Integrating the Autism Spectrum Disorder Student in the Architectural Studio Classroom

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ABSTRACT: Higher education's student population is growing more diverse, incorporating neurodivergent individuals such as autism spectrum disorder (ASD) students. Factors contributing to this trend include heightened awareness of learning differences, improved diagnostic processes for ASD, implementing enhanced individualized learning plans, and adopting more effective special education practices. Architectural education is no exception. The creative and collaborative framework fostered in architectural education, particularly in programs based on problem-based learning (PBL) pedagogy, presents critical challenges and opportunities for ASD students. This work examines such challenges and opportunities by considering all stakeholders involved, i.e., ASD students, their colleagues, and instructors. Through literature review and interviews conducted at Aalborg University (an institution that uses PBL), this work maps ASD symptomatology, ASD students' needs, the opinion of a mentor of mentally impaired students, the challenges and ad-hoc strategies used overall in higher education in general and by architecture and design faculty. Additionally, the paper presents the results of a small experiment conducted with architecture students without ASD that exposed them to an aural environment that emulates ASD-related auditory hypersensitivity. The paper articulates the different collected information to reflect on PBL adequacy in teaching ASD in architecture programs, the effectiveness of current practices, the impact of environmental factors (e.g., space, aural environment) in this population, and outlines potential pedagogical strategies for this student population in an architectural studio setting.

KEYWORDS: Architectural Education, Problem-based Learning, Pedagogy, Autism Spectrum Disorder, Inclusivity and Diversity

INTRODUCTION

The student population in higher education is becoming increasingly diverse in terms of social and cultural backgrounds and ethnicity. This phenomenon also applies to students with cognitive impairments, such as those placed with autism spectrum disorder (ASD) (Mulder and Cashin 2014). ASD individuals are gaining admission to universities at higher rates due to several factors, including: (i) heightened awareness of learning differences at all educational levels, (ii) improved identification and diagnostic processes for ASD, (iii) enhanced individualized learning plans, and (iv) more effective special education practices (Gobbo and Shmulsky 2014). Architectural education is no exception to these circumstances, as the number of students with high-functioning ASD is increasing in its ranks. The creative and collaborative framework fostered in architectural education, particularly in programs or classes that utilize problem-based learning (PBL) pedagogy, presents both critical challenges and opportunities for high-functioning ASD students (de Groot and Smeets 2017).

This work explores the complex dilemmas experienced by ASD students, their colleagues, and instructors in a PBL environment of an architecture studio class. The main goal is to assess the adequacy of PBL to this student population and outline potential strategies and practices to better accommodate and integrate ASD students without prejudice to other students.

To that end, this work introduces PBL and ASD symptomatology through a literature review. By doing so, it examines the pedagogical challenges (e.g., social anxiety, impaired empathy, and difficulty in top-down creative processes) and opportunities (e.g., adapting to new challenges and motivation) of adopting PBL in teaching architectural studios that include ASD students. It also summarizes best practices for teaching this specific student population at the university level.

Furthermore, this study delves into practical insights through interviews with an ASD architecture student, a faculty member mentoring mentally impaired students, and urban design and architecture faculty. The interviews took place at the Department of Architecture, Design, and Media Technology (CREATE) at Aalborg University (AAU), where instructors use PBL pedagogy in their teaching activities.

The paper also presents the results of a small experiment conducted with architecture AAU students without ASD to enhance their perception of the difficulties faced by ASD students in a studio class context. The experience exposed the students to an aural environment that emulates ASD-related auditory hypersensitivity during group supervision. After the experience, the participants answered a survey that rated their ability to process information, think, and participate in the discussion. They were also asked to suggest changes in the environment (both physical and social) that would facilitate their engagement in the discussion.

Finally, based on the literature, the results of the experience mentioned above, and interviews and surveys conducted by the author, this work discusses the effectiveness of PBL in teaching ASD architecture students, deviations and alignments with best practices, as well as speculates on strategies for a better integration and studio teaching of ASD individuals.

1.0 BACKGROUND

1.1 Problem-based learning

PBL is a constructivist learner approach where students use self-regulated processes to acquire or construct new information (Slavin and Davis 2006). Initially used in medical education, PBL expanded to various fields, including engineering and architecture (Servant-Miklos 2020). Emphasizing cooperation, PBL employs a top-down approach, requiring students to tackle ill-structured problems by decomposing them into manageable subproblems. Collaborative group work is central to PBL, but its pedagogical framework is adaptable to individual work with minor differences, such as discussion being more dependent on dynamics with instructors. This paper refers to work in Aalborg University's architecture program, following the Aalborg model (Servant-Miklos 2020), primarily based on group work described below.

