

**Exploring the Challenges of Digital Learning Environments: Perspectives of
Neurodivergent Learners in Higher Education**

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Abstract

Several contemporary researchers have examined the roles of cognitive load, academic success in higher education, and online education. Their findings indicated that neurodivergent learners faced significant challenges managing their cognitive load and self-regulated learning. While foundational insights into cognitive load and executive function management in neurodivergent individuals were well-established, higher education remained ill-equipped to address these learners' needs. This study advanced understanding of these challenges by interviewing three neurodivergent higher education students to explore their perceptions, responses to challenges, and strategies for reducing cognitive load. Using a case study approach, qualitative interviews revealed five key themes: sensory overload, emotional dysregulation during disorganization, demand for adaptable interfaces, preference for self-structured frameworks, and frustration with non-intuitive design elements. Participants emphasized autonomy in mitigating cognitive load and had diverging perspectives on GenAI's role – as a personal learning tool for autistic learners and a task-management assistant for ADHD learners. The discussion linked these findings to Universal Design for Learning (UDL) principles and cognitive load theory but noted unexpected gaps in participants' engagement with asynchronous collaboration tools and assistive technologies. This exploratory study underscored the need for learner-centered digital environments that reduced instructional ambiguity while supporting neurodiverse learners' agency.

Keywords: Neurodivergent learners, instructional design, cognitive load management, executive function, self-regulated learning, digital learning environment, higher education, Universal Design for Learning (UDL)

Exploring the Challenges of Digital Learning Environments: Perspectives of Neurodivergent Learners in Higher Education

Over the past few years, there has been a surge in technological advances that enable convenient and self-paced instruction, provide immediate knowledge for specific tasks or problem-solving, and suggest a promising path for personalized learning for everyone. Despite the flexibility of on-demand learning, the specificity of just-in-time learning, and the personalization afforded by Generative Artificial Intelligence (Gen-AI), some learners struggle in higher education because their challenges are not fully understood, considered, or accommodated in digital learning environments (Green & Rabiner, 2012; Friedman & Nash-Luckenbach, 2024). Rarely acknowledged by the institutions, instructors, and instructional designers responsible for creating their learning environments, many neurodiverse learners feel overwhelmed, undersupported, and left to navigate independently the significant obstacles frequently encountered during their studies, despite the latest educational and technological advances (Azuka et al., 2024; Burgstahler, 2018; Hamilton & Petty, 2023; Kelly, 2024).

In 2024, Le Cunff, Giampietro, and Dommett released a systematic review that addressed important questions regarding the relationship between cognitive load in online learning and neurodivergence. While noting that this is not entirely new, the authors revealed a concerning gap in the literature: out of the 90 studies conducted across 21 countries, a staggering 92% failed to consider neurodiversity as a potential factor affecting cognitive load in online learning (Le Cunff et al., 2024). What added further complexity to their findings was the emerging evidence that individuals diagnosed with neurodivergence may demonstrate unique patterns of cognitive load when engaging in digital learning platforms (Le Cunff et al., 2024).

Concerns about managing cognitive load and recognizing neurodiversity raise an important issue: the lack of neurodiverse representation in research studies. Le Cunff et al. (2024) highlight that studies including neurodivergent learners often rely on subjective measures for cognitive load, indicating a scarcity of objective assessments. As a result, this gap limits our understanding of how cognitive load affects these individuals and how instructional design can be adapted to support them.

Friedman and Nash-Lukenback (2023) also note a significant gap in learning theories for post-secondary neurodivergent learners by pointing out that higher education often neglects neurodivergent intelligences. Underscoring the need for a deeper understanding of the adult neurodivergent experience in higher education, Hamilton and Petty (2023) explore pedagogical approaches for these learners, while Kelly (2024) and Doo et al., (2020) call for enhanced accessibility, accommodations, and learner-centered scaffolding.

Research has proven there is a link between emotional cognitive load, well-being, and academic success (Asma & Dallel, 2020; Atiomo, 2020; Banu et al., 2021; Hamilton & Petty, 2023; Le Cunff et al., 2024; Taylor, 2023; Yu, et al., 2018; Wheeler, 2024). Therefore, given the relationship between cognitive load and executive function management (Figuerola et al., 2017; Grosvenor, 2022; Jones et al., 2016; Meijs, 2021; Southon, 2022), self-regulation (Meijs et al., 2021; Ng et al., 2024), self-determination (Alamri et al., 2020; Oga-Baldwin, 2015), and self-directed learning (Adlinda & Mohib, 2020; Al Mamun et al., 2020), neurodiverse college students may encounter more challenges, lower motivation, and diminished success (DuPaul et al., 2019). By collectively considering the factors of the absence of objective tests, the lack of neurodivergent pedagogy, and the scarcity of relevant instructional design theories, it becomes clear why neurodiverse learners often encounter significant difficulties due to their exclusion

from curriculum development and learning environments.

Statement of Purpose and Research Question

To design effective instructional strategies for managing cognitive load, a deeper understanding of this topic is required. Thus, the main goal of this study is to enhance current knowledge of emerging research on cognitive load faced by neurodiverse learners in higher education. Utilizing narrative analysis, three interviews will be conducted with neurodivergent learners to explore their digital learning experiences, responses to challenges, and solutions for reducing cognitive load.

This research prioritizes the perspectives of these learners and serves as an exploratory opportunity to guide my future design-based work. The goal is to provide evidence-based insights to instructional designers and educators for creating inclusive, effective digital practices that meet the needs of neurodiverse learners in higher education. I will begin this endeavour by asking: What challenges do neurodivergent learners face in digital learning environments?

Positionality

As an instructional designer and neurodivergent learner, I offer a unique perspective on the challenges faced by neurodivergent learners in higher education digital learning environments. My instructional design background deepens my understanding of the need to create accessible and inclusive digital spaces. Additionally, my experience as a neurodivergent student enriches my insight into the challenges faced by learners navigating cognitive demands. This dual perspective allows me to approach the research both critically and empathetically, while also prioritizing the voices of neurodivergent students.

As a researcher, I recognize the importance of being reflexive. I hold dual roles in this research: I am both the researcher conducting this study and a doctoral student with a neurodivergent diagnosis. This duality may introduce biases, such as assumptions about shared experiences. However, I will focus on the needs expressed by the participants and center their perspectives. I acknowledge that my dual positionality can enhance or detract from my research, and I accept my responsibility to address this with a mindful and critical approach.

