

WIP: The Role of Classroom Teaching Practices on the Academic Success of Engineering College Students with ADHD

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Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is a neurological condition that affects as many as 25% of college students with disabilities. Students with ADHD experience both strengths (e.g., creativity, divergent thinking, high energy levels, and the ability to hyper-focus on tasks of interest) and challenges (e.g., executive functioning, time management, organization, and study skills). Many of these challenges might be due to deficit-focused mindset common in some higher education environments. Some scholars have proposed that the teaching methods employed in college classrooms can significantly impact the academic achievement of college students with ADHD. Few studies, however, have investigated how students with specific neurodisabilities are influenced by particular science, technology, engineering, and math (STEM) learning environments or teaching approaches. Gaining insight into the strengths and challenges experienced by students with ADHD can help us understand how specific classroom teaching practices either facilitate or obstruct their academic success. This paper presents the research design of a qualitative interview-based study designed to understand the role of classroom teaching practices on the academic success of students with ADHD.

Introduction

According to the National Institute of Mental Health [1], ADHD is a neurodevelopmental condition marked by an ongoing pattern of three specific types of symptoms: “inattention (not being able to keep focus), hyperactivity (excess movement that is not fitting to the setting), and impulsivity (hasty acts that occur in the moment without thought).” Studies have shown that college students with ADHD experience academic challenges [2], [3], [4] and, on average, they receive lower grades than their peers without ADHD [5], [6].

The limited research studying the academic success of college students with ADHD has primarily focused on traditional academic success, outcomes such as grades, and persistence, but some research has addressed non-traditional measures of academic success, such as creativity [7]. Most research has not included students’ individual college experiences in the analyses, nor has it included college experiences as mediators in academic success models (e.g., [8]). Some research has explored creativity and divergent thinking of college students with ADHD [9], [10] as academic outcomes, empirically finding students with ADHD had higher levels of creative and divergent thinking compared to their peers without ADHD [9], [10].

Research evidence supports the idea that effective teaching practices – including building rapport with students, employing an instructional style that fosters learning, setting clear course objectives, offering high-quality feedback, and highlighting the relevance of the course – can enhance academic success (e.g., [11], [12]). However, college students with ADHD may perceive teaching practices differently compared to their peers without ADHD [3], and the academic achievements of students with ADHD may be especially affected by their classroom

experiences [13]. Students with ADHD often struggle with distraction and inattention [14], and they may have difficulty navigating the somewhat unstructured college environment with primarily lecture-based courses and long-term assignments [2].

Building a positive rapport with instructors is of particular importance for enhancing the success and self-confidence of college students with ADHD. Negative interactions and communication with instructors can have lasting effects on these students [3]. Perry and Franklin [3] discovered that students with ADHD heavily rely on instructor support, especially in response to accommodation requests like extended test time or written lecture notes, to succeed in college. The instructional style also plays a crucial role in the academic success of college students with ADHD. Students with ADHD often struggle with note-taking and the passive nature of lecture environments [2]. As a result, researchers have suggested that “hands-on” or active learning environments may be beneficial for college students with ADHD [13].

College students with ADHD sometimes face challenges related to disorganization, forgetfulness, and poor time management and study skills [4]. Therefore, having clear course goals can promote the success of students with ADHD. Finally, demonstrating the relevance of course material is believed to motivate adult learning [15], and it may also enhance the academic success of college students with ADHD. Some evidence suggests that when coursework is not in areas of high interest, students with ADHD may lack motivation to complete it [13]. In contrast, for tasks that pique their interest, some students with ADHD report being able to achieve high levels of motivation and focus [16].

Conceptual Framework

Terenzini and Reason's College Impact Model

The college impact model builds on Terenzini and Reason's [17] extension of Astin's Input-Environment-Output (I-E-O) college impact model, which is a lens for studying students' college outcomes. The I-E-O model theorizes that students' demographic characteristics and the environment influence their outcomes [18]. Expanding on the I-E-O model, Terenzini and Reason [17] proposed a model to account for multiple interrelated factors affecting student outcomes. Their framework also includes four salient factors: precollege characteristics and experiences (i.e., sociodemographic traits, prior academic preparation and performance, and student dispositions) and the three other factors comprising the student college experience: organizational context, the peer student environment, and the individual student experience (including curricular, classroom, and out-of-class experiences) [19]. For our study, we included neurodiversity in pre-college characteristics and experiences and introduced other factors that may be particularly relevant for students with ADHD, such as creativity, having close friends, having short-term motivation, time management, and study skills (Figure 1) [20].