PBL starts with a pre-discussion phase, where student groups address a framed problem in a specific context. First, they try to form a tentative explanation and find relevant learning questions to guide their investigation. Afterwards, the students individually acquire new insights and then reconvene to share and critically assess the application of the new information in solving the problem. The group iterates this process until a satisfactory solution is found (de Groot and Smeets 2017). This process activates prior knowledge, facilitates the discovery and acquisition of new information, and involves active processing (Schmidt et al. 2007). Teacher guidance facilitates, mediates, and provides a scaffold to build knowledge and skills. In sum, PBL is a (i) constructive, (ii) self-directed, (iii) collaborative, and (iv) contextual learning process.

PBL and project work in typical architecture studio courses share significant common ground. In fact, the distinction between PBL and problem-oriented project work, common in architecture, is hazy and subject to interesting debates (Servant-Miklos 2020). Since those debates are not the focus of this work, the author recommends Servant-Miklos (2020) to learn more about the minor differences between the two pedagogical approaches. The main point is that PBL is easily adopted (partially or fully consciously) in architectural studio/project courses, as studio instruction is based on structuring students' activities in solving specific open-ended problems (Alcock, Fisher, and Zmuda 2018).

Some see the self-directed learning process of PBL and its "minimal" guidance as a limitation (Kirschner, Sweller, and Clark 2006). Nevertheless, Schmidt et al. (2007) argue that the constructive principle of scaffolding does not mean that guidance is minimal; it just implements it differently as instructor guidance in formulating the problem, along with regular and consistent supervision, offers students a "scaffold," i.e., a structure that enables the acquisition of new information, knowledge, and skills (Schmidt et al. 2007).

The positive aspects of PBL include: (i) enhanced study motivation for studying and interest in the subject matter, (ii) higher satisfaction with the relationship between all stakeholders, (iii) and with applying knowledge in practice, (iv) improvement of practical, scientific, social and critical thinking skills (Loyens, Kirschner, and Paas 2012), (v) longer term retention of learned material (Schmidt et al. 2012), (vi) improved teamwork and communication skills (Fang 2012), and (vii) faster graduation and lower student dropout rates (Schmidt, Cohen-Schotanus, and Arends 2009).

1.2. Autism spectrum disorder symptomatology

This work focuses on highly functional ASD, as they are the most likely to take a college degree. Highly functional ASD students refer to those who can socialize (to a certain extent), communicate, and are typically considered efficient in handling specific tasks, such as the case of most Aspergers individuals. ASD individuals have severe impairments beyond the social challenges commonly found in this population (Neihart 1999). The following overarching models (Gobbo and Shmulsky 2014) summarize ASD symptomatology:

Mindblindness – or impaired empathy, is the lack of perspective of other people's mental and emotional states and an inability to respond appropriately, hindering ASD individuals from having normal social relationships (Baron-Cohen, Knickmeyer, and Belmonte 2005). Beardon et al. (2009) reported that around 40% of students with ASD express group work, social interaction, and communication with their peers as their biggest challenges. Knott and Taylor (2014) also show that ASD students often see their peers as less conscientious. Such aspects often lead them to execute most of the work by themselves.

Weak central coherence (WCC) – is a type of cognitive disorder that involves overlooking the "big picture" towards a more detail-centered way of processing. ASD individuals have difficulties processing overarching ideas and typically accumulate knowledge incrementally (Happé 2005). WCC hampers such individuals to tackle top-down processes that require inference, synthesis, and argumentation. The reduced generalization hypothesis (RGH) (Plaisted 2001) argues that the reduced ability to process similarity among ASD individuals hampers their ability to generalize information. WCC also explains some of the strengths associated with ASD individuals, including the ease in collecting data, conducting focused analysis, and performing tasks that require accuracy and attention to detail. ASD individuals prefer bottom-up than top-down approaches.