Methods

I conducted qualitative interviews with three neurodivergent higher education learners to explore their challenges in digital learning environments. My goal was to understand their current experiences, challenges, and strategies for solutions. Using a case study approach, I sought to understand their experiences and insights on cognitive load management challenges.

Settings and Participants

Since the setting aligned with my research objectives in higher education, I selected the George Mason, Fairfax campus as the site for participant recruitment. Following Ravitch and Carl's (2021), I weighed the advantages and disadvantages of using the campus for my studies, along with the various environments it offers. I provided each participant with the option to choose their preferred meeting place on campus or to be interviewed online via Zoom. All three participants opted for a Zoom meeting. Given the integrated screen recording and transcription capabilities in Zoom, this option was most beneficial for all.

For this study, I chose to use purposive sampling since I needed a specific population and setting (Ravitch & Carl, 2021). I needed higher education students who were diagnosed with neurodivergent traits. However, this was based on self-reported diagnoses since I was unable to

seek medical validation. In total, I sampled three participants.

Initially, I created a list of potential participants based on my knowledge of them and their diagnoses. Since I knew each participant personally, they had voluntarily disclosed their neurodivergent status to me. I then contacted each potential participant in person, via text, phone, or email, to gauge their interest and availability for an interview. For the confirmed participants, I had two males and one female. Among the three participants, two have ADHD, and one has autism. One participant is in their 20s, another is in their 30s, and the last is in their 40s. All participants are enrolled at George Mason and appear healthy, articulate, and highly functioning. One participant is enrolled in a part-time master's program, one was in a part-time doctoral program, and one was in a full-time doctoral program. One participant is a part-time employee, and two are full-time employees. One participant works off-campus, while two participants work on-campus. Table E1 presents the participant demographics for these interviews (Appendix E).

Then, I emailed each of them an *Interview Participation – What to Expect* letter (see Appendix A). Rooted in two of George Mason's best practices for neurodivergent learners: Course Design and Framing and Course Interactions (Sterns Center for Teaching and Learning, n.d.). My goal for this letter was to express my appreciation once again, clarify the purpose of the interviews, outline what participants could expect during the interview, and explain what to expect after the interview. After they had time to review the Interview Participation Letter, I sent them a text message or an email to arrange a Zoom appointment and reminded them that they could be on or off camera. I also took the opportunity to confirm that they were comfortable with the interview being recorded and a transcript created by the integrated Zoom features for analysis. Once they verbally agreed to the meeting, we scheduled a time that was mutually beneficial.

Data Collection

Before soliciting interview participants, I developed an interview protocol aligned with my research focus and presented it to a critical friend for feedback on readability. I revised the questions accordingly and shared them with a peer for feedback on appropriateness. After making minor adjustments, I submitted the finalized questions to an experienced researcher for feedback (see Appendix B). For the interview, I employed a semi-structured interview approach to ensure that my specific questions were addressed and that there was room to follow up on participants' remarks (Ravitch & Carl, 2021). When crafting my questions, I focused on several specific types: experience, opinion, knowledge, and sensory (Ravitch & Carl, 2021). This approach aimed to gain a holistic understanding of their engagement with digital learning environments. I also rehearsed my questions before the first interview and recorded them to ensure my delivery was appropriately timed and enunciated.

Data Analysis

All interviews were recorded and transcribed via Zoom. The first step I took was to clean my data and ensure the anonymity of my participants. During this process, I reviewed the interviews and conducted preliminary coding on keywords and paragraphs to identify potential key quotes expressed by the participants (Ravitch & Carl, 2021). In accordance with the suggestions made by Ravitch and Carl (2021), I read the interviews multiple times. First, to gain an overall understanding, I read them in chronological order and by participant. Next, to gain insights and validate concepts, I utilized an inductive approach to open-code my interviews while creating definitions for them. Then, I applied the axial coding process to deductively validate the patterns. Finally, I created my codebook (see Appendix C) after reviewing my annotations and codes in relation to my research question, the overall sentiment of the participants' responses,

and the linkages between cognitive load and self-regulated learning (see Appendix D).

Trustworthiness and Validity

To ensure trustworthiness, I engaged in a structured reflexivity process by regularly asking myself the validity questions outlined by Ravitch and Carl (2021). Additionally, I confirm my understanding of what the participants were explaining by employing member checking in two ways: during the interview to clarify points being discussed and post-interview for items still needing clarification. During the interviews, if there was something unclear to me, I would ask follow-up questions similar to, “So, if I hear you correctly, then I’m understanding that you...” (Ms. Thursday Interview), “So, what I hear you saying then is...” (Mr. Thursday Interview), or “When you say...do you mean...?” (Mr. Monday). In addition to member checking in the moment, I also established post-interview conversations if I needed to ask a participant about any discussion item that required clarification to assign the correct code. I also had critical friends read randomly selected passages to evaluate my code selections.

To establish validity, I utilized two forms of triangulation discussed by Ravitch and Carl (2021): data triangulation and perspective triangulation. For data triangulation, I conducted interviews with three participants at various times of the day and in different locations. For perspective triangulation, I selected participants with a range of jobs, distinct neurodivergent diagnoses, varying ages, different genders, and diverse academic focus areas.

Findings

The interviews met my expectations. As I reflect on the responses, I find them rich and helpful, as they provide specific examples, explanations, and context. Although participants had various engagement preferences, they all wanted options to configure the interface for success, minimize cognitive load, and promote active engagement. As someone with neurodivergent

traits, I also seek a digital learning environment that aligns with how our brains process and store information. Reflecting on my biases and skills prior to the interviews, I recognize that my neurodivergence had the potential to influence my perspectives since I was expecting the participants' responses to mirror my experiences with online learning frustrations and desires. Understanding this concern, I consciously avoided leading participants to preconceived answers, allowing them to respond freely based on their thoughts.

For the interviews, I structured my questions into two main categories: technology and user experience. This approach aimed to understand the participants' perceptions of their digital learning environment and their cognitive, emotional, or physical responses during these engagements. These categories were then subdivided to better capture specific aspects. The technology theme included two sub-categories: artificial intelligence (AI) and learning management system (LMS). The user experience theme had four sub-categories: behavioral, cognitive, experiential, and location. While I created these themes and categories as part of the interview protocol, the codes were derived from participants' responses. Table E2 presents the codes generated from the interviews (Appendix E).

