Sustaining Learner Engagement: Integrating Project-Based Learning & Cross-Cohort Approach

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Abstract— Effectively teaching students presents unique challenges in sustaining their engagement and promoting meaningful learning experiences. This paper presents project-based learning (PBL) employed in an 'Instructional Systems Design' course offered at the Indian Institute of Technology Bombay. Individuals with different levels of prior learning experience were brought together as a cross-cohort group in the course. The study features instructor actions and learning activities in fostering cross-cohort collaboration and engagement. Quantitative and qualitative analysis was conducted on various data sources, including survey responses, classroom observations, participation in learning activities and the final project output, to evaluate learner engagement. The learners expressed a positive perception of the cross-cohort teaching-learning approach, with 77.8% of survey participants (n=18) agreeing that they benefited from peer learning during their interactions. Content analysis of participants' responses revealed three major motivating factors for learners: teaching methodology, multi-cohort interactions and PBL. The analysis of participant involvement revealed a high level of engagement throughout the course, as evidenced by the submission of 125 entries (N=26) in a non-graded activity. The cross-cohort team successfully developed an impactful website. A significant majority (88.9%) of learners expressed agreement that the class activities associated were particularly rewarding in terms of their overall learning experience. These findings contribute to our understanding of the effectiveness and benefits of cross-cohort interactions in a higher education classroom. Moreover, the study presents an effective approach that integrates PBL and cross-cohort approach, providing implicit recommendations for instructors seeking to enhance learner engagement and involvement across diverse cohorts.

Keywords—Project-based learning, cross-cohort interactions, learner engagement, effective teaching, higher education

I. INTRODUCTION

Effectively teaching students, especially within the context of higher education, entails specific challenges in maintaining their engagement and fostering meaningful learning experiences. In this advancing digital era, traditional teaching methods may not effectively sustain learner engagement. Literature emphasizes the importance of innovative teaching in higher education, considering the rapid developments in ideas of knowledge, the role of educational technologies, and the evolving needs of students [1, 2].

Instructors must continually adapt and develop new strategies that not only capture learner engagement but also ensure effective learning in the classroom [3]. This paper aims to present a strategy used by an instructor from the Interdisciplinary Programme in Educational Technology (IDP-ET) at the Indian Institute of Technology Bombay. While teaching an Instructional Systems Design (ISD)

course, the instructor aimed at creating a balance between meaningful learning experiences and enhanced engagement. Here, we exhibit the integration of project-based learning (PBL) and cross-cohort approach, where individuals with different levels of prior learning experience from various cohorts are brought together as a cross-cohort group. Since the offering of project-based courses is common, the paper sheds light on the exploration of integrating the two approaches to enhance the learning experience.

The study goes beyond demonstrating the result findings by featuring specific actions taken by the instructor as practical suggestions for researchers and practitioners seeking to enhance learner engagement across diverse cohorts. Overall, this paper contributes to the ongoing discourse on innovative teaching practices in higher education, providing a tangible example of an instructor's approach to fostering engagement and meaningful learning experiences in an ISD course.

II. LITERATURE REVIEW

A. Project-Based Learning

Educators are constantly seeking methods to improve the engagement and learning of their students. PBL emerges as a promising approach that is being explored in conjunction with few other methods to foster learner engagement and transform learning into a more active student-driven experience [4]. One of the studies examined the effectiveness of using wikis for PBL in higher education across three disciplines [5]. While students mostly held a positive attitude towards the use of wikis for PBL, the level of participation on wikis varied among students of the three disciplines which was influenced by their previous learning experiences, technical backgrounds, etc. New active learning tools are also being investigated to enhance the PBL approach. A study investigated the integration of design sprint (DS) and PBL in teaching software engineering, specifically emphasizing user experience [6]. The results highlighted the positive impact of DS on student learning, emphasizing the importance of innovative techniques and prioritizing user experience in project-based software development.