Execution functions – refers to the mental skills that enable individuals to start, stop, and persist at cognitive, emotional, and behavioral goals. They keep individuals motivated and engaged and are essential in planning and monitoring the progress of resolving a problem or fulfilling goals. Execution functions also enable individuals to do conceptual and attentional shifting. ASD individuals struggle with essential execution functions, particularly planning and cognitive flexibility that enables conceptual and attentional shifting. Thus, ASD students often have difficulties with transitions in academic content, tasks, and environment. Unexpected or swift changes can trigger high levels of stress, depression, and anxiety (de Groot and Smeets 2017). Thus, prioritizing, organizing, managing time, initiating and aborting working on projects, quickly shifting between different sources of information or subjects, and planning, especially long-range, are challenging to ASD students.

1.3. Problem-based learning and autism spectrum disorder students

By relating ASD symptomatology to PBL's main constructivist ideas, it is possible to identify several points where the PBL teaching approaches might be aligned or at odds with the characteristics of highly functional ASD individuals.

A central aspect of PBL is collaborative learning, i.e., students cooperate to address a problem (e.g design brief). The aim is that students acquire new information, assimilate, and apply new knowledge by learning and collaborating with their peers. However, mindblindness hampers ASD individuals from socializing and cooperating. Communication deficits also hamper their ability to engage in collaborative learning tasks. Thus, collaborative learning poses a significant challenge to ASD students. Hence, it is necessary to devise strategies to facilitate and engage ASD students in collaboration tasks.

Contextual learning, i.e., acquiring and generalizing knowledge from a specific problem, is central to PBL. Nevertheless, due to WCC and RGH, ASD students have difficulties abstracting, generalizing, and applying knowledge or skills outside the context from which they acquired it. Therefore, this PBL aspect challenges such students and instructors must be aware of it and act accordingly.

PBL often favors top-down approaches (e.g., decomposing problems into easier-to-solve subproblems). Top-down problem-solving requires vital execution functions, such as structuring the problem, prioritizing, planning, initiating/aborting tasks, and articulating different parts of the problem in terms of scope and content. ASD individuals struggle with transitioning due to their limited ability in execution functions (de Groot and Smeets 2017). Hence, ASD students find transitioning in studio work burdensome, heightening anxiety and confusion. Thus, the top-down PBL aspect conflicts with the skill set of ASD individuals.

Given the above, it is reasonable to consider PBL inadequate for ASD individuals. Literature reports that higher ASD symptomatology correlates with increased difficulties in group work, communication, focus shifting, and contextual learning (de Groot and Smeets 2017; Gobbo and Shmulsky 2014). However, ASD students face similar difficulties with traditional pedagogical frameworks (Gobbo and Shmulsky 2014; Knott and Taylor 2014). Contrary to the notion that PBL is unsuitable for ASD individuals, Groot and Smeet (2017) argue that different aspects of PBL are well-suited for them, as follows:

- Although PBL often uses top-down approaches, it also supports collecting information and uses it to construct a whole. These features can provide solid scaffolding to accommodate top-down processing and build a stronger central coherence.

- PBL often delegates to students the tasks of selecting the topic of interest and formulating the problem. Highly functional ASD individuals usually have an abiding interest in specific subjects, which makes them seen by their peers as experts in certain topics. This helps socialization, group work, and motivation for ASD students.

- Although group work is challenging for ASD students, PBL groups are often small, which eases their interaction with peers, fostering familiarity. This encourages active participation in discussions, preventing passivity. Small group settings also provide a secure environment for ASD individuals who benefit from vocalizing thoughts to structure them.

- Commonly, PBL has a strict schedule, with proximal deadlines for projects and exams. Additionally, courses are typically given sequentially in PBL curricula, i.e., one at a time. These features can smooth the ASD difficulties related to some executive functions, such as planning, prioritizing, starting/stopping tasks, and transitioning between learning tasks.

- Although WCC hinders contextual learning, it presents some advantages. First, it often offers clear problems, alleviating frustration and stress for ASD individuals dealing with ambiguity (Gobbo and Shmulsky, 2014). Secondly, PBL facilitates differentiated teaching (Rubenstein et al. 2013), enabling gradual adjustments in context, content, learning issues, and goals, thus providing valuable scaffolding for ASD students. Thirdly, highly functional ASD individuals find motivation in the challenges and practical nature of PBL-formulated problems.