Analyzing the codes derived from participants' responses, I identified two categories: sentiment and engagement. Sentiment was conveyed in both positive and negative ways. For engagement, I recognized four topics that emerged across all three interviews: sensory needs, emotional regulation challenges, autonomy, and environmental adaptation needs.

Sentiment

While some positive expressions of sentiment were present, the majority of feelings were negative and focused on the frustrations they encountered. Mr. Thursday directed his

frustration towards his professors, “There's people trying to make it work who don't really know how to do online classes Sometimes it's nails on a chalkboard.” Mr. Monday conveyed frustration with disorganized course layouts:

...the way that I would do it is knowing the technology and how to better organize information and data for an individual for the class ... it's much easier to digest if it's in one place... You don't have to go to different areas within this technology that you may not even know where it went ... it's all about learning the technology and realizing the best way to organize it. To simply [for] any student.

Similarly, Ms. Thursday echoed frustrations with layouts: “I mean, the number one thing is it's got to be a well-organized online environment. There's nothing that drives me more bananas than an LMS course site has no rhyme or reason.”

Conversely, some positive sentiment was expressed when the participants discussed how they engaged with remote learning. Mr. Thursday preferred being on camera during synchronous sessions rather than traditional face-to-face sessions, “I find that easier in an online format. Because I feel less pressure than if there's a person kind of watching me expecting something, especially with connection issues that are common in kind of this format” (14:06:44). Ms. Thursday preferred the flexibility to be self-paced and interest-driven, “Yeah, well, I might just do one little piece each day... But it's just a little chunk every day. And it might even be a chunk of each of those, right?” Additionally, Mr. Monday enjoyed the functionality and convenience of using two screens:

So for the first screen is to have the visual, like this is where you and I are talking. And I like to have that full screen so I'm able to see you. And then the second screen is like any documents or anything that we may be working on or reading in class. So I

can always refer back to what we're talking about or continuously work with you at that same time.”

These positive remarks were aimed at creating moments of physical, cognitive, or emotional comfort during learning: Mr. Thursday found emotional comfort when he experienced reduced pressure of engagement and presence; Mr. Monday achieved physical comfort by organizing his digital learning layout; and Ms. Thursday attained cognitive comfort by engaging with her learning in small, manageable portions. As discussed here, the experiences and preferences of three individuals regarding their online learning environments indicate that overall, the participants have positive sentiments toward engaging with remote learning. However, most feelings expressed relate to frustrations with course organization and communication challenges.

Sensory Needs

Participants also struggled with auditory and visual stimuli in virtual environments. Mr. Thursday emphasized his need for physical movement to facilitate mental engagement, “This is actually very helpful for me because it does [not] engage if not active like thought processes. At the very least, I am engaging other parts of my body that need to be doing something.” Ms Thursday rejected timers and progress trackers due to anxiety, “But the timer, ...I can't deal with it. Just seeing the timer...stressful ...it's just, it's a distraction...You know, it's too much. And progress trackers, I don't need to compare. I don't need to know what I've done.” Mr. Monday shared his struggle for clarity of assignment instructions, “...the instructions were given in person, and then there's kind of like a vagueness on ... the Canvas platform, and then nothing in the document. So, you've got three different things happening. But none of it is clear.”

Emotional Regulation Challenges

In addition to the frustrations previously expressed, participants also discussed feelings of stress, overwhelm, and anxiety when discussing their academic experiences. Mr. Monday described his reactions to unclear assignment expectations as well as his engagement during collaborative assignments with peers, “But the rest of...my group had no idea what they were doing...the instructions ... are very vague...I do believe that the professor does that for a reason, but it can become very stressful and very confusing.” While Ms. Thursday felt overwhelmed by the lack of prioritization, “I felt very challenged when I saw multiple additional articles that I hadn't expected... and then try to come up with something that...[s]hows that I have read and, ...contributes to the discussion in a meaningful way...” Mr. Thursday articulated how time induces stress: “Time stresses me out. I have really bad test anxiety....That's going to freak me out because, oh God, I have to finish this before that time. Oh God, I have to finish that before this time.”

Autonomy

Mr. Monday emphasized the importance of controlling his learning environment by selecting the times and places he works, stating, “...I will go to a place where I know others are also working.” Meanwhile, Mr. Thursday expressed his need for physical activity and multitasking to enhance his engagement: “...being able to stand up and move...I have moved to a place where I feel more comfortable.” On the other hand, Ms. Thursday highlighted her desire to reduce distractions and manage cognitive load when it comes to nudges and notifications. She remarked, “No, do not nudge me. And don't send me notifications...I would want to turn off all those notifications. I mean, notifications are like my worst nightmare. So, yeah, I turned them all off on my phone. I really hate notifications.” As

illustrated by these quotes, every participant values the ability to control their learning environment, schedule, and the tools they interact with during learning. Additionally, these quotes also emphasize the importance of autonomy for neurodivergent adults.

Environmental Stress

Participants also discussed how physical and digital environments directly impacted their focus. Mr. Monday required a dedicated workspace to minimize distractions, "...I can't just classwork anywhere....I usually come to my office because it has that feel of I'm in a working environment." While Ms. Thursday preferred asynchronous tasks to avoid real-time pressures, "...I'm not the kind of person that like sits down and gets it all done... I need to think and i need to think just do little bits...when I have time to do something and I can think about it." Mr. Thursday preferred to work in timeblocks to manage his attention and workflow, "Like in a testing environment, ...if I set my sprints, ...I click the timer...20 minutes, then... Get up, stretch, have something to eat...it's a way to keep myself kind of in that moment and moving..." These learner-structured scaffolds indicate that individuals have distinct preferences for their work environments and methods, which significantly influence their focus and productivity. Table E3 presents a summary of the findings (Appendix E)

Discussion

From the data, there are theoretical links that support and explain the emerging themes. Universal Design for Learning (UDL) advocates customizable interfaces (CAST, 2024; Lange, 2024). Self-regulated learning, cognitive load, and executive function management frameworks emphasize environmental scaffolding (Doo et al., 2020; Figueroa et al., 2017; Kelly, 2024; Le Cunff et al., 2024; Meijs et al., 2021; Ng et al., 2023). Given this, it is not surprising that

cognitive load and *interface* were the most frequently coded themes. *Self-regulated learning strategies* have emerged as critical for managing neurodivergent needs, while user *attitude* codes highlight strong emotional responses to cognitive overload (See Appendix F, Code Co-Occurrence; Appendix G, Code Application by Interview; and Appendix H, Word Cloud of Codes).