B. Cross-Cohort Projects

A cross-cohort group refers to teams where the experience levels and specialities of the members are diverse [7]. Although the number of studies on the cross-cohort teaching-learning approach is limited, it is recognised that subjecting students to a cross-cohort project is one way to introduce them to a dynamic team with different knowledge and experience levels. One of the recent studies showed implementation of a cross-cohort

project in mechanical engineering where 2nd and 3rd year students collaborated on designing and analyzing a pick and place mechanism. Over half of the students (51%) had a positive impression of the cross-cohort project structure, and 85% of students considered it an effective way to apply course concepts [7]. Another article reported collaboration of academicians from diverse disciplines and multiple student teams to research and develop a note-taking tool, resulting in satisfying and thought-provoking learning experiences [8]. A similar study presented an undergraduate software engineering project where student teams from different cohorts also developed a note-taking app for academic clients at their university [9]. The study explored the benefits of student-staff collaboration, and addressed the challenges of multicultural teams with some recommendations to make the most of such projects.

In light of the existing literature that explores PBL and cross-cohort projects to an extent, our study aims to examine learner engagement on integrating the benefits of both approaches, specifically in the context of a higher education classroom. Specifically, we will investigate how instructor actions facilitate engagement of different cohorts in a project, considering their diverse knowledge and experience levels. Our study intends to enhance the understanding of the benefits and effectiveness of cross-cohort teaching-learning approach through PBL.

III. PEDAGOGICAL DESIGN

A. Goals of the Course

The ISD course was offered using the PBL approach among the cross-cohort group, with the following learning goals.

- To understand and apply the foundational concepts, principles, models, and theories that underpin effective instructional design practices.

- To apply the instructional design practices in a real-life project of creating 'Persons with Disabilities (PwD)' website for sensitizing the Institute community, while benefiting from the diverse experiences of the cross-cohort group.

- To promote learner-centered design, focusing on the needs and preferences of the target audience by seeking regular feedback from varied stakeholders.

- To understand the ethical responsibilities of instructional designers, including issues related to accessibility, copyright and data privacy, drawing on the collective experiences of the group.

By conducting the course as a cross-cohort group, the learners were provided with an opportunity to collaborate, share insights, and leverage the diverse expertise within the team to enhance the learning outcomes and the quality of the instructional materials developed.

B. Instructor Actions

The intervention focused on nurturing learners' engagement, fostering opportunities for meaningful learning and supporting a collaborative learning environment that surpassed traditional grade levels. The instructor's actions involved in this approach were categorized into three primary components, namely cultivating initial enthusiasm for the course, creation of meaningful learning activities and supporting cross-cohort collaboration and engagement (Fig. 1).

1) Cultivating initial enthusiasm for the course: This began with a strategic approach where the instructor first identified the multiple cohorts who could contribute to and benefit from the course at different levels. These cohorts, layered into 3 categories (Cohort X, Y and Z ranging from 1st year students to postdoctoral fellows) were envisioned to bring in a richness of perspectives and experiences to the learning environment. The instructor clearly defined the benefits tailored to each cohort in a powerpoint presentation and effectively communicated the same through an email to all. Through articulation of advantages in a compelling manner, participants could understand the value they would gain through the course. Equally important was respecting participants' autonomy by refraining from excessive follow-ups. The instructor provided individuals with the freedom to make their own decision to either engage or abstain from enrolling in the course.

2) Creation of meaningful learning activities: The instructor took several proactive measures to design and facilitate meaningful learning activities. The evolving interests of different cohorts were realized by providing a dedicated online writing space, which was called Homework 0 and has been elaborated further in the next subsection. Here, the participants could express their learning preferences and ensure course content relevance.

Learning activities were designed, striking a balance between the learners' interests (as identified from Homework 0) and the intended goals of the course. By incorporating elements that appealed to the participants' individual motivations, the activities were designed to be more relevant and engaging. Tasks were broken down into manageable learning objectives aligned with pedagogically appropriate learning activities. These activities encouraged critical examination and were open to diverse and valid perspectives from multiple cohorts.

3) Supporting cross-cohort collaboration and engagement: A key strategy that the instructor employed to support cross-cohort collaboration and engagement was the inclusion of a high-significance class project, inspiring a sense of purpose and commitment. The project here encompassed creation of a PwD website to sensitize others to four specific disabilities in the context of the Institute, and providing guidelines for inclusivity.