Additionally, the study shows that the Autism Quotient score (AQ-score) is a good predictor of experiencing problems and benefits in PBL. Higher the AQ-score, higher the likelihood for ASD students to experience more difficulties. However, the study also demonstrated that the AQ-score is not a good predictor for student performance. The results showed that ASD students perform well in a PBL environment regardless of their perceived difficulties and benefits. The authors present two main reasons for these findings:

- Perceived problems are experiences and not objective measures. Thus, students reporting group work difficulties don't necessarily perform poorly; it may be a perception rather than a genuine issue. However, dismissing this feeling is unwise, as ASD students are more prone to stress, depression, and anxiety (Sterling et al. 2008).

- The study indicates ASD students accommodate well to PBL challenges. Anecdotal evidence reveals ASD symptoms affect the early years more than the upper years. Additionally, a challenging learning environment supports their growth. Although desirable difficulties might cause discomfort, they also provide positive outcomes, such as grades or the feeling of overcoming limitations. Thus, exposing ASD students to certain challenges prepares them for a post-educational setting.

1.4. Current best practices in supporting autism spectrum disorder students in higher education

PBL desirable challenges support academic growth for ASD individuals but may cause stress and anxiety (de Groot and Smeets, 2017). Mitigating stress causes and providing structure in a self-regulated learning approach is crucial for both ASD and TD students.

Gobbo and Shmulsky (2014) surveyed faculty in a college catering to students with learning impairments, including ASD. While not specifically centered on architectural studios, their broad recommendations are applicable to education in architecture. The study proposes two groups of best practices, as follows:

Provide structure: A way to provide structure is to reduce ambiguity, introduce predictability, and minimize change or abrupt transitions in teaching. For example, previewing the supervision and using routines reduces confusion and facilitates a smoother transition between topics and tasks. These strategies can mitigate difficulties related to executive functions. Using clear and concise language also helps ASD students with WCC-related difficulties. Additionally, providing opportunities for ASD students to exercise their strengths and pursue their interests fosters interest, social integration, motivation, and self-esteem.

Reduce Anxiety: Instructors must identify potential stressors during teaching, staying attuned to students' emotional states, especially noting early signs of agitation. Addressing agitation promptly is crucial, with strategies like adjusting the discussion pace or promoting breaks to reduce sensory stimuli. Engaging in one-on-one discussions with ASD students about potential discomfort aids in quick detection and intervention. Explicitly stating behavioral expectations can assist with mindblindness-related challenges, fostering discussions on individual differences in experience, expression, and learning styles at the course's outset.

The suggested instructional strategies are heuristics derived from experienced instructors with ASD students. These approaches extend beyond ASD individuals and can also benefit TD students facing similar challenges. Therefore, these teaching strategies prove valuable for the entire student population.

2.0 METHODS

To assess the practice of teaching ASD architecture students in a PBL context, the investigation departed from the literature review by adopting the following approaches and tasks described below.

Interviews: The author held interviews with an AAU ASD student and with an AAU teacher in architecture who is a mentor to students with mental disorders. The interview with an ASD student aimed to identify the difficulties, needs, and benefits experienced by such students in a PBL setting, as well as their coping strategies. The interview with the faculty mentor aimed to provide insight into the role of the mentor in supporting students with mental impairments in a university that uses PBL as its main pedagogical framework. Although their anecdotal nature, both interviews provide a valuable perspective of an instructor/mentor and an ASD student in an architecture program based on PBL.

Questionnaire/Survey: This task consisted of a questionnaire that aimed to survey the pedagogical strategies used by the current faculty of the architecture, urban, and industrial design sections in CREATE at AAU in addressing the inclusion of ASD students in studio classes based on PBL.

Studio supervision experiment: This experiment simulated auditory hypersensitivity, an ASD symptom, among TD students of the Architecture master's program at AAU. They experienced a sound clip emulating how ASD individuals perceive the aural environment during a project group supervision. Exposed to auditory overstimulation for approximately 2 minutes, students engaged in discussion or presented their work. The sound clip was based on videos from the Interacting with Autism research project (Harris and Kinder 2015). Following the experience, students anonymously rated their ability to process information, think, and participate using a Likert scale. They also shared feelings and suggested actions to enhance supervision accessibility. The goal was to increase awareness and empathy for ASD colleagues while involving students in creating a more inclusive environment by proposing changes in supervision structure and the physical and social environment.

