From Catalog to Cards: A Two-Cycle Experience of Applying Neuroinclusive Agile Practices in Software Engineering Team-Based Learning

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Abstract

Neurodiversity remains underexplored in Software Engineering education and agile teamwork, and actionable interventions to support developers with *Autism Spectrum Disorder* (ASD) and/or *Attention Deficit Hyperactivity Disorder* (ADHD) are still limited. This experience report documents two iterative action research cycles aimed at fostering neuroinclusive agile practices in undergraduate SE team-based learning. In the first cycle, we developed and piloted the *Catalog of Neuroinclusive Recommendations for Agile Software Engineering Teams*, a set of 34 recommendations organized around *Agile Practices*, *Communication and Social Interaction*, and *Leadership and Organization*, with 117 students across 17 agile teams. Findings confirmed the feasibility of the recommendations but also revealed that the catalog format posed adoption and comprehension challenges. In the second cycle, the catalog was transformed into a physical card-based toolkit and evaluated with 14 Computer Science students (neurotypical and neurodivergent) using a 7-point Likert questionnaire (about *Usefulness*, *Ease of Use*, *Ease of Learning*, and *Satisfaction*). Results across both cycles indicate high perceived usefulness and learnability, with qualitative evidence highlighting the value of recommendations that reduce cognitive load and increase predictability. These findings demonstrate that practice-oriented tools can feasibly support neuroinclusive agile collaboration in educational SE contexts and motivate further evaluation in professional agile teams.

Keywords

Neurodiversity, ASD, ADHD, Agile Methods, Team-based Learning, Card-based Toolkit, Software Engineering Education

1 Introduction

Diversity, Equity, and Inclusion (DEI) have gained increasing attention in Computer Science (CS), particularly in the field of Software Engineering (SE). Despite progress, persistent inequalities remain regarding social markers such as gender, race, ethnicity, sexual orientation, age, disability, and other factors [1, 38]. Recent scholarship has even described this situation as a diversity crisis in SE, in which tools, practices, and organizational environments continue to reproduce exclusionary dynamics [1, 23].

Over the past decade, research on diversity in SE has advanced substantially, especially with regard to gender. Systematic reviews and empirical studies show that diverse teams are often more innovative and productive [38]. However, aspects such as race, ethnicity, age, and disability remain comparatively underexplored [23, 38]. Moreover, although the IT industry often recognizes diversity as a competitive advantage for innovation and software quality [5], there is a growing mismatch between academic findings and industrial practice, with some companies reducing or even discontinuing their DEI programs [12, 23]. At the same time, recent analyses suggest that external communication and public campaigns on diversity have decreased, but many IT companies continue to sustain or reconfigure internal initiatives [12, 23]. This reinforces the importance of continued and broader DEI research in SE. Still, the literature remains primarily centered on gender, with limited attention to issues such as intersectionality and specific disabilities, particularly neurodiversity [21].

In educational contexts, initiatives to foster inclusion have sought to mitigate barriers to access and retention in Computer Science programs. Studies highlight the creation of safe spaces as an effective strategy for supporting students from underrepresented groups [13, 21]. Yet, even where progress has been achieved, the effects of diversity on software teams are not yet systematically understood [27]. SE, and CS as a whole, may be particularly attractive to neurodivergent individuals due to the alignment between software development skills and neurodivergent cognitive styles, as well as the perception of computing spaces as more compatible with neurodivergent ways of thinking and interacting [11, 26]. However, most SE investigations have focused on isolated diversity dimensions, overlooking the complex interactions between technical and social factors [19].

Neurodivergent students often struggle in team-based computing and engineering projects due to communication, collaboration, and executive functioning challenges, as reported in studies of STEM group work [40] and teamwork experiences in engineering teams [41]. These difficulties are particularly concerning because collaborative projects are a central component of preparing students for professional software development and AI workforce environments [24], where soft skills and teamwork are critical yet frequently under-taught in CS and SE courses [7]. Large-scale educational initiatives indicate that expanding access to authentic CS experiences can positively affect engagement and persistence, but requires intentional instructional design to be effective [36]. This aligns with the need to operationalize neuroinclusive recommendations in agile project settings, where teamwork practices and ceremonies can increase cognitive load, communication demands, and uncertainty for developers with ASD or ADHD.