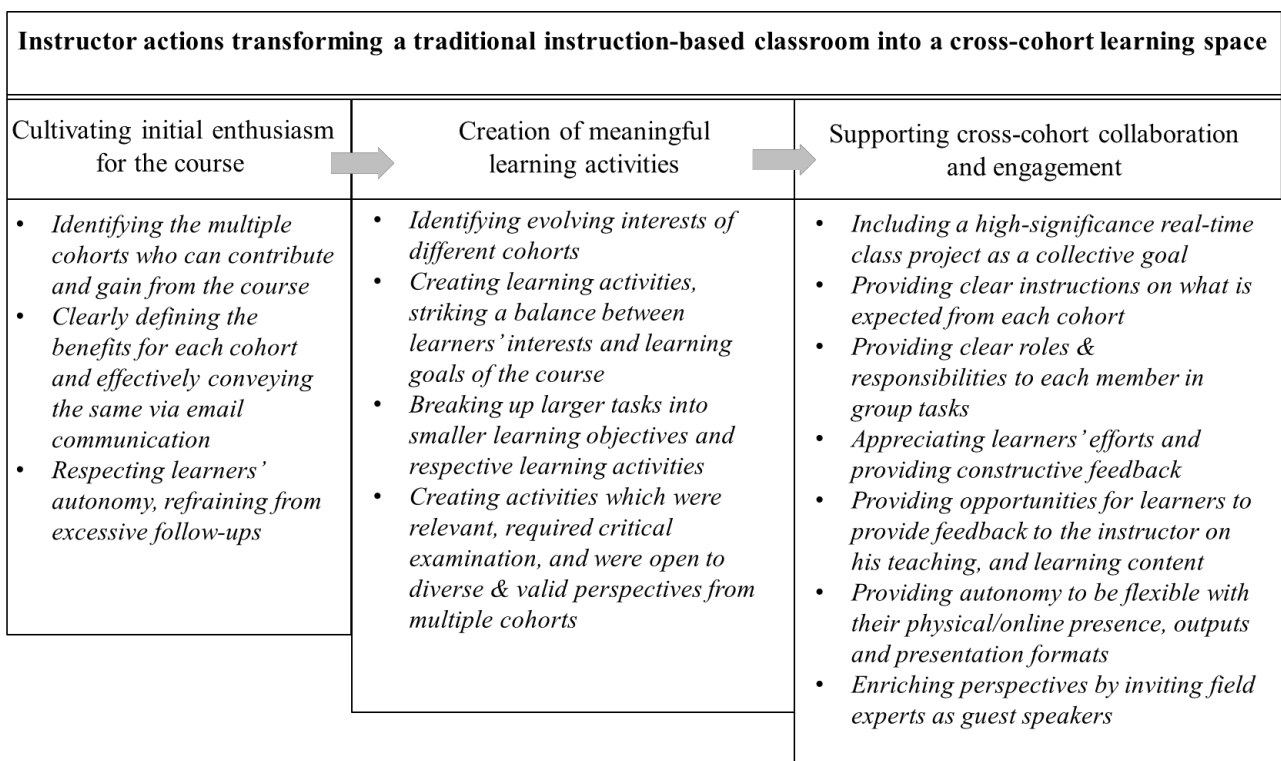| Instructor actions transforming a traditional instruction-based classroom into a cross-cohort learning space		
Cultivating initial enthusiasm for the course	Creation of meaningful learning activities	Supporting cross-cohort collaboration and engagement
• *Identifying the multiple cohorts who can contribute and gain from the course* • *Clearly defining the benefits for each cohort and effectively conveying the same via email communication* • *Respecting learners' autonomy, refraining from excessive follow-ups*	• *Identifying evolving interests of different cohorts* • *Creating learning activities, striking a balance between learners' interests and learning goals of the course* • *Breaking up larger tasks into smaller learning objectives and respective learning activities* • *Creating activities which were relevant, required critical examination, and were open to diverse & valid perspectives from multiple cohorts*	• *Including a high-significance real-time class project as a collective goal* • *Providing clear instructions on what is expected from each cohort* • *Providing clear roles & responsibilities to each member in group tasks* • *Appreciating learners' efforts and providing constructive feedback* • *Providing opportunities for learners to provide feedback to the instructor on his teaching, and learning content* • *Providing autonomy to be flexible with their physical/online presence, outputs and presentation formats* • *Enriching perspectives by inviting field experts as guest speakers*

Fig. 1. The figure illustrates the instructor's actions, categorized into three primary components.