3.0 RESULTS

3.1. Interview to a mentor of students with mental disabilities at CREATE (AAU)

Due to restrictions of space the following summarizes the outcome of this interview. The interview showed the relevance of the mentorship program in providing structure to students with mental disabilities, including ASD ones. The interview shows that trust is critical in the relationship between mentor and student, as the mentor is often seen by ASD students as a figure of authority that provides safety and insight. Through open conversations the mentor guide ASD students to better understand their limitations and cope with them.

The mentor provides structure by helping students developing a detailed study plan with proximal deadlines for different types of tasks. This gives a clearer path for the students and, therefore, reduces their anxiety, stress, and helps them to cope with transitioning in their academic life. Nevertheless, such study plans can only be effective if the course instructors facilitate a detailed and well-structured course plan beforehand. Thus, a good collaboration between instructors and mentors is paramount for successfully support ASD students. Another way to provide structure is to develop certain study and behavioral patterns (e.g., request pauses in long lectures or work sessions), as ASD students gradually adjust to a new situation through repetition.

The mentor also works with the students in developing their self-awareness about their academic strengths and difficulties and to clearly communicate them to their peers and instructors. This facilitates the social integration of such students, putting into a better use their potential. It also helps them to improve their self-esteem and motivation. Finally, the mentor referred that is important for the students to be open about their condition, both with their peers and instructors, in order to build an environment characterized by empathy and trust. Knowing the condition of ASD students is also vital for the instructor to address their needs while balancing the needs of others. In sum, trust is essential for integrating the ASD student in a PBL environment. Moreover, the work of mentors is critical, as it provides continuous and consistent support for the accommodation of such students to PBL and other environmental challenges.

3.2. Interview to a student with autism spectrum condition at CREATE (AAU)

The student is diagnosed with attention deficit disorder (ADD) and ASD. The student openly talked about difficulties regarding group supervision in architectural studio, and studio exam, which is typically a group oral exam in CREATE. The following summarizes this interview.

In architectural studio's group supervision, the student highlighted some communication challenges. The feeling of sometimes not having a voice was recurrently mentioned. This happens because the student needs time to carefully ponder every discussion aspect (a WCC trait), while the other members quickly move between topics. Additionally, the student appreciates when the instructor directly promotes the student's participation in group discussions, as social anxiety often prevents the student to pose questions. Often, the student is annoyed if the discussion lingers in a subject that is not interesting or already fully understood by the student by not the rest of the group. Despite the challenges, the student acknowledges that being gradually exposed to group work helps to cope with social anxiety and create social bonds.

Finally, regarding project examination, the student mentioned an increasement of anxiety with the presence of several people and if the jury is composed of people the student has never met before. To better cope with the exam environment, the student often requests special dispensations that might include the presence of a close family member and more time to understand a question and formulate an appropriate answer or even conducting part of the exam alone.

3.3. Questionnaire about teaching students with autism spectrum condition at CREATE (AAU)

Nine CREATE instructors from Urban Design, Architecture, and Industrial Design responded to a questionnaire with the goal was to get an overview of the teaching strategies that address ASD students in studio supervision and project exams. If the respondents were unaware that they instructed an ASD student, they needed to imagine such a situation.

The studio related questions addressed the inclusiveness of ASD students. Regarding promoting their participation, most teachers think that methods used to engage more introverted students are applicable, such as: (i) directly asking questions, while being attentive to their well-being, (ii) discuss the communication methods used by the group, and (iii) directly ask the ASD student opinion often. Some additional strategies include discussing with ASD students about the supervision structure and helping the group develop rules for supervision that address ASD individuals' needs. Strategies for an equitable distribution of tasks mostly rely on helping the students develop a work plan and an agreement about task distribution, which is already a typical PBL strategy.

The responses were more diverse regarding fostering creativity. Some believe there is no need to address this, showing their unawareness that WCC and RGH hamper creativity of ASD students in typical top-down PBL workflows. Others were vague in describing some strategies such as "active listening," "externalize ideas on paper," and the common PBL strategy of shifting tasks between individuals, which might be at odds with the difficulty that ASD individuals have in transitioning.

For design studio exams, ensuring a comfortable yet challenging environment is unanimous among respondents. Clarity about the exam format, outline, and time schedule is deemed essential. The variation lies in the formality of communication, with preferences ranging from conversational to detailed explanations before the exam. Some respondents acknowledge the WCC and executive function challenges of ASD students, emphasizing the need for clear and unambiguous language in questions. They suggest allowing students to ask for question reformulation,

extra processing time, and consider these strategies sufficient for managing exam-related stress and anxiety. Some respondents propose additional measures like individual supervision before the exam, a 5-minute break during the exam, calming down the student if agitation arises, and offering the opportunity to visit the exam room beforehand, which can help in transitioning. Finally, examiners are advised to maintain a calm.