This experience report addresses this gap by documenting two iterative action research cycles: (1) the development and pilot application of the *Catalog of Neuroinclusive Recommendations for Agile*

Software Engineering Teams, and (2) the transformation of the catalog into a *Card-Based Toolkit* and its preliminary evaluation with neurodivergent and neurotypical students. By reporting on both cycles, we aim to provide practical lessons on how neuroinclusive practices can be operationalized in SE team-based learning and to motivate further validation in professional contexts.

2 Background and Motivation

2.1 Neurodiversity

The concept of neurodiversity describes a positive perspective of embracing the natural variation in human brain function and cognitive processing, framing atypical neurological profiles (i.e., neurodivergent), such as Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD), as distinct modes of cognition rather than deficits to be corrected [6, 33]. This perspective recognizes that many of the challenges faced by neurodivergent individuals arise not from inherent cognitive limitations, but from environments and social norms designed around neurotypical standards [3, 19, 33]. In software engineering contexts, individuals with ASD are often associated with strong aptitude for analytical reasoning, sustained attention to detail, and pattern recognition, alongside differences in social communication and adaptability to change [6, 30]. Individuals with ADHD, in turn, may face difficulties with routine task organization and sustained attention, but frequently demonstrate creativity, divergent thinking, and the capacity for intense states of hyperfocus on complex technical problems [19, 34]. Both profiles represent cognitive configurations that can simultaneously pose challenges and contribute distinctive strengths to software development teams, a duality that motivates the neuroinclusive perspective underlying the present work.

2.2 Neurodiversity in SE Studies

Interest in diversity, equity, and inclusion within SE has expanded in recent years, yet neurodiversity remains an emerging field of investigation. This perspective frames conditions such as ASD and ADHD not solely from a clinical standpoint, but as distinct modes of cognitive functioning that can represent both challenges and strengths for software teams [18, 32, 46]. Early SE studies had already pointed to the difficulties neurodivergent (ND) individuals face in collaborative activities. Rashid et al. [37] observed that issues related to communication, emotional regulation, and executive functions directly affect the participation of professionals with ASD and ADHD in teamwork. These findings were later expanded by qualitative research, such as Gama and Lacerda [18], which showed how specific cognitive characteristics can both support and hinder agile practices, influencing everything from daily meetings to pair programming.

Recent empirical work, such as Verma et al. [46], compared ND and neurotypical (NT) engineers, revealing significant differences in perceived productivity, well-being, and social interaction styles. These studies reinforce the view that neurodiversity should not be framed only in terms of limitations, but also as an opportunity to leverage strengths such as attention to detail, creativity, and hyperfocus [5, 14]. In the educational context, Márquez et al. [32] highlighted that CS students with ASD encounter additional barriers in practical and collaborative activities, often due to the lack of institutional support and adapted pedagogical strategies. Wortman et al. [48] similarly argue that inclusive teaching practices are fundamental for supporting the retention of underrepresented groups in IT programs.

In the corporate environment, inclusion programs implemented by major IT companies have been analyzed in industry studies [5, 14]. These works report that adjustments in recruitment processes, team training, and task design generate tangible gains in innovation, quality, and productivity. More recently, Gama et al. [19] proposed a socio-technical grounded theory to explain how cognitive dysfunctions associated with ASD and ADHD affect SE performance. Despite these advances, the literature remains scarce and fragmented. Complementary evidence from survey-based studies highlights both barriers and enablers for inclusion of autistic individuals in SE [32, 47], and empirical research confirms that ND developers often experience challenges more frequently than neurotypical peers [33, 34].

2.3 Neurodiversity in SE Education

Research on neurodivergent students in computing education is still limited. In a recent systematic literature review [49], out of 1,943 screened papers, only 14 met the inclusion criteria, with most studies focusing on conceptual recommendations rather than empirically evaluated interventions. The review emphasized the need for evidence-based pedagogical practices, particularly in active learning and collaborative settings.