Clear instructions and expectations from each cohort kept learners focused and motivated. While assigning new learning activities, the instructor provided answers to questions, such as: How much time will it take? Why should I do this? How do I do this? What aspects should I write about? For group tasks, clear roles and responsibilities were assigned to each cohort, promoting collaboration and accountability. This structure empowered individuals to contribute meaningfully and fueled their motivation to persist. The instructor regularly appreciated learners' efforts and offered constructive feedback for improvement. Moreover, the instructor actively asked for feedback from the learners regarding his teaching methodology, and the relevance of course content through Homework 0 reflections as well as quick surveys conducted in the classroom. By valuing their input and actively incorporating their suggestions, the instructor engaged and supported learners.

The instructor also embraced flexible classroom presence, accommodating both physical and online attendance where active learning was prioritized in the hybrid mode as well. The learners had significant freedom in creating their project outputs, allowing them to explore and express ideas in unique ways. This autonomy fostered a strong sense of ownership and pride in their work, motivating them to excel. Lastly, the instructor enriched the course perspective by inviting field experts as guest speakers, who shared their knowledge and experiences, providing valuable insights and engaging learners by showcasing the real-world applications and significance of the course.

C. Learning Activities

Utilizing PBL and cross-cohort interactions in the classroom, the instructor integrated diverse learning activities to enhance the course experience.

- *Homework 0*: Throughout the duration of the course, the instructor offered participants a designated Google doc space called Homework 0. This ungraded writing activity served as an avenue for learners to express their expectations, desired learning outcomes, and provide feedback on what they liked or disliked about the course. Additionally, learners benefited from reading about others' perspectives and reflections, enhancing their overall learning experience.

- *Group activities:* To collectively achieve the goal of completing the website creation project in the course, the larger tasks were divided into smaller ones, and assigned to multiple cross-cohort groups. Group sessions were conducted during class time to brainstorm ideas, which were then implemented as assignments outside of the class hours. Each group, with 5-6 learners, was a mix of expertise, including Cohort X, Y and X which fostered a dynamic exchange of fresh ideas and experience, benefiting all participants involved. In these group activities, distinct roles were assigned to each cohort. Cohort Z (senior cohort) contributed their valuable experience and expertise, offering guidance and insights without aggressively imposing their ideas. Cohort X (junior cohort) brought a fresh perspective and innovative ideas to the table, offering creativity and novel approaches. Cohort Y (mid-level cohort) contributed a balanced mix by combining their experience with actively assisting Cohort X in exploring proposed techniques, fostering a collaborative and stimulating environment within the group.

- *Constructive discussions:* The instructor employed a range of active learning strategies, including

think-pair-share, each one say one, reflection exercises, debates, etc. to cultivate constructive discussions in the classroom. An example of such an activity was "Pin the Instructor" which was an optional learning exercise. Participants from Cohort X and Y were encouraged to trap the instructor in a contradiction by posing challenging questions related to the course content. Cohort Z, on the other hand, was tasked with helping the instructor navigate and address these traps during class discussions. The activity, which led to significant discussions and learning in the classroom, was conducted just before the mid-semester examination with an intention to serve as a revision opportunity for learners to revisit the course content. Such discussions also facilitated the incorporation of diverse perspectives, coming in from multiple cohorts, when making project decisions, resulting in rich and valuable learning experiences.

- *Presentations and feedback:* Groups presented their respective work in the class at every project milestone. Cohort X was assigned the responsibility of delivering the presentation on behalf of the cross-cohort group, aimed at enhancing their presentation skills and fostering their ability to seek feedback and respond to questions. These sessions were scheduled at regular intervals throughout the course to share their progress on different aspects, such as instructional materials, initial drafts of the web page structure, findings from usability studies, and other relevant milestones. This allowed for a valuable exchange of ideas, where the group received feedback and suggestions from both their peers and the instructor. The cross-cohort groups were able to provide feedback to teams beyond their own, fostering a collaborative learning environment. Hence, the sessions facilitated constructive criticism, offered suggestions for improvement, and encouraged the exchange of varied viewpoints.

IV. METHODS

A. Research Question

The aim of this study was to create an engaging learning experience through PBL among a cross-cohort learner group, transcending hierarchical boundaries. Thus, the following research question was investigated in this study: How does the instructor's pedagogical design support effective integration of PBL and cross-cohort teaching-learning approach to engage diverse cohorts?