In our project, we focus specifically on the individual student experience, comprising curricular experiences, classroom experiences, and out-of-class experiences [21]. **Curricular experiences** encompass students' unique coursework patterns, their choice of an academic major, the extent of their integration into the field, and their participation in additional academic experiences within the general or major field curriculum. (e.g., internships, cooperative education, study abroad). **Classroom experiences** include, among other things, types of teaching methods

students experience in their classrooms. Finally, students' **out-of-class** experiences which include students' living arrangements during school, their level of engagement in co-curricular activities, study hours, family and work commitments, and the support they receive from their families.

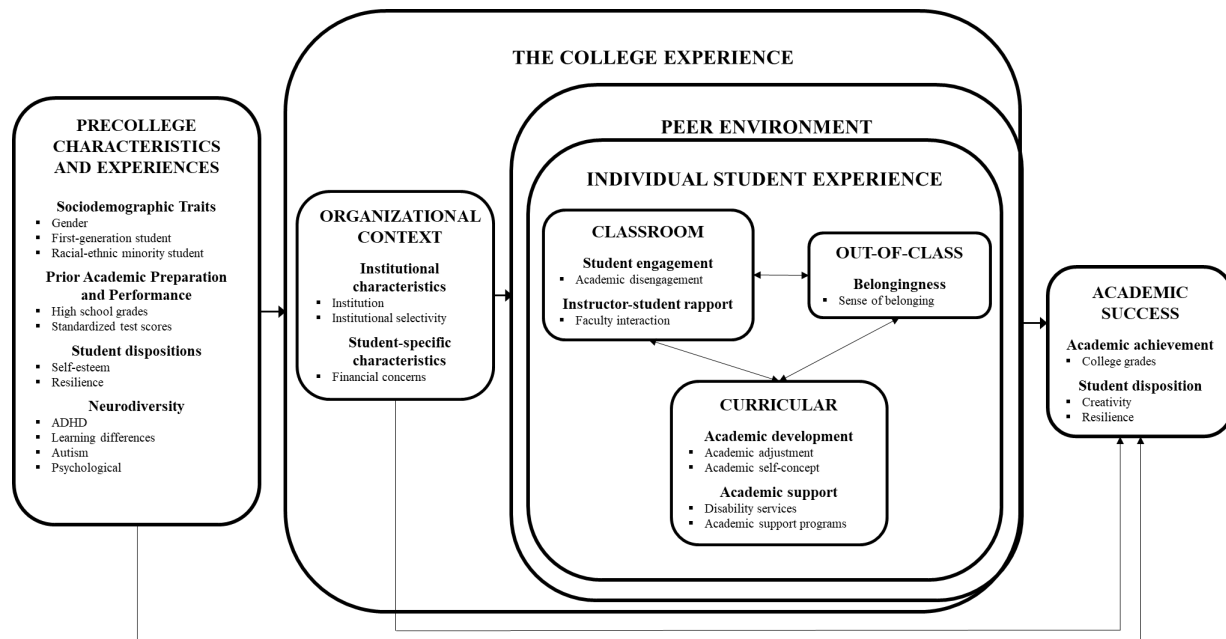


Figure 1. Our conceptual framework [22]

Methods

The goal of our study is to understand the role classroom teaching practices play in the academic success of engineering students with ADHD. This study is part of a larger, mixed-methods project about the academic success of STEM college students with ADHD. Other parts of the study include a quantitative analysis investigating which collegiate experiential elements have a significant relationship with academic success [16] and a scoping literature review exploring the complex relationship among the elements and additional factors that should be considered when studying the college experience [23], [24]. The study described in this paper aims to understand the complex relationship between classroom teaching practices and the college experience by answering the following questions:

RQ1. How do engineering college students who have ADHD perceive that traditional lecture-based courses influence their collegiate experiences (academic adjustment, classroom experiences, and sense of belonging)?