3.4. Studio supervision experiment

Architectural studios in AAU are loud and lively open spaces like most studios in other programs, exposing ASD students to a high risk of sensory overload through their auditory hypersensitivity. As previously mentioned, this experiment exposed several TD students to auditory hypersensitivity for 2 minutes using a sound clip listened through headphones during supervision. The experiment involved 20 participants from the first semester in AAU's Master of Science in architecture. Figure 1 shows the results of the questionnaire that the participants filled after the experiment. It summarizes the ability of students to conduct essential tasks in a project supervision session including engage/participate, concentrate, reason, and follow/understand the discussion. Students rated their ability to perform such actions during supervision using a 7-step Likert scale that goes ranges from -3 (very difficult), 0 (neutral), to 3 (very easy).

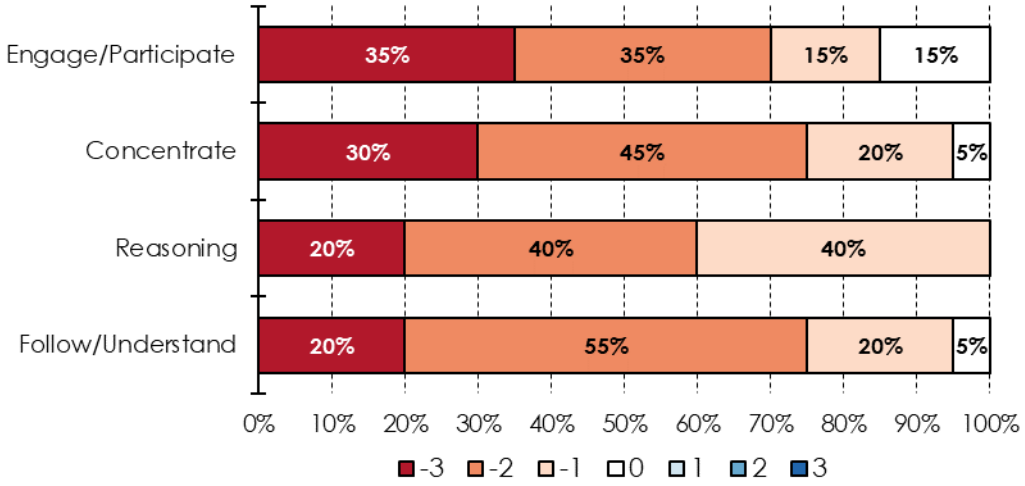

Figure 1: Results of the survey that assess the experience of TD students when exposed to auditory overload as commonly experienced by ASD students. Source: (Santos 2024)

Figure 1 shows that most participants experienced difficulties in all typical supervision tasks (85%-100%). The most divisive task was to engage/participate in the discussion as 70% reported that was very difficult (-3) or difficult (-2) while 30% indicated that they had a slight or neutral difficulty level. This can be explained by some participants being used to loud environments that require constant social interaction, e.g., some students work or worked in bars or restaurants. Regarding concentration, 75% of the participants reported that it was difficult (-3 and -2). Follow and understanding the supervision score the highest in category -1 (difficult) which is concerning as discussion consistency and the comprehension of the discussed concepts, and their enchainment, is central in architectural studio supervision. Finally, all students struggled in reasoning during supervision. Such overall difficulty is linked to the hardships in concentration and understanding. Although reasoning is essential to react and generate alternative design strategies/solutions, it is less concerning than the challenges in following/understanding as it requires maturation and partially happens after the supervision.

When asked about what their group colleagues could do to facilitate the participation in supervision, participants replied that using body cues such as gestures to grasp the attention, directly address the person that is experiencing a sensory overload, and use other communication tools such as drawing and writing. Students provided similar responses when the question focus on the instructor such providing supervision but adding and stressing the importance of the instructor use clear and straightforward language and directly. Point-out the part of the drawing or model being discussed, draw diagrams about the discussion topic, speak slowly, emphasize (by repeating) the main points and take-aways of the discussion, and breaking long supervision sessions in smaller ones with breaks were other useful suggestions.