After completing my analysis, I uncovered two unique findings and two gaps. The findings included the employment of Gen-AI and engagement with structured systems. The gaps were the absence of dialogue regarding asynchronous discussions and assistive technology. Although these findings are not generalizable to larger populations, they offer an interesting direction for potential future studies.

When discussing the potential use of Gen-AI, Mr. Thursday, a participant with Autism, wanted to incorporate Gen-AI into digital learning environments to personalize his learning. He advocated for AI to present information based on his learning preferences, “I need this problem presented in this way. Click and have it restructure it.” Conversely, the two participants with ADHD wanted to incorporate Gen-AI as a personal assistant. Mr. Monday discussed the potential of AI to keep him abreast of pending assignments and notifications for upcoming events, “Of like, ‘hey, there's an assignment coming up ... in like three days. Have you started on it? And if not, how can I assist you with that?’” Similarly, Ms. Thursday wanted the capability for AI to act as a personal assistant but desired options for when and how to employ it, “Yeah, give me options. Give me choices. I mean, I'm a one type of learner one day and another type another day, you know.” Ms. Thursday also articulated the desire to help organize her learning if it could “find things or let you know if what you submitted meets the minimum requirement,” by providing “immediate feedback to fix and issues,” but she wanted AI to act proactively: “Before

it became an issue, an AI that could help you find things on the LMS.” Although this is relatively early for an observation, it's a topic I'd like to revisit in the future to determine if this is generalizable across these specific neurodivergent subtypes and other subtypes not represented in this small sample.

The second surprising aspect of my findings is paradoxical: while participants rejected system-generated structures (such as progress bars or timers) and instructor-generated frameworks (like course outlines and formats), they each advocated for the ability to create their own structure. This implies that it is not the nature of the structure they reject but the predetermined construction of that structure they wish to personalize to accommodate their individual cognitive preferences. Ms. Thursday discussed organization, “You know, I mean... Part of it is because I have my own ideas about how you know an lms you know a course in an LMS should be organized right and I don't have a lot of tolerance for deviation from that.” Mr. Thursday stated, “...it's not something that exists currently.” Mr. Monday advocated for clarity of instructions, “When I think about my feelings towards it, what I wanted more than anything was for them to be clear. On what we were doing as well, because I remember my confusion And the stress that came with it.” As with each of these examples, the self-structure is an attempt to align the course requirements and presentation with an internal structure that facilitates executive function management and cognitive load management. Given the close relationship between executive function management and cognitive load, this desire for autonomy and self-created structures may indicate the participants’ attempt to reduce their extraneous cognitive loads while employing strategies to manage their working memory (Figueroa et al., 2017; Grosvenor, 2022; Jones et al., 2016; Meijs, 2021; Southon, 2022).

Finally, two thematic gaps emerged: a lack of discussion about asynchronous peer

collaboration tools (such as forums) and a lack of discussion regarding assistive technologies (such as text-to-speech). Only one participant mentioned the existence of asynchronous peer collaboration tools. Mr. Monday briefly noted that he was collaborating with peers while discussing an assignment, “We have to come together and use a Word doc that we all have access to online.” There were no further mentions of collaboration tools, the support they received when using these tools, or the level of cognitive load management necessary to engage with them. This suggests that the participants may easily integrate these components into their learning preferences. However, these types of tools might not be included as components in their current courses, or there could be limitations in the interview methodology.

Additionally, none of the participants mentioned using assistive technologies to address their learning challenges. This implies that the participants may not view their choice of assistive technology as a viable strategy for mitigating their learning challenges, they might not have access to assistive technologies, or there may be limitations in the interview methodology. Since the neurodiversity was self-reported and I was not asking for medical documentation of their diagnosis, I did not ask if they were enrolled in George Mason’s Office of Disability Services.

Limitations

The primary limitation of this study is its small, purposive sample size, which limits the transferability of the findings to broader populations of neurodivergent learners in higher education. Furthermore, relying on self-reported data without accompanying observations may reduce trustworthiness due to subjectivity and recall bias, despite the presence of member checking and structured reflexivity processes. Although discussions took place regarding neurodivergent learners in higher education, executive function management, and cognitive load theory, no definitions were provided for these terms to ground them in the perspectives of either

Barkley (2013) or Sweller (1988). This distinction is necessary because of Barkley's recognition as an authority on attention deficit hyperactivity disorder (ADHD) and Sweller's acknowledgment of creating the influential theory of cognitive load.

Future Research

Future research should utilize a larger and more diverse sample of neurodivergent learners in higher education. This sample should include an examination to determine whether there are general variations in customization preferences among neurodiverse subgroups. Similar to the participants in this study, there was vocal support for integrating Gen-AI, but opinions diverged on its application. A mixed-methods approach could provide quantitative insights into preferred engagement methods and academic outcomes. Following this, future research should investigate how customizable digital tools impact cognitive load, self-determination, self-direction, and learner autonomy in higher education settings.

Conclusion

So if you were to give an instructor kind of like, 'I need you to do this for me personally to make learning easier, for just finding the materials and understanding the assignment online' what would you say to that professor? (Mr. Monday, 10:37:25)

Although this was an exploratory study aimed at learning how to conduct qualitative interviews and perform data analysis, it successfully explored the perspectives of neurodivergent learners in higher education and the challenges they face in digital learning environments.

Instructional ambiguity and customizable interfaces emerged as themes from all the interviews. Although customizable interfaces are limited to LMS developers, we can investigate the concept of instructional ambiguity and how to deliver actionable insights, provided there is an understanding of the barriers, strengths, and interaction challenges faced by neurodivergent learners (Azuka et al., 2024; Burgstabler, 2018; CAST, 2024; DuPau, et. al, 2018; Friedman & Nash-Luckenbach, 2024; Green & Rabiner, 2012; Hamilton & Petty, 2023; Le Cunff et al., 2024; Pierrès et al., 2024; Roa, 2021; Wallace, et al., 2016). Centring participants' voices emphasizes the need for learner agency and adaptability in digital learning environments. Furthermore, this exploratory study highlights the importance of higher education instructors rethinking their course presentations to reduce instructional ambiguity that might stem from their organizational styles.

