies that used qualitative methods to generate quantitative surveys, no emergent analytic approach was identified to write the initial pool of survey items, nor was there a clear record of how analyses were conducted to generate the item wording, creating a methodological gap [12]. Within engineering education, journal articles that describe the development of new instruments often provide a high-level description of their process to

develop their initial pool of items but focus more on the steps of instrument development beyond this initial item development [13], [14]. As such, there is limited guidance for new researchers on how to go from interview data and theory to an initial pool of items. We hope that sharing the specifics of our process will support other researchers who are interested in developing quantitative survey items from qualitative data.

Theoretical Foundation

Role identity, or one's sense of self within a distinct role, is informed by how individuals perceive they are understood by others [15], [16], as well as social factors and specific contexts [17]. As such, scholars have studied specific types of identity development as they relate to particular roles; for example, discipline-based role research was expanded to understand engineering [9], science [5], and physics [6] identities.

The researcher identity framework outlined in the dynamics of research identity and epistemic thinking model (DRIEM) [18] demonstrates how a student conceptualizes themselves as a researcher, informed by their research experience and knowledge of researchers, in addition to their aspirational self and other held identities [18]. Drawing on Carlone and Johnson [5], Hazari [6], and Godwin's [9] conceptions of researcher identity, we posit that the four dimensions that comprise individuals' sense of researcher identity are performance, interest, recognition, and competence. Although our conception of researcher identity shares commonalities with those of Carlone and Johnson [5], Hazari [6], Godwin [9], Carlone and Johnson did not include the dimension of interest and Godwin's definition combined the dimensions of competence and performance.

Since we are focusing on the construct of interest in this paper, we will only define that construct here. Interest is classified as a student's enjoyment of their discipline, the topics they are researching, or the act of research itself. This interest can perpetuate continued engagement in discipline-specific activities and the desire to develop skills for their future career either as a researcher or in another profession.

Methods

This paper focuses on the process we used to develop an initial pool of survey items to measure the dimension of interest. We followed DeVellis and Thorpe's scale development guidelines [19] in concert with Johnston's [20] process for conducting secondary data analysis. Secondary data analysis, or a new examination of data initially collected for a different study, is a strategy for exploring new research questions or utilizing methodological tools that were not included in the initial analysis [1], [2]. While the use of secondary data analysis is increasing [3], [1], there is less literature that explores the use of secondary analyses of qualitative data for the express purpose of developing quantitative survey instruments. To start, we analyzed previously collected qualitative data that examined students' self-perceptions of their researcher identity [20], [21]. This secondary data analysis was conducted using data from interviews with 20 undergraduate engineering students with research experiences across six institutions. This data is appropriate to use for our goal of developing an initial item pool for a survey on researcher

identity because it was initially collected to explore undergraduate students' researcher identities [21] and used the same theoretical foundation to define identity.

Our initial analysis focused on identifying instances or examples of the dimension of interest. The first step of DeVellis and Thorpe's [19] process is to clearly define what you want to measure. We developed working definitions of researcher identity and the four individual dimensions by analyzing previous work by Carlone and Johnson [5], Hazari [6], Godwin [9], and [21]. Then, the first and second author coded the interview data deductively in atlas.ti, using each of the four dimensions as broad codes. We engaged in consistent discussion throughout the coding process to identify and resolve any disagreements related to code application. Then, we sorted the coded text by the individual dimensions of researcher identity and generated a report in atlas.ti of all coded data. We drafted survey items by either using actual text from participants or by staying as close to the participants own words as possible to ensure appropriate representation of the dimension. As encouraged by DeVellis and Thorpe [19], we discussed our process and sample items with an expert in generating survey items from qualitative data who provided us with standard root text of possible items (e.g., I want to; I enjoy; I plan to), supporting the refinement of the initial item list.