Regarding potential changes to the physical environment students stressed that open spaces are not adequate when exposed to such auditory overload. Suggestions include moving to a quieter preferable enclosed space or shield the group space from noise using furniture, sound absorption materials, and movable partitions. One participant suggested asynchronous supervision with other supervisions to mitigate confusion and noise levels.

CONCLUSION

This paper discussed the challenges and opportunities of teaching ASD architecture students within a PBL context by examining the literature and assessing the current practice of an architecture and urban design program in a PBL university, AAU.

Despite the difficulties perceived by ASD students, PBL poses desirable challenges that allow gradual accommodation towards academic success. Additionally, PBL's practical nature addresses some limitations related

to executive functions, as PBL's contextual nature reduces ambiguity and progressively prepares ASD students for a post-academic life. The interview with the ASD student and mentor showed that PBL can bring the rewarding feeling of overcoming obstacles. PBL can help build self-esteem and tackle some mindblindness limitations. Additionally, the typical structure of PBL programs of sequential classes and proximal deadlines can help ASD individuals manage their time and expectations. Nevertheless, PBL's top-down and transitioning nature poses challenges related to WCC/RGH that should be addressed using some of the techniques discussed below.

PBL's desirable challenges need to be presented in ways that mitigate stress and anxiety in ASD students and foster a pleasant learning experience for all students. To that end, some typical PBL strategies, such as helping project groups establish clear rules for work distribution, communication, and learning outcomes, are helpful. Other learning strategies more targeted towards ASD students also have the potential to benefit the other students, such as promoting regular breaks in supervision, providing a supervision plan beforehand to accommodate transitioning, avoiding using ambiguous language, smoothly and consistently shifting topics in a discussion, and keep consistent supervision patterns and styles. Another critical point is building an environment of trust between ASD students, their peers, and instructors. To generate trust, it is essential that ASD students communicate their condition and that their peers and instructors should be available and empathic towards their needs. Both the literature and the interviews highlight that trust and openness are critical for the personal, social, and academic growth of ASD students. Another vital strategy is to help them know and communicate their skills and limitations.

Although studio instructors are not formally trained to teach ASD students and often are not aware of their presence, they have a good intuition on how to act, integrate, and address the needs of such students. Most of the strategies mentioned in the questionnaire align with current practices reported in the literature, showing that common PBL strategies suit both TD and ASD individuals. However, some of the faculty survey responses are poorly systematized, indicating a lack of an overview on how to integrate the ASD student and balance the different psychological needs of a diverse studio environment. Furthermore, the lack of awareness that the number of ASD students is increasing prevents instructors from acting more conscientiously. Thus, consistently promoting public sensibilization actions and small workshops on these matters could improve awareness and equip faculty to address mental impairments in studio supervision and exams. Additionally, this work suggests that knowing more about ASD symptomatology helps adjust learning activities in a way that can benefit all students.

A mentorship program for mentally impaired students is also crucial in providing support, structure, and confidence to ASD students. The interviews with the mentor and ASD student indicate that students gradually become more capable of socializing tasks and structuring and managing their academic responsibilities.

From the studio supervision experiment, it is possible to verify, once more, the need to provide a clear structure for the supervision in terms of discussion content and communication procedures. Exposure to sensory overload in a studio group supervision causes stress and exhaustion that hampers the ability to engage/participate, concentrate, reason, and follow/understand the supervision discussion. Therefore, frequently emphasizing essential aspects of the supervision by using body language and drawings, swiftly acting upon signals of agitation, such as promoting a short break or modulating the supervision pace and tone (e.g., structuring the desk critique into different periods, such as initial discussion, break, a quick exercise, and summary discussion), can effectively help reduce anxiety levels and grasp the attention of both ASD and TD students. It was also clear that a loud and lively open space is adverse to ASD students. Thus, the author recommends, whenever possible, supervising groups with ASD students in separate classrooms or rearranging the space of the specific group to mitigate the exposure of sensory stimuli to ASD students.

Finally, this study briefly addresses a complex problem that demands a multidisciplinary approach. Considering the limited size of experiment participants, the interviews, and the questionnaires conducted in this work, it can only provide anecdotal evidence. Nevertheless, this study offers relevant insights into a topic seldom addressed in literature. Future work would expand the number of participants in interviews, questionnaires, and experiments and devise new experiments to assess the proposed strategies more systematically.

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