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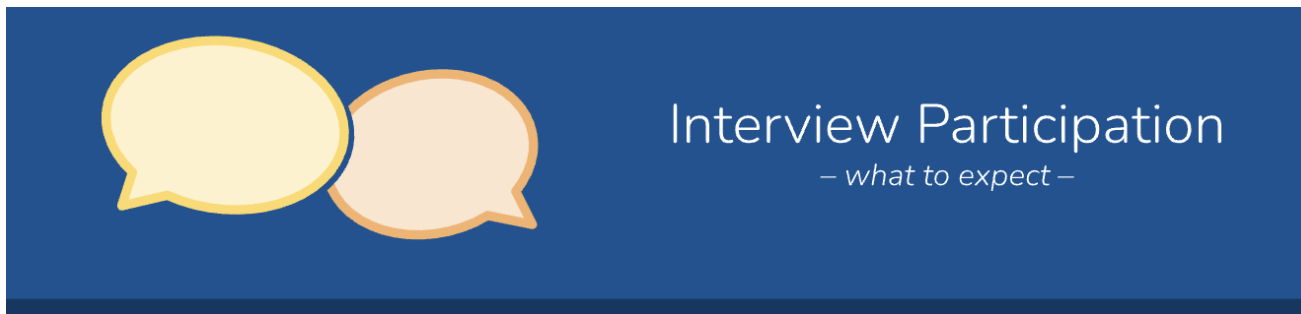
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Appendix A

Interview Participation Letter

An Interview Participation letter was emailed to each participant prior to their interview in the hopes of mitigating anxiety about what to expect during the process.



Thank you so much for agreeing to meet with me for an interview!

First, I want to explain why I invited you to meet with me:

1. This interview is for an assignment in my class, *EDRS 812: Qualitative Methods*.
2. The assignment is to understand how to plan for an interview, write the questions, and lead one with three people.
3. I can choose the topic and who to invite for the interview.
4. My topic is how learning in digital environments can be designed to be more cognitively inclusive. In other words, I am exploring ways to make learning easier to navigate and more engaging when it is done online for people who think the same and differently from everyone else.
5. I thought about interviewing you since we previously talked about this topic.

Now, I want to tell you what to expect DURING the interview:

- Your participation is **entirely voluntary**.
- The most important thing to know is that you can withdraw from the interview at any time before, during, or after it. There will be no consequences if you do.
- The second most important thing to know is that you may stop the interview and refuse to answer any question at any point. There will be no penalty if you choose to do so.
- The interview should not last more than 45 minutes.
- I have created a list of open-ended questions about your experiences using online learning environments.

- You can ask me to clarify or rephrase anything you do not understand.
- Since we will be on Zoom, I will use their embedded recording and transcription features to get the documentation I need for my assignment. You can choose to be on-camera or off-camera.
- By volunteering to participate, you are agreeing to our interview being audio-recorded.

Finally, I want to tell you what to expect AFTER the interview:

- If you withdraw after the interview, I will not include your interview in my assignment and will delete the recording and the transcript.
- I will keep the information confidential. Since the interviews will be on different days, I will disguise your identifying information and refer to you according to the day we meet (for example, Interviewee Monday). I will only share the interview documentation with my professor if he requests it.
- I will share a copy of the transcription with you if you want it.

Since this is only a class assignment, you do not need to sign or do anything. This informational sheet was created to explain my assignment, give you a sense of what to expect, and ensure that you know your participation is completely voluntary.

Please feel free to reach out to me if you have any questions. I am available by phone or email at cburris2@gmu.edu.

Thank you again for agreeing to participate. I look forward to seeing you next week.

Kindly and Gratefully,

Cheryl

Appendix B

Interview Protocol

An interview protocol was created and offered to each interview participant before their scheduled session, in an attempt to ease any anxiety beforehand.

Introduction Script

Thank you for joining me today!

I invited you to participate in this interview because I am completing an assignment for my EDRS 812 - Qualitative Methods class. For this assignment, I have to interview three people about my potential research topic, cognitive load for neurodivergent students in online learning.

Today, I will ask open-ended questions about your experiences using online learning environments and plan to be finished within 30 minutes. As we proceed, please ask me to clarify or rephrase anything you do not understand.

Before we begin, may I ask you a few admin questions:

- *Since we are using Zoom, I plan to record our interview and use the embedded transcription feature. You can be on-camera or off-camera – it is your choice. Do I have your permission to start recording now?*
- *Did you receive the PDF I sent via Google Forms that outlines this interview process?*
- *For this assignment, I will protect your identity by keeping your personal information confidential and not including your name. I will only share the documentation with my professor if requested. Are you comfortable with this arrangement?*
- *You may stop the interview and refuse to answer any question at any point during it. Are you comfortable with my reassurances that there will not be any penalty if you choose to do so?*

Before we begin, do you have any questions, comments, or concerns?

Leadoff Questions

1. Walk me through your most recent experience completing an assignment during an online learning engagement.
 - a. What does that process look like from start to finish?
 - b. Describe the situations during that process that make engaging with the digital materials challenging.
 - c. Describe how the process could be improved to make engaging with the course materials easier.
2. Describe how you think being neurodivergent impacts your ability to engage in online learning.
 - a. Describe how your traits help your ability to engage with the assignment.

- b. Describe how your traits hinder your ability to engage with your assignment.
- c. Describe an ideal engagement in an online class if it could be designed specifically for how you best learn.

Primary Questions

1. What happens with your thinking (cognitively) when switching between different media formats (videos, discussion boards, readings, etc) during your coursework?
 - a. How does your attention shift when you need to move from visual content (e.g. videos) to text-based content?
 - b. Describe how you manage information from multiple formats.
 - c. What are the physical sensations you experience when working with multimodal formats?
2. What features in online learning environments are effective in helping you complete complex tasks?
 - a. Tell me about a time when the lesson's template changed how you approached the lesson.
 - b. How do you navigate digital tools or lessons when instructions are unavailable?
 - c. What differences do you notice when cognitive aids (such as timers or progress trackers) are built into the learning environment versus those without them?
3. What adjustments (physical, digital, social, environmental, etc.) do you make when you feel overwhelmed by the demands of digital learning environments?
 - a. Explain how you typically reorganize your screen when you are overloaded.
 - b. Describe your decision-making process when you need help in a digital learning situation.
 - c. How do you determine when to continue working versus pausing during challenging engagements?
4. How does the sequence of information influence your ability to process content during digital learning engagements?
 - a. Compare a previous course that worked well to one that did not work well for you.
 - b. What visual cues do you look for during a digital learning activity that help you anticipate what is coming next?
 - c. How could instructors organize their lessons to create a better flow through the content?
5. How would technological capabilities adapt to your needs as they change during digital learning activities?
 - a. Describe how you would design the ideal digital interface to minimize your struggles during digital learning experiences.
 - b. What features come the closest to meeting your neurocognitive needs?
 - c. How do you perceive that artificial intelligence (AI) may assist your interactions in digital learning environments?

