

WIP: Evidence-Based Revisions to Survey Design and Implementation for Investigating Neurodivergent Learners in STEM Education

Miss Leila Elizabeth Williams, Clemson University

Leila Elizabeth Williams is seeking a dual degree in Biological Sciences and Psychology at Clemson University within their Honors College.

Theodore Colby Arden, Clemson University

Theodore Colby Arden is a third-year Sociology Major in the Clemson Honors College.

Kylie Nicole Avitabile, Clemson University

Mr. Alec Jon Bauer, Clemson University

Alec Jon Bauer is a senior Biological Sciences major at Clemson University.

London Hoxworth, Clemson University

Jeffrey Nathaniel Moody, Clemson University

Jeffrey Nathaniel Moody is a junior Secondary Education and Mathematics double major at Clemson University

Miss Katherine Ann Rockett, Clemson University

Katherine Ann Rockett is a senior Biological Sciences major at Clemson University.

Paige O Winkler

Dr. D. Matthew Boyer, Clemson University

Dr. Boyer is a Research Associate Professor in the Department of Engineering and Science Education and an Educational Proposal Writer in the College of Engineering, Computing and Applied Sciences.

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Introduction

Differences among learning styles for neurodivergent learners can greatly impact their experiences within higher education. Neurodivergence is described as a neurological variation in which the brain processes information, leading to individuals having different strengths and weaknesses [1]. While neurodivergence is generally well understood in professional settings, universities must ensure proper access to necessary accommodations and information in order to support students in STEM fields. Standard STEM educational practices emphasize innovation and problem-solving, but systemic barriers within higher education can hinder success. This study, which is part of a course-based undergraduate research experience, builds on prior research to address the nuanced experiences of neurodivergent learners in STEM fields, emphasizing their strengths and challenges within academic contexts. By refining the survey design and incorporating targeted outreach strategies, this research ensures broader participation and more representative data.

Literature Review

Neurodivergence is a non-medical term used to describe the different ways that people process information [1]. The terminology promotes inclusivity and encompasses multiple groups of people such as those with conditions such as autism spectrum disorder, attention-deficit/hyperactivity disorder, obsessive-compulsive disorder, and many others. The concept of neurodivergence challenges traditional deficit-based views by bringing the value of diverse perspectives to light.

Although the number of neurodivergent students entering STEM education is growing, there is currently a shortage of research on the experiences of neurodivergent learners in STEM education at the higher education level [2]. This leaves these neurodivergent learners underrepresented and stuck facing challenges due to stigma and lack of accommodations within their university. Neurodivergent individuals face many barriers to engaging in STEM education even though they possess various strengths and talents that can be effectively applied in all higher educational settings [3]. STEM fields seem to be desirable to many neurodivergent learners due to common strengths such as hyperfocus and extensive visual processing skills aligning with common practices of problem-solving in STEM subjects [4].

In order to improve advocacy for neurodivergent learners in STEM fields, more research needs to be collected in an effective manner. Inclusive research practices that take into account the needs of neurodivergent participants and opportunities for expansion are crucial in the eventual implementation of meaningful change. Anonymous and open-ended responses, whether verbal or written, have been shown to be effective in allowing neurodivergent research participants to convey their thoughts on various subjects [5].

Methods

To explore the experiences of neurodivergent students in STEM fields, we utilized a refined survey that was adjusted based on results received in our pilot study and available literature on the topic. Similar to our previous study, the refined survey included two blocks: one for those who self-identified as neurodivergent and one for those who self-identified as neurotypical. All participants were asked to provide information on their affiliations within the university; however, participants were additionally asked about their social media use and their interactions with autism-related information on social media. These new questions were added to collect more information for a subtopic within our research. Several questions relating to other subtopics within our research were added or revised in the neurodivergent block of the survey. Figure 1 displays some of the revisions made to survey questions to allow for detailed open-ended responses, which allowed for a more comprehensive understanding of neurodivergent strengths within higher education.

Figure 1

Previous Questions	Revised Questions
Do you feel you have a special skill or talent?	Do you feel that your neurodivergence contributes to a strength or strengths that has/have helped you in higher education?
Which category do you think your skill or talent fits in?	If yes, I would describe my strength(s) as...
Have you ever witnessed discrimination or unfair treatment towards a neurodivergent individual within your institution?	To what extent do you agree with the following statement: "I have encountered discrimination from the institution related to my neurodivergent identity." (0 being you do not agree at all and 100 being you agree fully.)

Participants who self-identified as neurodivergent were asked to specify their type of neurodivergence and complete several questions related to their experiences at the university, their perceived effectiveness of currently offered accommodations offered by the university, and their experiences with discrimination at the university. These questions prompted participants to rate their experiences using a question-specific quantitative scale of 0-100. Additional questions regarding personal communication of neurodivergent status with the university and preferences with effective study strategies were asked using an open-ended response format. Overall, this block of the revised survey remained mostly unchanged from the pilot study with the exception of the quantitative scale implementation.