Findings

In deriving our item pool directly from qualitative data, we ensured that each item would be an accurate reflection of students' experiences and perceptions as they related to interest. Table 1 highlights sample items and the data that informed the development of the item. We expect that each item will utilize a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

Table 1 Interest Items/Measures and Supporting Data

Item	Supporting Data
I am interested in research because I plan to go to graduate school, which involves doing more research.	"I would like to go to grad school and I would like to end up getting a PhD because that allows me to do cool things. Going to grad school involves doing more research..."
I wanted to do research because it is inherent to my field.	I [started doing research because] it's inherent to my field, I think, kind of. It was the kind of stuff that I actually wanted to end up doing.
I became/am interested in research because I wanted to see what a career as a scientist would be like.	"I've sometimes thought about just being a straight up scientist working in a lab, and so I wanted to see what that would be like to see if I wanted to go into a career like that."
I enjoy doing research because it allows me to apply what I am learning in my classes in a hands-on way.	"I thought that was really cool, especially because I was a high schooler and this professor was letting me really get my hands dirty with a real experiment instead of just having me filing papers."

I became interested in doing research because all of my friends were doing it.	"A lot of my friends were also into scientific fields, and I knew that there was an internship program where juniors and seniors could choose to research. And just because it was a thing that I'd heard a lot of my friends were doing, I decided to look into it."
I like doing research because I enjoy contributing to new advances in my field and the opportunity for continued learning.	"I just wanted to participate in making new advances in medicine and technology, as relating to innovation and learning new things."

Discussion and Implications

Results from this study are twofold. This Work-In-Progress paper outlines our process for conducting a secondary data analysis which ultimately translated qualitative data into items for a quantitative survey to measure undergraduate student researcher identity. In describing the steps taken to do so, other researchers interested in exploring this topic now have an example that can be followed. Additionally, this study moves beyond the URSSA which focuses on outcomes of engaging in undergraduate research experiences and measures students' perceptions of themselves as researchers as well as how they conceptualize research and researchers. Implications from this study may result in a better understanding of undergraduate engineering students' expectations and perceptions of UREs so that mentors can craft experiences that best support the development of students' researcher identity. It is our hope that research mentors measure students' researcher identity at multiple points throughout their research experiences so that adjustments can be made, when needed, to cultivate confident future scientists, engineers, and researchers.

Future Work

As we continue our work, we will draft items for the other three dimensions of researcher identity: competence, recognition, and performance. Once we have items for all four dimensions, we will conduct focus groups with experts in identity, experts in psychometric analysis, and undergraduate students with research experience. We will then pilot the items in a survey sent across multiple institutions to undergraduate students who have engaged in engineering research. The ultimate goal of our work, after multiple rounds of revisions, is to develop a survey instrument to measure undergraduate engineering students' researcher identities, with the aim of providing faculty mentors with a tool that can help inform and shape students' research experiences.

Acknowledgements

We would like to express gratitude to Dr. Samantha Brunhaver who met with us to discuss this work and offered valuable guidance. We thank the participants and researchers who were part of the original study.

References

[1] A. Hunter, S. L. Laursen, and E. Seymour, "Becoming a scientist: The role of undergraduate research in students' cognitive, personal, and professional development," *Science Education*, vol. 91, no. 1, pp. 36–74, Oct. 2006, doi: 10.1002/sce.20173.

[2] A. Stephens, K. Brenner, and J. Gentile, "Undergraduate research experiences for STEM students: Successes, challenges, and opportunities," Washington, DC, USA: National Academies Press, 2017.

[3] A. Zydney, J.S. Bennett, A. Shahid, and K.W. Bauer. "Impact of undergraduate research experience in engineering." *Journal of Engineering Education,* vol. 91, no. 2, pp. 151-157, 2002.

[4] T. J. Weston and S. L. Laursen, "The Undergraduate Research Student Self-Assessment (URSSA): Validation for use in program evaluation," *CBE—Life Sciences Education*, vol. 14, no. 3, pp. ar33, 2015, doi: 10.1187/cbe.14-11-0206.