RQ2. How do engineering college students who have ADHD perceive that active learning influences their college experiences?

We will answer the questions through qualitative analysis of focus groups and individual interview data collected from engineering college students with ADHD. In both types of data collection, we will explore students' experiences in a class where the instructor solely uses lecture to convey class or one where the instructor used active learning. As such, the focus groups and interviews provide an opportunity to explore: (1) specific challenges that students with ADHD face when trying to engage in different teaching practices in STEM courses, (2) the impact of teaching practices on students' college experiences, (3) strategies that students have

found to be most helpful and recommendation for instructors, and (4) potential barriers to implementing different teaching practices in engineering courses for students with ADHD.

Research site and Participants

For our study, we recruited engineering college students with ADHD at a research-intensive institution located in the Midwest. We obtained a list of all engineering students enrolled at the university at the end of the third week of Fall 2023 ($n=11,104$). Then, we emailed a random sample of 1,800 students inviting those who had been received an official ADHD diagnosis¹ to participate in focus groups addressing either lecture-based instruction, active learning, or both.. The recruitment email stated *“We are studying the experiences of engineering college students with ADHD and the role of classroom teaching practices on their academic success. If you are an engineering student who has previously received an ADHD diagnosis, we invite you to participate in our study.”* Our recruitment email also provided details about the focus groups focused on two types of teaching modality: lecture-based instruction and active learning. We offered ten total focus groups times - five separate sessions addressing lecture-based instruction and five addressing active learning. To be inclusive of student preference, three sessions for each teaching modality were offered as in-person, and two were offered virtually by Zoom. Students were also invited to indicate they would be uncomfortable with a focus group arrangement and would prefer an individual interview.

As part of our data collection and as recommended by Pfeifer [27], potential participants first completed a brief online screening survey to confirm their eligibility for the study and provide information about their knowledge of both types of teaching modality. The screening survey also included demographic questions - including age, gender identity, and college year - as well as an opportunity for students to identify whether they had previously participated in a lecture-based course and/or an active-learning-based course (if they were intending to participate in one of those types of focus groups). As a final indicator of eligibility, students were asked if they had received a formal ADHD diagnosis and, if so, at what age (students without ADHD or who had not received a formal diagnosis were ineligible).

Data collection

After receiving approval from the University of Michigan Institutional Review Board for human subjects research, we proceeded to recruit participants for our study. A total of 40 eligible engineering students with ADHD completed our screening survey; 32 registered to attend a focus group, and eight preferred an individual interview. We offered a total of ten focus group

¹ We acknowledge that many individuals who have ADHD have not received an official diagnosis and that we may be missing important insights in our project. However, we intentionally recruited students who had received an ADHD diagnosis both because having a diagnosis can provide individuals with a better understanding of their condition, promoting self-awareness and reducing negative attitudes towards ADHD [25], and because studies have demonstrated that having a clinical diagnosis provides a standardized framework for understanding and categorizing participants [26]. We hope to expand our research in the future to adopt a more inclusive definition of ADHD, and in the meantime, we expect that our research findings will be applicable to many students who have ADHD symptoms, whether or not they have received a diagnosis.

sessions, and 31 participants representing 21 unique individuals participated in at least one session (three attended only a lecture-based session, 8 attended only an AL focus group session, 10 attended both, and 9 students who had registered to attend did not participate even though they received two reminder emails). We incentivized student participation by providing a \$50 gift card for each focus group and interview attended (thus, a student could receive up to \$100). Table 1 presents attendance information for each focus group session.

Table 1. Focus groups participants pool

	Lecture	Active learning
Session 1	0	2
Session 2	3	4
Session 3	4	5
Session 4	3	4
Session 5	3	3
Total	13	18

Research Instruments

The focus groups, conducted in Fall 2023, were 90 minutes in length, and they followed a semi-structured protocol (included in Appendix A). The individual interviews, to be conducted in Winter 2024, will be up to 60 minutes and will follow a similar protocol. Both the focus groups and interviews will be audio-recorded and subsequently transcribed.

