Case Study

Best practices for communicating complex technological concepts to diverse audiences

Making STEM curriculum more accessible and inclusive to neurodivergent audiences

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Introduction

With an estimated 2.2 million people in India being diagnosed with neurodiversity (according to National Institute of Mental Health and Neurosciences, NIMHANS) and many more yet undiagnosed due to regressive conversations around disabilities on a national basis, it becomes imperative to design and implement coursework structures that enable neurodiverse students to access and succeed in science, technology, engineering and mathematics (STEM) programs, for which our country is lauded internationally. Neurodivergence encompasses a spectrum of cognitive variants such as autism, ADHD, dyslexia and others, presenting both an unique set of challenges as well strengths.

Such students have distinct processing styles which have the potential to contribute greatly to academia, characterized by deep focus, creative thinking and pattern recognition abilities. However, given this diagnostic diversity among students and that neurodivergent students are the fastest growing diversity groups in tertiary education, a majority of post-secondary STEM institutions fail to meet the personal and specific needs of their students. This highlights the incessant need for not only an inclusive framework for higher education in STEM, but also a framework that is co-created with the demography in question, thus promoting co-production in course design and delivery.

A. Sushma's Story : One size does not fit all

Sushma, an undergraduate computer engineering student, was informally diagnosed with ADHD right before moving away to Bangalore from her hometown, for college. While her psychologist agreed that she displayed symptoms of ADHD in adult females, she was hesitant to prescribe anything to her.

'You are doing well in school, so it is not a matter of urgency."

Sushma had not performed very well in her Class 12 boards, but had received decent enough marks to be accepted into a college of her liking. But she had a feeling that she could have done much better in school if she had gotten the help that she needed as a neurodiverse individual. Her teachers always said that she had "great potential" but was "unwilling to work for it". However, she was ready to start a new life with the opportunity that was in front of her.

Sushma always had an inclination towards coding and technology, and she had excelled in this particular course at school. In college, she found the lectures and coursework to be fascinating, but was somehow unable to keep up with the content, even if she put in more effort than her peers. She enjoyed problem solving questions and class-discussion/debates, which her peers were not too fond of. Instead, her central challenge by the first-half of her first semester was retaining her attention when the lectures were theory-heavy and fast-paced, and keeping up with assignments during submission weeks, and constantly feeling exhausted and burnt-out. The presentations prepared were also simply text on a slide, which made the information difficult to grasp for her, as she is a visual learner. Sushma decided to confide in her professor about these issues.

'I understand Sushma," said the professor. "And I am very sorry that you are going through this, but computer engineering courses are always designed like this. There is so much ground to cover that there is simply not much else that we can do."

Sushma had gravitated towards coding in the first place due to the patterns that she could trace and the problems that could easily be solved by code. She was also interested in the different social discourses surrounding technology and coding. However, these topics were hardly addressed in class.

She resorted to simply copying her written submissions off online sites, and found that she was doing little learning due to this. There was little creative or cognitive input that she could add to the assignments, and it made the work feel unproductive. Her grades in the mid-semester exam also suffered greatly, as she found that memorising material from the dense presentations that

professors uploaded was a tiring and monotonous task. Her parents had brushed off her concerns, blaming her for not studying hard enough, so she decided to confide in her roommate.

While her roommate, Karishma, was a good listener, there was little that she could do to help. “You could try making your own visual infographics using the notes made in class,” she suggested, unaware that Sushma already had difficulties with listening and taking down class notes simultaneously, as writing hindered her ability to absorb the information. “You could also try working in advance, so you did not have to overwork yourself right before deadlines.”

Sushma sighed. Karishma had her best interests at heart, but none of this advice helped her. Sushma did not feel motivated to work unless she was under pressure, which caused her to burn herself out often. Even though she was passionate about the subject, maybe this was not the course for her, after all.

Synopsis : Case of STEM course framework being non-inclusive of neurodivergent minds and unique learning styles, leading to a gap in education and success.

Keywords : Inclusivity; curriculum planning; neurodivergence; STEM education.

Learning Objectives :

- Identifying the non-inclusive nature of STEM coursework and teaching practices
- Understanding the diverse nature of the audience and their distinct learning styles that remain largely unaddressed.
- Evaluating the nature of STEM coursework, and its general lack of learner-centric approaches.
- Proposing revisions and strategies to widen the scope of the course, and thus, broaden the demography of learners that it successfully targets

Discussion Questions :

- What were the major gaps between the already existing coursework and Sushma’s processing style?
- How can the unique sensibilities of neurodiverse audiences be used to bring fresh perspectives to complex technological subjects?
- What changes, without redoing the entire curriculum, can be brought into the coursework which makes it much more inclusive?