Overall, computing and software engineering are often perceived as attractive domains for neurodivergent individuals due to the alignment between software development activities and neurodivergent cognitive styles, as well as the perception of computing spaces as more compatible with neurodivergent ways of thinking and interacting [33, 34]. However, neurodivergent students also face important educational barriers. Characteristics associated with autistic cognition, such as difficulties with abstraction, context interpretation, and executive functioning, can conflict with core SE activities including decomposition and software modeling [42]. Similarly, Butler [7] discusses how collaborative agile practices may create additional stress due to communication mismatches and reduced psychological safety.

Other work has explored inclusive pedagogical strategies. A Universal Design for Learning applying principles in engineering courses [8] reported reductions in anxiety and improvements in neurodivergent student engagement and belonging. In a more practice-oriented intervention, a five-week online AI course for autistic community college students combined technical and communication training with structured scaffolding [24]. Their findings suggest that integrating technical and social learning objectives can improve both engagement and workplace preparation.

Beyond instructional design, we also found work highlighting challenges in collaborative learning environments. Neurodivergent students frequently report difficulties with communication, teamwork, conflict management, and executive functioning during group projects [40, 41]. These issues are very relevant in SE education, which is a context where agile and team-based practices are central to preparing students for professional software development environments [3, 42].

In general, these studies are evidence of growing awareness about neurodiversity accommodations in CS and SE education, but empirical and practice-oriented evidence is still scarce. For instance, there is still limited research investigating how neurodivergent students experience collaborative agile software engineering practices and which interventions effectively support their participation and learning, which is a key motivation in our work.

2.4 Card-Based Pedagogical Artifacts

Card-based toolkits have been increasingly used as pedagogical and reflective instruments because they externalize complex knowledge into tangible prompts that can be selected, arranged, and debated in group activities, supporting structured dialogue and shared sensemaking [35, 44]. In educational settings, such artifacts can foster engagement, creativity, and collaboration by enabling learners to compare alternatives, prioritize concepts, and articulate reasoning during facilitated discussions, as reported in studies of digital card toolkit transformations and playful collaborative learning activities [20, 44]. This approach can be particularly relevant for neurodivergent people when tool design offers visual structure and reduces reliance on improvised verbal interaction. For instance, a co-designed goal-setting toolkit for autistic adolescents and adults used illustrated cards to support communication, prioritization, and autonomy [4].

Beyond education, cards have also been framed as translational design tools that bridge academic evidence and practice by encapsulating recommendations into short, actionable prompts that teams can apply in context [16, 35]. Fedosov et al. [16] developed the Sharing Economy Design Cards (SEDC), a 24-card deck providing domain-specific principles to designers, and demonstrated that the cards could serve not only in collaborative ideation workshops but also in individual evaluative activities, functioning as structured checklists that practitioners cross-check against existing designs. Participants reported that the cards supported more systematic design activities, including brainstorming, prototyping, and communication with stakeholders, particularly through actionable recommendations and concrete examples. A subsequent iteration of this line of work, the SSF toolkit [17], extended the translational card-based approach into an educational context by deploying a 38-card generative deck in a graduate Social Design Studio. The cards helped participants both understand and frame problems and reflect on design improvements, acting as scaffolds for domain knowledge and collaborative process improvement.

The relevance of card-based artifacts is further reinforced by the broader literature on team-based learning in computing education. Systematic reviews of group work in CS and SE project courses highlight that students often face challenges related to communication, collaboration, and task coordination [28], precisely the areas where structured pedagogical instruments can provide scaffolding. Similarly, a review of project-based learning (PjBL) in computing education identifies teamwork and communication skills as among the most frequently targeted learning objectives, while also noting that students consistently benefit from structured support activities and facilitation resources throughout their projects [43]. Card-based toolkits, by making implicit team norms and practices explicit and discussable, can serve this facilitation function in ways that complement other forms of instructor and peer support.