Data Analysis – Focus groups and interviews

The next steps for this study involve reviewing the focus group and interview audio files and preparing analytics memos to develop descriptive summaries of the data, which will then inform the coding process. Then, after transcribing the focus group and interview data, we will analyze both using reflexive thematic analysis [28]. We will conduct initial coding using a deductive approach following the college experience described in the conceptual framework. This analysis will be followed by an inductive coding approach [29], which allows for the emergence of themes and patterns in the data. Throughout our analysis, we will focus on elucidating information about students' perceptions and experiences of how active learning and lecture-based classes influence their classroom experiences, academic adjustment, and sense of belonging.

Summary

This qualitative study aims to explore the role classroom teaching practices play in the academic success of engineering college students with ADHD by conducting focus groups and interviews. This will allow us to explore students' perceptions of how active learning and lecture-based classes influence their classroom experiences, academic adjustment, and sense of belonging and will help us understand the unique challenges these students face and will help educators tailor their approaches to cater to diverse learning needs better. The findings of this study can inform

policies and practices aimed at fostering inclusive educational environments, supporting STEM students with ADHD, and enhancing educational outcomes.

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Appendix

1A. Focus groups protocol for active learning sessions

Academic Success of STEM College Students with Attention Deficit and Hyperactivity Disorder
and the Role of Classroom Teaching Practices

Active Learning Focus Groups Protocol

Part 1: Background [5 minutes]

Hi everyone. My name is _____, and I will serve as the session moderator today. My colleague _____ is also joining us today – he will be observing the FG and taking some notes. In order to have consistency across our FGs I will be following a script. We will end this focus group by X:XX at the latest.

This FG is part of a study funded by the National Science Foundation to learn about the college experiences of engineering students with ADHD (or Attention Deficit and Hyperactivity Disorder) and the role of classroom teaching practices. Thank you for being here and for sharing your experiences as someone who has been diagnosed with ADHD. Just to confirm, everyone here has received an ADHD diagnosis, correct? (brief pause) Thanks! We appreciate your insight. At the end of today's session, we'll tell you how to collect your \$50 prepaid gift card.

In order to recall the conversation, we will be recording today's FG session. However, no one outside of our research team will have access to the recording. Do you have any questions about that? If not, I'm going to enable the recording now.

(activate video recording)

OK, thanks. I want to begin by letting you know that your participation in this FG is **voluntary** and you may choose not to answer any of the questions. In addition, your participation will be **confidential** to everyone outside of our research team and this group. We may use your comments for our research, but your specific comments will not be attributed to you by name. Your privacy and confidentiality are important - will everyone please verbally agree to not discuss this FG after you leave this session now?

(request verbal agreement from each participant to maintain confidentiality)

Thank you. This will be a fairly open-ended discussion. We have a few guiding questions, and our goal is to hear your thoughts, examples, and ideas. As a moderator, I want to review the guidelines for participating in the FG:

- Please speak one at a time.
- Please be as open and honest as you possibly can.
- Be specific and speak about your own experiences.

- Speak as often as you like, but please allow others the opportunity to speak.
- If you choose to disagree with others' comments or opinions, please do so respectfully.
- **(and, as this is a virtual meeting, it would be really helpful if you turn on your cameras - so please go ahead and do that)**

Does anyone have a question about the structure of the FG? Ok, great.

Part 2: Introductions [10 minutes]

To begin, I'd like to go around the room and ask you to identify yourself by telling us your name, preferred pronouns (if you feel comfortable), your year in college and your program. For instance, "I'm _____, I use He/Him, I am a second year PhD student in Engineering Education." Thank you.

(allow participants to identify themselves)

Thank you for doing that.