- Apart from neurodiverse students, will these changes positively impact other students as well? How?
- Apart from the difficulty in communication, how else does the current pattern of coursework do a disservice to individuals like Shushma?

B. Teaching Note

Case Overview

Sushma, an undergraduate STEM student, faces immense challenges with coursework due to the one-dimensional nature of it. The coursework does not highlight any of her unique abilities, but instead focuses on a mainstream style of learning, disadvantaging neurodiverse students greatly, While the dense and complex nature of a STEM course is undeniable, certain normative delivery methods of the content itself makes the coursework hard to grasp by certain demographics. Even after Sushma seeks help from faculty, she is unable to receive any constructive method to improve her condition. Her peers, who are not formally sensitised to neurodiversity are also not able to help her through the debacle, only reiterating advice that does not benefit Sushma. Conclusively, Sushma is left feeling dejected and inferior to her peers due to the communication and education gap.

Learning Objectives

1. **Accepting that STEM courses have room for inclusion -** Students should look at STEM coursework objectively, and try and analyse how it may purports normative teaching styles that are not applicable to every individual
2. **Identifying gaps in inclusive education -** The case emphasizes on the set of skills that its protagonist possesses, but is not employed by the existing coursework. Discussions on how such gaps can be addressed will lead to holistic modifications made in the existing coursework.
3. **Proposing inclusive education strategies -** Students will be asked to develop strategies to enhance the existing STEM curriculum and analyse teaching and assignment choices, suggesting how they can be opened up for a wider set of knowledge systems and processing styles.
4. **Sensitisation towards disability and neurodiversity -** Students should develop a consciousness of the disabled and neurodiverse who occupy the same spaces as them instead of viewing them as others, thus calling for action to make these spaces more occupiable for the marginalised.

Discussion Questions

1. **What are major gaps between the coursework and Sushma's processing style?**
   This question invited students to analyse the key breakdowns of the coursework that led to Sushma's disengagement from it. Students should identify the

normative knowledge systems, teaching practices and assignments that led to a lack of clarity and achievability on Sushma's part.

2. **How can the STEM coursework be modified to include the diverse range of inputs that neurodiverse audiences can bring to it?**
   The focus here should be on Sushma's interests and learning alignments, and how they can bring about unique and fresh perspectives to a saturated curriculum. Students should consider the addition of problem-solving discussions, creative assignments, audio-visual or practical engagements, et cetera.

3. **What are the benefits of a more learner-centric approach for other students as well?**
   Students can draw from their personal experiences and anecdotes and propose practical benefits that a more inclusive curriculum and personalized teaching methods for complex technological education could bring for all. They should consider existing limitations that even non-neurodiverse students face on an everyday basis, and how, along with a more inclusive approach to curricula, a seminal change in the way education works can be implemented as well.

4. **How does the current course plan do a disservice to individuals such as Sushma?**
   This question should encourage students to think outside of their normative values and develop sensitivity towards neurodiversity and disability. They should think critically not only of normative value systems but also of their everyday interactions and how they, as individuals, can personally foster inclusivity.

Key Teaching Concepts

1. **Inclusivity in normative knowledge systems :** This case illustrates the reality of many individuals around the country, and how simple structural faults can escalate to disadvantaged learning and education.
2. **Rethinking STEM curricula :** The case explores the complexities of institutional values and lived experiences, and urges to rethink how complex technological education should be rethought to cater to a broader audience.
3. **Balance between normative and alternative knowledge systems :** Not discarding existing systems entirely, but urging for it to be radically rethought in order to cater to diverse student demographics could lead to holistic education.

4. **Sensitization and awareness :** The case challenges normative understandings of knowledge production, asking students to think differently about how they think of education and learning from a marginalised, nuanced positionality.

Teaching Approach and Methodology

- **Case Discussion :** Begin by asking students to analyse the case and the failures of the current STEM coursework, and identifying the key challenges that were faced by Sushma. Use the questions to guide the discussion forward.
- **Group Work/ Breakout Session :** Have students break into small groups and propose solutions to the issues outlined in the class.
- **Peer Feedback :** After proposing solutions, students can provide feedback on each other's approaches, which will encourage critical thinking and refine coursework changes and discussions on inclusivity.
- **Wrap-up :** Conclude by discussing the long-term implications and take-aways from the case. How does adopting inclusive methods towards STEM coursework benefit everyone in the long run?

Additional Resources

- **Inclusivity and inclusive practices :** The case can also be a framework to rethink the world and education spaces as varied and multiple.

Conclusion

This case highlights the regressions and limitations still present in STEM courseworks, and invites audiences to critically engage with discussions about diversifying complex technological education for disabled and neurodivergent audiences. Sushma's experience is the lived experience of many STEM students across the country, and shows how pertinent it is to diversify and broaden the range of our normative educational practices and communicative techniques that we often take for granted.

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