3 Intervention Design and Evolution

3.1 Context

This work aimed to develop guidelines and adaptations of agile methods, practices, work models, and environments to better support the inclusion of neurodivergent individuals (particularly those diagnosed with ASD and/or ADHD) in agile SE teams. Grounded in cognitive ergonomics and designed to be accessible across different levels of knowledge and development experience, the work was initially conducted in the context of undergraduate Computing students.

Two iteration cycles were conducted, both at the Universidade Federal de Pernambuco (UFPE). The First Iteration was carried out in two phases: the first within a 2-year training program on mobile software development (across two 15-day sprints, totaling 30 days of application), and the second in a Software Engineering course in the undergraduate Computer Science program (across one 15-day sprint). The Second Iteration was conducted in two 40-minute sessions with neurodivergent and neurotypical students, also from the undergraduate Computer Science program at the same institution.

In this regard, the study followed an *Action Research methodology*, situated at the intersection of routine practice (e.g., software development work) and academic research, with the aim of improving such practice [45]. The method employed followed the principles of practical action research [22], which differs from technical action research because the proposed improvements are designed and driven by the practitioners themselves. The basic action research cycle (Figure 1) consists of four recurring stages: (1) *Planning* (defining guidelines and proposals for improvement); (2) *Act* (implementing the improvements); (3) *Describe* (monitoring and collecting feedback); and (4) *Evaluate* (analyzing collected data and refining the toolkit for subsequent cycles). In our study, the Action Research cycle was structured around iterative phases, as described in Figure 1.

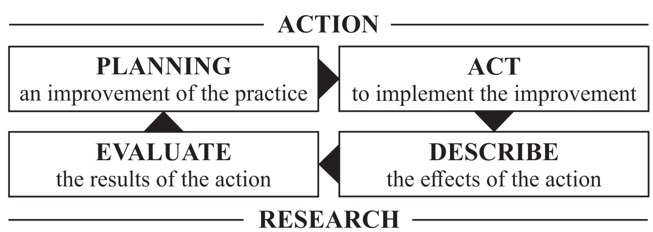

Figure 1: Basic action research cycle based on Tripp [45].

In our study, the action research cycle was structured around the iterative phases depicted in Figure 2. This project was conducted after approval of the university's ethics review board[1].

3.2 First Iteration: Catalog of Recommendations

The first iteration began with the development of version 1 (v.01) of the *Catalog of Neuroinclusive Recommendations for Agile Software*

[1]CAAE number 84787024.8.0000.5208

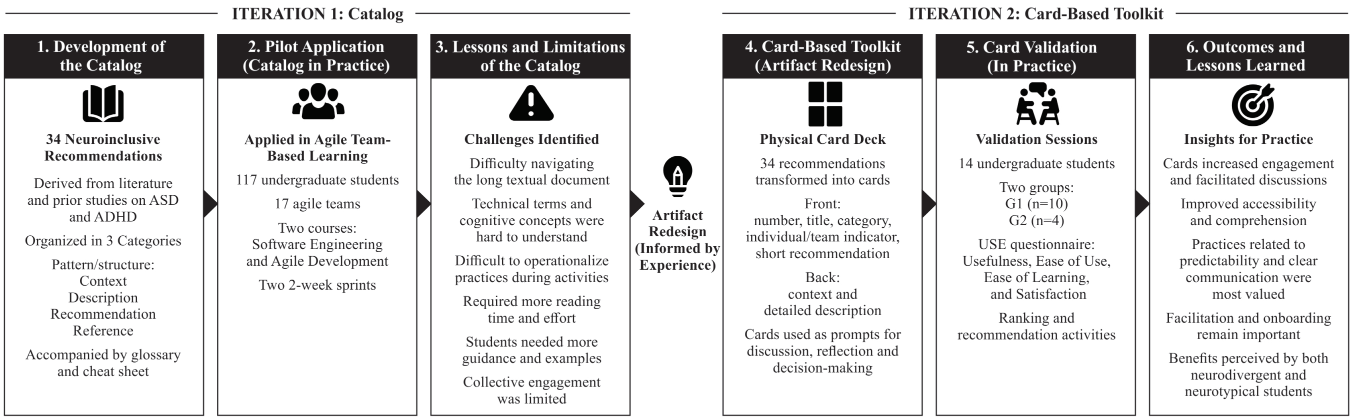

Figure 2: Evolution of the neuroinclusive intervention from catalog to card-based toolkit.