Conclusion and Thanks

1. I appreciate you investing time, effort, and energy into this interview.
2. Is there anything that I didn't ask about but you would like to share?
3. May I share the transcript with you after the interview and check in to hear your final thoughts?

Appendix C

Codebook

The following table displays the six themes that appear across all three interviews, providing a clear structure for readers to follow and understand the data. This codebook is also accessible on my Google Drive [by clicking this link](#).

Category 1: Technology	
Description: The hardware, software, or infrastructure used to create an engaging and inclusive learning experience	
Theme 1-1: Potential Future Integration of AI into Instructional Design	
Description: Generative Artificial Intelligence (Gen-AI) using Large Language Models (LLMs)	
Code 1-1-1	Acts as a Personal Assistant
Description	Use of Gen-AI to aid the learner in organizing, assigning, prioritizing, predicting, and managing tasks
Quote	“Yeah, the first thing that comes to mind is informing me. Of like, hey, there's an assignment coming up and, you know, not just the normal like ding, notification, whatever, like the assistant coming up and saying hey I hope you know i hope you know This assignment is coming up in like three days. Have you started on it? And if not, how can I assist you with that?” (Mr. Monday, 10:41:58)
Code 1-1-2	Facilitates Personalized Learning
Description	Use of Gen-AI to tailor instruction to meet the user's unique learning needs
Quote	“Or you could have something in a standardized test software ... where, okay, I don't quite get what this means in this format. What if? Click. And you can switch the same problem. Again, this would just require more like standards and like talking to general like standards organizations But cool, I need this problem presented in this way. Click and have it restructure it.”

	(Mr. Thursday, 14:38:52)
Theme 1-2: Current Design of Digital Learning Environments	
Description: Current experience while using digital learning environments such as Canvas or Blackboard	
Code 1-2-1	Assignment
Description	A discussion of an assignment
Quote	“I think what would help and the way that I would do it is knowing the technology and how to better organize information and data for an individual for the class because if you have the training or the knowledge on how to use it. Best and how to organize you know assignments information online, it's much easier to digest if it's in one place. Like you were saying, if you understand that Canvas can put a syllabus in and you can link directly to modules. You don't have to go to different areas within this technology that you may not even know where it went because once you uploaded it, it's where you go. I think it's all about learning the technology and realizing the best way to organize it. To simplify any student.” (Mr. Monday, 10:39:45)
Code 1-2-2	Course
Description	Mentions aspects of the course structure, environment, or subject matter
Quote	“You know, I mean... Part of it is because I have my own ideas about how you know an LMS you know a course in an LMS should be organized right and I don't have a lot of tolerance for deviation from that. So, for me, I think ... what it looks like is, you know, it's easy to find the assignments, I can go to modules that are organized weekly ...you know, that I'm just I'm able to and things are labeled properly. That's one thing that I don't always see. And those are the kinds of things. So just like well-organized well labeled and you know you just you go to that page and you know what to do next. (Ms. Thursday, 15:48:09)
Code 1-2-3	Instructor
Description	A discussion of an individual instructor and their teaching style, attitude, or engagements
Quote	“So if you were to give an instructor kind of like, I need you to do this for

	me personally to make learning easier, just finding the materials and understanding the assignment online, what would you say to that professor?" (Mr. Monday, 10:37:25)
Code 1-2-4	Peers
Description	A discussion of engagement with other participants enrolled in the course
Quote	"That's it. I see that stress come into ... like, for instance, one of them that we had that's due in a day or two ... when someone doesn't complete their part and it's integral. The stress on the other group members it's just immediately going to happen." (Mr. Monday, 10:12:37)
Code 1-2-5	Interface
Description	The visual and interactive elements that guide the user's engagement
Quote	"But in that place, if we had to do it as a call, there's a call mechanism in this I guess, yeah, I keep trying to move my hands, but you can't it's not here But if you have multiple people on that call. There's more of a sense of presence, like you're in the same space and that way it's more of how you're in a room with somebody. You look at somebody, it's more natural than just staring at a flat screen." (Mr. Thursday, 14:16: 37)
Category 2: User Experience Description: What the user is experiencing behaviorally, cognitively, and experientially	
Theme 2-1: Behavioral Responses During Digital Learning Environment Engagements Description: How the learner is feeling and acting during their engagements	
Code 2-1-1	Attitude
Description	What the learner is experiencing emotionally during their engagements
Quotes	"I mean, the number one thing is it's got to be a well-organized online environment. There's nothing that drives me more bananas than an LMS course site has no rhyme or reason." (Ms. Thursday, 15:42:37)
Code 2-1-2	Reaction

Description	How the learner is acting in response to their engagements
Quote 1	“Like we needed to come together, whether it was virtual or in person and discuss those things. And that I think is what that assignment is lacking. And a lot of times I felt myself throughout the entirety of it feeling stressed because I was like ... I need to answer this. I need to make sure that I read whatever you decide the question is going to be about. Because that's the other thing that's not discussed there. It's not all the readings. It's not all the viewings. So yeah, it's high anxiety, a lot of stress.” (Mr. Monday, 10:12:37)
Quote 2	“Yes. So the taskbar is very helpful. Time stresses me out. I have really bad test anxiety.” (Mr. Thursday 14:25:12)
Theme 2-2: Cognitive Responses During Digital Learning Environment Engagements Description: Learner’s mental activities such as thinking, reasoning, remembering, learning, decoding, etc.	
Code 2-2-1	Cognitive Load
Description	The amount of mental effort required to process information or complete a task
Quote	“Yeah, I mean, I think, you know, a well-organized homepage is important. I'm a huge advocate, actually, and I truly believe that all College courses should have the same organization on the LMS. Which would, I believe, would reduce cognitive load for all learners and then also prevent students from needing to learn how each instructor organizes a course Right. And so I just think that you have a clear front page and you and your students know exactly what to do next. To me, that is what would make a great flow.” (Ms. Thursday, 15:49:24)
Code 2-2-2	Executive Function Management
Description	a learner's ability to plan, organize, and execute tasks, focus attention, and follow instructions to achieve goals
Quote	“I don't sit things down very well, if I'm going to be 100% honest with you. So... one thing's going on i want to just like hammer through it, hammer through it and get it done. Which, again, not always particularly