B. Participants

The ISD course was offered as a credit course in the IDP-ET for all first year students in Spring (January-April) 2023. However, the course was also participated by other cohorts playing different primary roles in the course (Table 1). There were 8 first year MTech and PhD students (Cohort X), 12 PhD students from 2-4th year (Cohort Y), and 6 learners including 5th year PhD students and postdoctoral researchers (Cohort Z).

TABLE 1: COHORT PARTICIPATION IN ISD COURSE

Cohort	Participant Information	Primary Roles
X (n=8)	Ist year MTech & PhD students	Learning technical concepts and exploring new ideas through application of disciplinary practices
Y (n=12)	2-4th year PhD students	Supporting Cohort X in application of idea through their previous knowledge
Z (n=6)	5th year PhD students & postdoctoral researchers	Mentoring the group and providing directions to think about without thrusting their own ideas

C. Data Sources and Data Analysis

The data sources of this research came from a survey questionnaire administered in the classroom to evaluate engagement, classroom observations, and the analysis of Homework 0 and final project output created by learners (Table 2).

To design the survey questionnaire, we reflected on the purpose of our research, and focused questions towards understanding learners' engagement and experience in the course. There were a mix of questions (five multiple-choice and six open-ended questions) related to general interest in the class, class activities, project work and cross-cohort interactions. The multiple-choice questions (MCQs) were evaluated on a 5-point Likert scale followed by an open-ended question on each of them. To illustrate, some of the questions that were a part of the survey were:

- I look forward to attending the ISD class (MCQ). Please provide evidence or reasons to support your answer.
- I find the class activities rewarding in terms of experience (MCQ). Please provide evidence or reasons to support your answer.
- I am learning from others during cross-cohort interactions (MCQ). How is this interaction mechanism different (better/worse) than interacting with your own classmates?

The study used two types of data analysis: quantitative and qualitative. The quantitative data was examined by performing frequency analysis of data from the Likert scale to yield percentages. Qualitative data analysis was conducted on the responses collected from the participants to examine their engagement with the course. Inductive thematic analysis [10] was conducted to understand their perceptions, involving open coding and subsequent frequency analysis of categorized responses. The analysis involved identifying the emerging themes and patterns from the data without pre-established categories. The study also utilized classroom observations to monitor a few key aspects. Specifically, the classroom observation protocol was limited to identifying the specific cohort of the learner, tracking daily participant attendance, as well as monitoring their consistent entries and active engagement in Homework 0 space. Furthermore, Homework 0 analysis of reflections was performed to evaluate their level of engagement with the task.

A wide range of stakeholders, including students, faculty members and external organizations with expertise in the field of PwD, were invited to provide feedback on the project outcome. An in-depth analysis was conducted to evaluate the project output, considering user experience studies, audience relevance and stakeholder feedback to gain valuable insights on the quality and its alignment with the project goals.

TABLE 2: DATA SOURCES FOR EXAMINED FACTORS

Data Sources	Factors Examined
Classroom observation Survey questionnaire	Cross-Cohort Learning Benefits
Classroom observation Survey questionnaire Homework 0 analysis	Participant Perspective and Involvement
Final project analysis	Project Outcome

V. RESULTS

A. Cross-Cohort Learning Benefits

The course (N=26) had a mandate for only 8 first year students; however, the proposed cross-cohort approach enthused 18 (69%) learners from other cohorts to commit to the course. 77.8% of the survey participants (n=18) agreed that they learnt significantly from others during their cross-cohort interactions. Below are some examples of responses obtained from participants representing Cohorts X, Y, and Z, highlighting the benefits of cross-cohort learning in the course.

- Cohort X: "Interactions in ISD class include senior students, postdocs and the instructor. Their contributions to the discussions are always enriching. Discussions with classmates are of course fruitful but such cross-cohort discussion leads to more learning."

- Cohort Y: "It brings specific dialogues or conversations from different places and time (courses that were attended in different years or projects where I did not participate)."

- Cohort Z: "For me interacting with juniors has always been useful, they ask questions that make me reflect on my prior knowledge more deeply."