Table 1: Condensed Version of the Agile Practices Recommendations (R)

R	Title	Recommendation
01	**Baby Steps**	Break down larger tasks into smaller and concrete units, enhancing clarity, manageability, and execution. Use a schedule with deadlines for these smaller milestones to support progress monitoring. [18, 19]
02	**Divide and Conquer**	To make Sprint Planning more inclusive, ensure that task breakdowns are explicit and clear for neurodivergent team members, with well-defined criteria of what counts as a completed part. [19, 30]
03	**Test First**	Consider adopting Test-Driven Development (TDD), since it requires writing tests before implementing a functionality, thus naturally enforcing task decomposition into smaller, manageable subtasks during the Sprint. [19]
04	**Mental Offload**	To support visualization of upcoming work, start by writing down all tasks in any order, whether through written notes, audio recordings, or sketches. Listing everything externally can help reduce cognitive load and assist with memory challenges. [15, 18, 32, 34]
05	**Focused Batch**	Group similar Sprint tasks into batches to reduce frequent context switching, or allow uninterrupted time blocks on a single task to leverage hyperfocus in neurodivergent team members, supporting task completion. [19, 30]
06	**2x2 Matrix**	Support prioritization by introducing the Eisenhower Matrix, which classifies tasks into two categories: −Urgent/+Urgent and −Important/+Important. Incorporating visual or tactile elements such as color coding can further aid in identifying priorities, especially those in the +Urgent and +Important quadrant. [15]
07	**Monotony Mission**	During Sprint Planning, explicitly identify and highlight tedious or repetitive tasks. Some neurodivergent team members may struggle to complete them, while others may actually prefer executing them. [19]
08	**Realistic Estimate**	Provide support in adjusting delivery estimates for neurodivergent team members, as formulating realistic estimations can be a significant challenge. [30]
09	**Flexible Roles**	Define roles and responsibilities clearly within the team, but allow neurodivergent team members to switch roles when these tasks become a source of stress. [30, 32]
10	**Stable Routine**	Limit unnecessary changes and maintain stable routines, including meeting schedules and agile ceremonies. An Agile Team can serve as an environment of psychological safety and stability, enhancing both comfort and performance for neurodivergent team members. [19]
11	**Fast and Effective**	Shorten the duration of pair programming sessions and ceremonies such as the Daily and Sprint Review, in order to reduce the likelihood of cognitive fatigue among neurodivergent collaborators. [18, 19]
12	**Written Daily**	Enable the adaptation of the Daily ceremony (in-person or online) into a written format, using online project management or communication tools (e.g., a #daily channel on Slack), in which collaborators write: what I did, what I am doing, what I will do, and my blockers. [18, 19]
13	**1:1 Daily**	Offer the possibility for neurodivergent collaborators not to participate in the Daily ceremony, instead providing written updates or one-to-one follow-ups with leadership in person or online throughout the day. [18, 19]
14	**End-of-Day Focus**	Prefer scheduling meetings and agile ceremonies for the end of the workday, rather than in the morning or early afternoon, allowing neurodivergent collaborators to conclude their day with a moment for stress reduction or emotional self-regulation. [18, 19]
15	**Informed Meeting**	Clearly state the purpose of a meeting to reduce anxiety and assist in planning for neurodivergent collaborators, and provide documents in advance to allow processing time before discussions. [9, 30, 34]
16	**Rechargeable Battery**	Respect different work rhythms and support energy-based task cycles to meet the needs of neurodivergent collaborators and reduce cognitive fatigue. [30, 34]
17	**Mandatory Stop**	Monitor whether neurodivergent collaborators are wasting time on unnecessary tasks, engaging in gold plating, or overcommitting to work, and guide them on when to conclude tasks. [18]
18	**Friendly Question**	Encourage and normalize help-seeking and clarification requests regarding task execution, thereby avoiding ambiguities and preventing bottlenecks or isolation of neurodivergent collaborators. [19, 30]
19	**Out of the Box**	Be open to reformulations of ideas or to recognizing that a task may be performed in ways not previously considered, as neurodivergent individuals may present different reasoning or problem-solving approaches. [15]
20	**Dynamic Duo**	Establish pairing between a neurodivergent collaborator and a neurotypical "buddy." Buddies are members of the same Agile Team who support neurodivergent individuals in daily engagement and productivity, such as initiating and maintaining task focus, prioritizing, and managing workload. [5, 18, 19, 34]