	feasible depending on the situation. But switching between modes is fine. Like if it was more of a hybrid situation where I have some classes on Zoom, some classes not on Zoom.” (Mr. Thursday 14:18:18)
Code 2-2-3	Self-Regulated Learning
Description	The process where learners set goals, monitor their own learning, and regulate their cognition, motivation, and behavior to achieve those goals
Quote	“And, usually when we are looking for these things, it's the examples that they're using in class ... and so when we find it, I download it and add it to the file that I personally have in my Google Drive so I know exactly where I can find it always.” (Mr. Monday, 10:36:57)
Code 2-2-4	State of Mind
Description	A description of what the learner is experiencing cognitively
Quote 1	“Oh my goodness. I think... I mean, starting with the confusion on instructions the amount of anxiety. Yeah, that anxiety and stress can you lose out in learning because you're so focused on trying to finish the assignment however it's supposed to be done. You're not necessarily paying attention to what questions are being asked or what people are discussing and and feel like you're a part of this conversation that is nonverbal. And so you're like, I just want to get my points. I want to get this done.” (Mr. Monday, 10:12:37)
Quote 2	“Yeah, I mean, my attention is split in a million different directions and so You know, engagement is like a fundamental part of it, right? If I'm not engaged, my brain is going in a hundred different directions. But if I'm engaged, I'm like the super hyper-focused person and I'll read all the articles and then some and then ... you know, go beyond. I think that's the difference, right? Like it's really hard to lock in when you're... struggling to find relevance and interest and also, the pressure of like, I want to be able to say something meaningful and contribute and sound like...” (Ms. Thursday, 15:37:40)
Code 2-2-5	Desired Outcomes
Description	What the learner wishes/d would happen
Quote	“So... When I think about my feelings towards it, what I wanted more

	than anything was for them to be clear. On what we were doing as well, because I remember my confusion. And the stress that came with it. And I didn't want my fellow classmates to be there as well.” (Mr. Monday, 10:08:35)
Code 2-2-6	Strategies
Description	Techniques or suggestions made by the learner
Quote	“Yeah, I would say within the Canvas system itself One of the greater things you can do is minimize sections. So like, for instance, it can be extremely overwhelming if you're looking at every single module and every single assignment and every single fill in the blank. But I like to minimize the ones that have happened or are yet to come to where I can only focus on that week, that module. That helps tremendously.” (Mr. Monday, 10:41:05)
Theme 2-3: Experiential Responses During Digital Learning Environment Engagements Description: Learner’s action(s) while using the digital learning environment	
Code 2-3-1	Limitations
Description	What the user dislikes about the learning environment
Quote 1	“Yeah, I mean, my attention is split in a million different directions and so You know, engagement is like a fundamental part of it, right? If I'm not engaged, my brain is going in a hundred different directions. But if I'm engaged, I'm like the super hyper-focused person and I'll read all the articles and then some and then ... you know, go beyond. I think that's the difference, right? Like it's really hard to lock in when you're... struggling to find relevance and interest and also, the pressure of like, I want to be able to say something meaningful and contribute and sound like...” (Ms. Thursday, 15:37:40)
Quote 2	During these times, I think...During the calls, I think... just hearing things I'm particularly good at. Cool, you hear or you say it, I hear it, and then it kind of gets internalized and that's just How I learn. I don't necessarily need all the social piece of it but i think In the case of having multiple classes like Again, during COVID when everything was kind of going all over um my brain switching, it can help to be cool. I'm working

	on this project for this other class While I'm in the call and still paying attention just...Paying attention to multiple things. I don't know that it... I don't know how much of that is neurodivergence because i think a lot of it is the A lot of it is like the more autism side where Where it's very just uncomfortable to be in that space. (Mr. Thursday, 14:14:04 and 14:14:47)
Code 2-3-2	Strengths
Description	What the user likes about the learning environment
Quote	“I find that easier in an online format. Because I feel less pressure than if there's a person kind of watching me expecting something, especially with connection issues that are common in kind of this format.” (Mr. Thursday, 14:06:44)
Theme 2-4: Location of the Digital Learning Environment Engagements	
Description: The engagement location/context of the user’s experiences	
Code 2-4-1	Digital/Virtual
Description	Remote learning while using the digital learning environment
Quote 1 - Positive	“So for the first screen is to have the visual, like this is where you and I are talking. And I like to have that full screen so I'm able to see you. And then the second screen is like any documents or anything that we may be working on or reading in class. So I can always refer back to what we're talking about or continuously work with you at that same time.” (Mr. Monday, 10:26:53)
Quote 2 - Negative	“Yeah, I mean, I think being overwhelmed in the environment to me means I need to take a break. I need to step away. I am absolutely freshest very early in the morning Right. And so if I'm making adjustments, right, my adjustment is I mean, if I'm overwhelmed, I have to take a break because there's no learning that happens I probably have kids screaming in the background you know.” (Ms. Thursday, 15:45:29)
Code 2-4-2	Traditional/Physical learning while using the digital learning environment
Description	Co-located/face-to-face learning while using the digital learning environment
Quotes	“Yeah, I think I would do... Ironically, something similar that we asked

	for in our class in the previous semester is I would give an example I would show them what a what that word doc looks like in the past with consent from those people that had filled it out before of This is what the summary looks like. This is what this person does here. And you can see how it flows.” (Mr. Monday, 10:10:18)
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Appendix D

Coded Transcripts

The following links are for the annotated and color-coded interviews produced by Dedoose. Since they cannot be imported to appear as they do in the Dedoose export document, they are also accessible on my Google Drive by clicking the links below:

Transcript B1: Mr. Monday - Link to the document on my Google drive is found at

https://docs.google.com/document/d/1eG2d6PLzC1ZohNSWG-bstK3a-dTKXoIZ/edit?usp=drive_link&oid=103969184851893979577&rtpof=true&sd=true

Transcript B2: Mr. Thursday - Link to the document on my Google drive is found at

https://docs.google.com/document/d/1b35XX0S4ZSAXMn-EvrEJkCgeqSTbOaon/edit?usp=drive_link&oid=103969184851893979577&rtpof=true&sd=true

Transcript B-3: Ms. Thursday - Link to the document on my Google drive is found at

https://docs.google.com/document/d/1VguOzD0qTDMoDv4OGEWCJ2FKDLRZmDML/edit?usp=drive_link&oid=103969184851893979577&rtpof=true&sd=true

Appendix E

Findings

The following tables present the findings from the coded interviews. Table E1 presents the demographics of the study's participants. Table E2 presents a summary of the codes from the codebook. Table E3 presents a summary of the findings after analyzing the interviews.

Table E1: Demographics of Participants

Participant	Neurodivergent Subtype	Gender	Age	Academic Status	Employment Status
Mr. Monday	ADHD	Male	30's	Doctoral Student Part-time	Full-time On-campus
Mr. Thursday	Autism	Male	20's	Master's Student Part-time	Part-time Off-campus
Ms. Thursday	ADHD	Female	40's	Doctoral Student Full-time	Full-time On-campus

Table E2: Summary of Codes

Theme	Category	Code
Technology	AI	Acts as a Personal Assistant, Facilitates Personalized Learning
	LMS	Assignment, Course, Instructor, Peers, Interface
User Experience	Behavioral	Attitude, Reactions
	Cognitive	Cognitive Load, Executive Functions Management, Self-Regulated Learning, State of Mind, Desired Outcomes, Strategies
	Experiential	Limitations, Strengths
	Location	Digital/Virtual, Traditional/Physical

Table E3: Summary of Findings

Category	Topics	Summary
Sentiment	Positive	The participants have learned how to make adjustments to achieve emotional, physical, and cognitive comfort during the learning process to mitigate negative experiences associated with digital learning environments.
	Negative	The participants were discouraged with disorganized course layouts, frustrated with the challenges of remote instruction, and highlighted the need for better organization in online courses.
Engagement	Sensory Needs	Participants in virtual environments encountered difficulties related to sensory stimuli, anxiety from timers and progress tracking, and a lack of clarity in assignment instructions, highlighting the importance of physical engagement and clear communication for effective learning.
	Emotional Regulation Challenges	Challenges revolved around the feelings of stress, overwhelm, and anxiety experienced by participants in their academic environments. They express frustrations related to unclear assignment expectations, an overwhelming <u>amount</u> of unexpected materials, and the pressure of time constraints, which all contribute to their overall stress in academic settings.
	Autonomy	Neurodivergent adults valued the ability to control their learning environments to enhance engagement and minimize distractions, highlighting the importance of autonomy in their learning processes.
	Environmental Stress	Individuals have distinct preferences for their work environments and methods, which significantly influenced their focus and productivity.

Code Co-Occurrence

table is also accessible on my Google Drive by clicking on [this link](#).

Technology																			TOTALS									
Act as a Personal Assistant	Facilitates Personalized Learning	Facilitates Learning										Course Assignment	Instructor Interface	Peers	Attitude	Reactions	Cognitive Load	Desired Outcomes	Executive Function Management	Self-Regulated Learning	State of Mind	Strategies	Limitations	Strengths	Digital / Virtual	Traditional / Physical	TOTALS	
AI																												
Act as a Personal Assistant		Facilitates Personalized Learning										1	3			1	2	1						1	1	1	1	4
LMS																												
Assignment Course		3										6	1	2	1	9	14	1	2	3	4	10	6	6		2	2	60
Instructor Interface		3										1	1	1	1	4	5	1	1		2	4	2	2		6	34	
Peers		1										3	6	1	1	12	7	5	7	4	6	9	6	8	22	98		
		2										1	1	2	1	3	2	2	1	3	3			3	3	18		
User Experience																												
Behavioral		1										1	1	2	3			1	2	2	3	1			3	3	21	
Attitude Reactions		9										4	12	1	3	14	3	11	6	11	10	11	3	17		120		
Cognitive																												
Cognitive Load		2										14	1	5	7	3	14	2	5	7	15	10	9	1	14	2	111	
Desired Outcomes		1										1	2	5	2	1	3	2	1	1	1	1	1	1	8		29	
Executive Function Management		2										3	1	7	2	11	5		4	7	11	3	2	4		62		
Self-Regulated Learning		4											4	1	2	6	7	1	4	5	8	2	2	6		52		
State of Mind		10										2	6	3	3	11	15	0	7	5	1	6	3	8	2	82		
Strategies		1										1	6	4	2	9	1	10	10	1	11	8	1	3	6	10	1	85
Experiential																												
Limitations		6										2	3	6	11	9	1	1	3	2	6	3			10		62	
Strengths												2		8	3	1	1	1	2	2	3	6			8	1	38	
Location																												
Digital / Virtual		1										2	2	6	5	22	3	3	17	14	8	4	6	8	10	8	1	130
Traditional / Physical		4										10	24	37	99	19	34	100	111	70	52	82	95	59	120	7		

Appendix G

Code Application by Interview

The following table shows the frequency of codes by interview. This table is also

	Ms Thursday	Mr. Thursday	Mr. Monday	Totals
Technology				
AI				
Acts as a Personal Assistant	1		1	2
Facilitates Personalized Learning		7	2	9
LMS				
Assignment	10	1	14	25
Course	2	5	4	11
Instructor		4	4	8
Interface	7	16	7	30
Peers			6	6
User Experience				
Behavioral				
Attitude		2	6	8
Reactions	9	13	14	36
Cognitive				
Cognitive Load	11	7	23	41
Desired Outcomes	5	2	5	12
Executive Function Management	2	15	3	20
Self-Regulated Learning	3	4	9	16
State of Mind	7	6	18	31
Strategies	5	11	14	30
Experiential				
Limitations	5	6	7	18
Strengths	2	4	5	11
Location				
Digital/ Virtual	8	13	18	39
Traditional/ Physical			3	3
Totals	77	116	164	0

Appendix H

Word Cloud of Codes