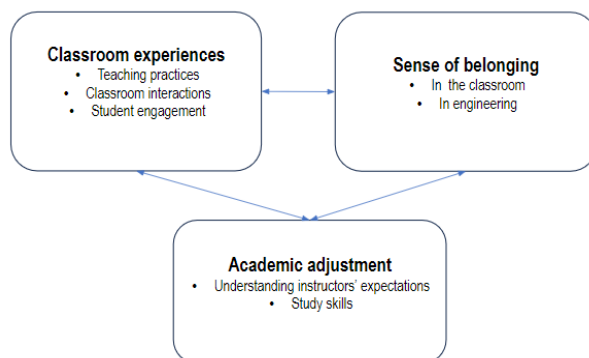
*(The interviewer would give the participants a **BLUE** hand-out (or drop the PDF into the chat) that includes the diagram of the college experience)*

You will now receive a blue hand-out with a diagram describing our research. I'm going to step through the diagram; please feel free to ask any questions along the way.

There are three main elements: classroom experiences, academic adjustment, and sense of belonging - these elements will be the focus of today's discussion. In our research, we are studying the way each of these three elements interacts with the other two.

First, **Classroom experiences**, as you can see here, are everything related to *teaching practices*, *classroom interactions* with the instructor and other students, and *student engagement*.

The second main element is **Academic adjustment** - it is related to how students adjust to college and it includes items like understanding instructors' expectations and developing study skills and finally, the third element, **Sense of belonging** means feeling valued and included in both the classroom and in engineering.



Any questions? No, then, let's get started.

Part 3: The influence of a traditional active learning course on the college experience
[40-60 mins (60 MAX)]. 4 mins per prompt max

We know you are here today because, as an engineering college student with ADHD, you are interested in improving future education for other students with ADHD. So we'd like to have you tell us about your own experiences. Let's start by hearing your general thoughts about an active learning class (that is, classroom activities that involve students engaging with course material by doing something other than listening and taking notes, for instance, answering clicker questions, discussing concepts with classmates, or solving problems in a group during class).

1. **Classroom experiences** - There is some evidence that a student's classroom experiences can impact their academic success - let's dig into that a little more
 1. **Teaching practices:**
 - First, think about a specific class session where your instructor used active learning to convey class material. Can you tell us more about how this played out in your class? What, specifically, did your instructor do?
 - How would you describe your experience in that specific class? For instance, do you like the style of instruction or not; does it help you understand the class content or is it challenging? What do you think?
 2. **Classroom interactions:**
 - Let's talk about classroom interactions now, starting with the instructor. Can you tell us how you interacted with your instructor during that active learning class? On a scale from 1 to 3, with 1 meaning no interaction and 3 meaning a lot, how was the level of interaction among you and your instructor.
 - How about your peers in the class? Tell us about your interactions with them. Again using the same scale of 1 to 3, how was the level of interaction among you and your classmates during class?
 3. **Student engagement:**
 - In that same active learning class, how engaged did you feel?
 - What do you think helped you feel engaged, or on the other hand, what made you feel disengaged?
2. **Academic adjustment** - Another important element that can contribute to a student's success is their academic adjustment - that is, their process of adapting to or coping with academic demands in college, such as instructor's expectations and study skills.
 - a. **Understanding instructors' expectations**
 - Do you think you understood your instructor's expectations for that active learning class you had in mind? Can you tell us a little bit more?
 - b. **Study skills**
 - Next, let's discuss study skills like time management, organization, note-taking, and test-preparation. Can you tell us about your own?
 - How do you feel the active learning class you've been discussing aligned with your study skills?
 - Was there anything about the class format that influenced your study skills?
3. **Sense of belonging** - And now, for the last box - sense of belonging - this has to do with whether students feel valued and included.
 - a. **Classroom:**

- How do you think that active learning course influenced your sense of belonging in the classroom?
- Can you share examples where you felt more or less valued or included in the classroom?

b. Engineering:

- Now, how about your engineering major, how has this course influenced the extent to which you feel valued and included in your major?
- Can you share any specific examples that affected your sense of belonging in engineering as a student with ADHD?

4. General questions

1. Can you tell us how having ADHD might be helpful or a hindrance for you in an active learning class?
2. Do you have any suggestions for an instructor about what to do or not to do in an active learning class?

That's great, thank you so much! We're about finished, but first I want to let you each share any final thoughts you might have about how an instructor's use of active learning might influence your college experiences. Great, thank you so much for your candid feedback. We really appreciate your time. Please fill out this google form to provide your address and we'll process your \$50 incentive within the next month. Thank you.