B. Participant Perspective and Involvement

Despite the absence of an attendance policy, the classroom witnessed a minimum of 80% (N=26) attendance in all classes. Content analysis of participants' responses identified four distinct categories of factors that motivated their participation and engagement in every class. Fig. 2 displays the frequency distribution for each category. To provide insights into the learners' perspectives, below are the definitions of the emerged themes along with examples of learner quotes for each category.
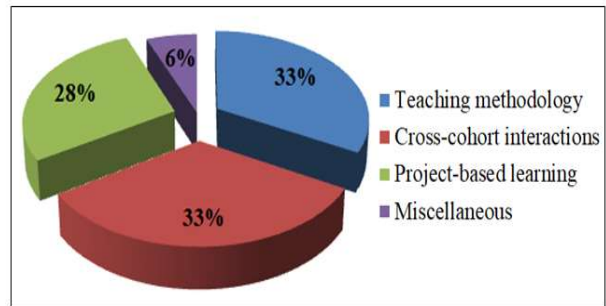
Fig. 2. Factors that helped sustain learner engagement in the course.

1) Teaching methodology: The responses (33%) regarding teaching methodology indicated explicit mention of the approach and strategies employed by the instructor to introduce new concepts, facilitate discussions, orchestrate class activities in order to shape the learning path.

"I am interested to know how the understanding of concepts in the class will shape the training module. How is the lecture designed for the day e.g. what activities, what sort of discussions among students, etc. Homework 0 is discussed in the class in some form either as a muddy point or some activity. This leads to deeper reflections."

2) Cross-cohort interactions: The responses (33%) regarding cross-cohort interactions referred to the dynamic and engaging discussions, non-formal structure that characterize the learning environment, and how it helped in meaningful exchange of diverse perspectives.

"Helps me notice shared assumptions and conceptions about loosely defined terms and have real-world contextual discussions. Also because of the diversity in opinions and perspectives, and the space allowing for free flowing expression/engagement."

3) Project-based learning: The responses (28%) regarding PBL referred to the interesting and challenging nature of the class project.

"It is lively. Project is interesting and challenging."

4) Miscellaneous: The miscellaneous responses referred to random comments, such as credit, that did not align with any specific theme.

The analysis of participant involvement in learning activities revealed that the non-graded Homework 0, designed to encourage post-class reflection, witnessed high engagement. This was evident through the active participation of 26 learners, who collectively submitted 125 reflection entries throughout the course period. Moreover, the considerable word count of 26,999 within these entries indicated the participants' motivation to express thoughtful reflections, emphasizing their engagement with the course. To exemplify the profound extent of introspective reflections from Cohort X, two learner quotes have been presented below.

"I liked how a lot of different instructional strategies like writing down our reflections alongside in the slides itself and discussing their significance, Think-Pair-Share, pointing out to the need for writing down our thoughts to reduce cognitive load, etc. were used in the ISD class itself. Besides, the use of an inductive approach, that is letting us

write an instructional plan first and only in the end introducing the corresponding ADDIE model was very useful to actually understand the model and not just remember its steps in a row. So I just felt that we were actually able to observe and feel the use/implementation of different ISD strategies during the class instructional process only."

"One can be mindful of the learning objectives during the class by being aware of the 'hat' they are wearing. Interactions with Prof. Swati Pal highlighted an important aspect regarding the project goals, which was the temporal aspect, i.e. short and long term goals (or goals that can be implemented in the near future vs. long term goals). While brainstorming on the solutions, the form of the solution is also an important factor, in the context of Instructional Design, it can be either a series of videos, posters, websites, etc. Receiving critique on ideas at a nascent stage is a new experience."

As evident above, learners actively engaged in post-class reflection, not merely as a task but as a transformative learning experience. Their thoughtful entries in non-graded Homework 0 revealed a journey of self-discovery and understanding. The terms 'observe' and 'feel,' used by learners, encapsulate this introspective process, allowing them to bridge theory and practice, gaining profound insight into the process of instructional design. This experience deepened their understanding and elevated their engagement with the course, highlighting the effectiveness of the instructor's pedagogical approach. Moreover, as evident through the second quote, this introspective approach encouraged students to be mindful of the learning objectives and the various roles they play in the learning process.

C. Project Outcome

One of the learning goals of the ISD course was to apply the instructional design principles to create a PwD website for sensitizing the Institute community. The cross-cohort interactions played a crucial role in utilizing their diverse perspectives and experiences when making important decisions during the creation of this highly significant project. The course team, consisting of Cohort X, Y, and Z, collaboratively developed a website addressing the needs of PwD in the context of the Institute (https://sites.google.com/view/iitb-pwdcell-training/). This website encompassed various components, including videos, scenario-based learning activities, reflection questions with feedback, guidelines, posters, etc. (Fig. 3).