In our pilot study, we found that many of the self-identifying neurotypical participants were unfamiliar with the term neurodivergence and its applications, making it difficult for participants to respond to questions. In an attempt to resolve this issue, the revised survey implemented several new questions and question formats to better gauge the understanding of neurotypical participants. With the use of both open-ended and yes or no questions which can be seen in Figure 2, we gained more insight on the level of understanding and familiarity that neurotypical participants have with neurodivergence.

Figure 2

Yes or No Questions	Open-ended Questions
Prior to this survey... <ul style="list-style-type: none">- Prior to starting this survey, I have heard the terms 'neurodivergent' or 'neurodivergence'?- I am familiar with the meaning of 'neurodivergent' or 'neurodivergence'?- Prior to starting this survey, I have heard the terms 'neurodiverse' or 'neurodiversity'?- I am familiar with the meaning of 'neurodiverse' or 'neurodiversity'?- I believe that 'neurodivergent' and 'neurodiverse' are interchangeable terms.	Think of a time when you worked or studied with someone who seemed to have a different approach to problem-solving or creativity. How did this affect your collaboration or interaction?
Do you know someone who is neurodivergent?	In your opinion, what are some strengths of people who think or learn differently?

For the distribution of the survey, we again sent the survey to various clubs and organizations on campus, including academic clubs, honors societies, social organizations, athletic groups, residential hall groups, and various classes. In addition to this, we also posted QR codes for a survey at several different locations on campus and social media to reach a larger audience. Going forward, we plan to distribute the survey institutionally to further expand participant engagement.

Results

To evaluate the data collected from the revised survey and better understand the experiences of neurodivergent learners in STEM fields, we performed both a thematic and descriptive statistical analysis on the 66 collected participant responses. We further analyzed the responses of those participants majoring in STEM fields, bringing our sample size to 55 participants. Out of these analyzed responses, 26 participants self-identified as neurotypical and 27 self-identified as neurodivergent.

From the neurodivergent responses, a majority of participants disclosed that they had not communicated their neurodivergence status to their university, with only 22% of participants that had. When asked to reflect on their mental well-being as it relates to their experience as a neurodivergent learner, most responses included terms such as “overwhelming,” “challenging,” “stressful,” “struggling,” and “frustrating” as descriptors. When asked about using personal strategies or methods to support their study skills as a neurodivergent student, responses frequently mentioned the use of repetition, creating and following study schedules, body doubling, and noise cancellation as being helpful or necessary when studying. When asked about the effectiveness of provided accommodations with 0 being ineffective and 100 being effective, the average ranking was 65.71.

From the neurotypical responses, all 26 participants knew someone who was neurodivergent. Based on this, participants were asked to reflect on an academic collaboration they had with someone who had different approaches to problem-solving and creativity. Responses varied, but there were general trends of miscommunication, new perspectives, compromise, and helpfulness. When asked about their interpretation of strengths held by people who think or learn differently,

multiple responses included themes of creativity, having different points of view that are helpful to problem-solving, and determination.

Discussion

Based on the responses to the revised survey, neurodivergent students in STEM fields were unlikely to communicate their status to their university to potentially receive helpful accommodations. Similar to the findings of a study aimed around autistic college students being unwilling to disclose their diagnosis to their college, this may be due to previous negative experiences with disclosure, fear of lack of confidentiality, or finding disclosure unnecessary due to provided accommodations being unhelpful to an individual [6].

In addition to this, many neurodivergent participants indicated that the personal strategies and methods they use to improve their studying were strengths rather than points of weakness. This highlights how neurodivergent students navigate education centered around their unique experiences as neurodivergent learners. Based on collected results, neurodivergent students in STEM fields do encounter obstacles related to their neurodivergence but offer multiple strengths to academic collaborations and projects.

We encountered a barrier to the institutional implementation of our revised survey protocol due to the untimely Institutional Review Board's consideration of an amendment. This delayed the intended distribution of our revised protocol to all student, faculty, staff, and administrator emails. Due to the limited sample size of this survey, the findings from this study cannot be generalized to all institutions or individuals. The emerging themes from this research may still be applicable to refining research processes and building potential implementations.

Conclusion

This work-in-progress study attempts to gain insight into the experiences of neurodivergent learners in STEM education. By using evidence-based revision to the previously used survey protocol, we can expand our understanding of neurodivergent learners in STEM fields and their experiences within higher educational settings. As we continue to expand this research, the insights gained from surveys and interviews will help guide us toward eventual institutional implementation.

Future Directions

During the Spring of 2025, we will again pursue institutional implementation. The information collected by the revised survey has prompted the exploration of various topics surrounding neurodiversity within higher educational settings. Groups of undergraduate researchers have begun to pursue various areas of interest to gain a more comprehensive understanding of the experiences of neurodivergent learners in STEM fields. Primarily, this will include student-led interviews, including those participants who indicated they were open to being interviewed on the revised survey. We intend to use the feedback given in these interviews to begin institutional implementation to improve support, inclusivity, and accommodations for neurodivergent students in STEM programs.

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