[5] E.M. Brey, M.F. Campanile, and N.G. Lederman, "Evaluation of a nine year summer undergraduate research program in biomedical engineering," presented in 2015 ASEE Annual Conference & Exposition, Washington, DC, USA, June 2015.

[6] O. Pierrakos, "A Study of Mechanical Engineering Students' Learning Outcomes During Summer Undergraduate Research Experiences," presented at the ASME International Mechanical Engineering Congress and Exposition, Boston, MA, USA, October 2008.

[7] J. Gentile, K. Brenner, and A. Stephens, "Undergraduate research experiences for STEM students: Successes, challenges, and opportunities," Washington, DC, USA: The National Academies Press, 2017. https://doi.org/10.17226/24622

[8] H.B. Carlone and A. Johnson, "Understanding the science experiences of successful women of color: Science identity as an analytic lens," *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, vol. 44, no. 8, pp. 1187–1218, 2007.

[9] Z. Hazari, G. Sonnert, P. M. Sadler, and M. Shanahan, "Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study," *Journal of Research in Science Teaching*, vol. 47, no. 8, pp. 978–1003, Feb. 2010, doi: 10.1002/tea.20363.

[10] A. Godwin, "The Development of a Measure of Engineering Identity," presented at the 2016 ASEE Annual Conference & Exposition, New Orleans, Louisiana, USA, June 2016.

[11] J.H. Hammer, C.J. Wright, M.E. Miller, and S.A. Wilson. "The Undergraduate Engineering Mental Health Help-Seeking Instrument (UE-MH-HSI): Development and validity evidence." *Journal of Engineering Education,* vol. 113, no. 4, pp. 1198-1225, 2024.

[12] L. Ricci, J-B. Lanfranchi, F. Lemetayer, C. Rotonda, F. Guillemin, J. Coste, and E. Spitz, "Qualitative Methods Used to Generate Questionnaire Items: A Systematic Review," *Qualitative Health Research,* vol. 29, no. 1, pp.149-156, 2019. doi:10.1177/1049732318783186

[13] J.H. Hammer, C.J. Wright, M.E. Miller, and Wilson, S. A., “The Undergraduate Engineering Mental Health Help-Seeking Instrument (UE-MH-HSI): Development and validity evidence,” *Journal of Engineering Education*, vol. 113, no. 4, pp. 1-28, 2024. https://dx.doi.org/10.1002/jee.20615

[14] W.C. Lee, J.L. Hall, A. Godwin, D.B. Knight, and D. Verdín, “Operationalizing and monitoring student support in undergraduate engineering education,” *Journal of Engineering Education*, vol. 111, no. 1, pp. 82–110, 2022. https://doi.org/10.1002/jee.20431

[15] P.J. Burke, and J.C. Tully, “The measurement of role identity,” *Social forces,* vol. 55, no. 4, pp. 881-897, 1977.

[16] G.J. McCall and J.L. Simmons, *Identities and interactions,* New York, NY, USA: Free Press, 1978.

[17] D. Holland, *Identity and agency in cultural worlds,* Cambridge, MA, USA: Harvard University Press, 2001.

[18] C.J. Faber, R.L. Kajfez, D.M. Lee, L.C. Benson, M.S. Kennedy, and E.G. Creamer, “A grounded theory model of the dynamics of undergraduate engineering students' researcher identity and epistemic thinking,” *Journal of Research in Science Teaching,* vol. 59, no. 4, pp. 529-560, 2022.

[19] R. F. DeVellis and C. T. Thorpe, *Scale Development,* Thousand Oaks, CA, USA: SAGE, 2021.

[20] M.P. Johnston, “Secondary data analysis: A method of which the time has come.” *Qualitative and quantitative methods in libraries, vol.* 3, no. 3, pp. 619-626, 2014.

[21] Faber, C. & Benson, L., “Undergraduate engineering students’ development of a researcher identity.” *American Educational Research Association Annual Conference, 2015*