While it was important to achieve the learning goal by completing the project, equal emphasis was placed on assuring the quality of the output within a practical context. Along with the feedback received from the instructor and cross-cohort groups, the website also underwent comprehensive user studies and received valuable insights from various stakeholders to ensure its alignment with the needs and standards of the field. Besides, the project's successful completion resulted in a highly positive learning experience for the course participants. 88.9% of the survey participants (n=18) expressed agreement that the class activities associated with the project were especially rewarding for their overall learning experience. As evidence, the team created an impactful website, subsequently handed over to the PwD Cell of the Institute

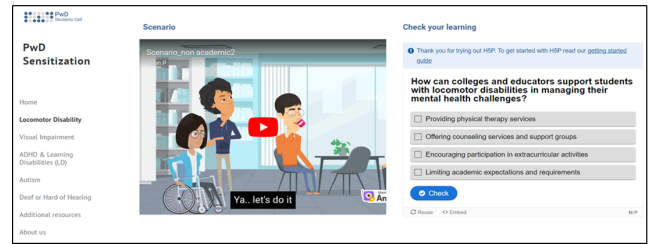for further enhancements and eventual hosting on their official platform.

Fig. 3. A screenshot of a scenario-based learning example from the PwD website

VI. DISCUSSION

In the context of higher education, the need for innovative pedagogical approaches has become increasingly evident [1]. While the individual benefits of PBL and cross-cohort interactions are recognized, there is much less research that investigates effective integration of these strategies in the higher education classroom, and its impact on learner engagement. Literature suggests that the quality of teaching holds the greatest influence on the quality of student learning [11]; therefore, the pedagogy employed by the instructor in any new context assumes paramount importance. Based on the results, the effective integration of PBL with a cross-cohort approach was evident, resulting in high learner engagement, positive impact on their learning experiences, and the successful creation of a meaningful website for sensitizing the Institute community about PwD. In addition, the study offers practical insights for instructors aiming to enhance learner engagement and create a more inclusive and dynamic learning environment.

Learner engagement was evaluated through survey responses, classroom observations, participation in learning activities, and examination of learners' final project output. The course drew a diverse group of participants, with 69% falling in Cohort Y and Z, indicating the cross-cohort approach appeal. 77.8% of participants acknowledged learning from others through these cross-cohort interactions. Testimonials from different cohorts emphasized the role of these interactions in their learning experience. This is in agreement to a previous study which reported inter-cohort connections as an important experience for learners [8]. Participants' engagement in the course was evident through their consistent attendance in the class even without an attendance policy. Teaching methodology, cross-cohort interactions and PBL were identified as factors that helped sustain learner engagement in the course. The pedagogical design, presented here, exhibits how instructor actions can support the cross-cohort collaboration and engagement in this integrated learning approach. Active participation in non-graded Homework 0 reflected participants' motivation to express and actively engage with the course. The cross-cohort course teams successfully developed a Project website, which was subsequently handed over to the Institute for eventual hosting on their official platform.

Interestingly, pedagogical innovation is considered as a process rather than an outcome and innovative teachers as people who engage in that process [1]. Through this ISD course, the instructor engaged in one such process by combining the benefits of PBL and cross-cohort teaching-learning approach. The course enabled the learners

to apply course concepts to develop a real-life project and experience the advantages of collaborating with diverse cohorts. Our study on the widely offered ISD course contributes to the existing literature by providing empirical evidence and insights on the effectiveness of integrating these approaches, fostering collaboration, knowledge sharing, and enhancing learning outcomes among diverse learners.

At the same time, the study's limitations, such as a small sample size of 26 participants and the absence of a control group, restrict the generalization of the findings to a broader context or population. To address these limitations and advance our understanding on the topic, future research with expanded scope and a substantial sample size is warranted.

In conclusion, this study represents an important initial step in demonstrating the effectiveness of implementing PBL with a cross-cohort teaching-learning approach in the context of a higher education classroom. The findings offer valuable insights for designing future courses that prioritize engagement and impactful learning experiences for learners.

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