Engineering Teams. Its elaboration was based on literature reviews and prior studies on executive brain functions and the challenges faced by developers with ASD and/or ADHD in the software industry. The first foundational study consisted of an exploratory investigation with four interviews conducted in Portuguese with software developers with ASD and/or ADHD. A subsequent study was conducted under the *Socio-Technical Grounded Theory* (STGT) approach with 30 interviews, investigating how neurodivergent

Table 2: Condensed version of the Communication and Social Interaction Recommendations (R)

R	Title	Recommendation
21	**Crystal Clear**	Make social norms explicit (e.g., in an onboarding guide) and regularly verify comprehension and confirm whether communications are being received as intended, in order to prevent misunderstandings with neurodivergent collaborators. [15]
22	**Plain Speech**	Maintain clear, accessible, and jargon-free language whenever possible, ensuring that all neurodivergent collaborators can comprehend communications regardless of their background or expertise. [15]
23	**Written Reinforcement**	Avoid asking too many questions or providing lengthy instructions purely orally; instead, reinforce communications with written documentation (including after meetings) and in general practice. [14, 19, 30, 32]
24	**Reading Audio**	Utilize tools that transcribe audio messages (e.g., Slack, WhatsApp) to enhance communication with neurodivergent collaborators. [14, 19, 30, 32]
25	**Straight to the Point**	When communicating with a neurodivergent collaborator via email or message: introduce the subject in the title or at the beginning of the text to reduce anxiety, be very clear and specific (action verbs may help), keep messages brief and/or structure them into topics if lengthy, and highlight important words or sections. [14, 19]
26	**Optional Camera**	Allow neurodivergent collaborators to keep their cameras off during online meetings, thereby alleviating social anxiety and recognizing that turning off the camera does not equate to disinterest or inattention. [14, 19]
27	**Social Bridge**	Paired neurotypical "buddies" can also assist neurodivergent collaborators with communication and socialization within the company, such as in client interactions or sending messages/emails to unfamiliar colleagues. [15, 19]
28	**No Pressure**	Extend invitations, but recognize that some neurodivergent collaborators may prefer not to attend Agile ceremonies or team/company "social" events, and should nonetheless be considered as much "team players" as those who do participate. [14, 19]

Table 3: Condensed version of the Leadership and Organization Recommendations (R)

R	Title	Recommendation
29	**Empathic Management**	Provide individualized treatment and clear accommodations for neurodivergent employees, while ensuring that such accommodations are well-communicated to the organization, thereby fostering psychological safety. [10, 18]
30	**Results-Oriented**	Always assess the performance of neurodivergent employees based on productivity and quality of deliverables, rather than on "speed of task completion" or "apparent presence/participation" in team or company activities. [15, 30]
31	**Shared Load**	Identify the needs of neurodivergent employees and take responsibility for requesting and negotiating accommodations with other organizational units, preventing the full burden from falling on the individuals themselves. [9]
32	**Productive Allocation**	In project-based work models, when possible, keep neurodivergent employees assigned to teams with familiar colleagues, as this may support communication, socialization, engagement, and productivity. [19]
33	**Reserved Space**	Provide the option to reserve a private office or workspace during in-person periods, with adjustable controls such as lighting, temperature, and ergonomic furniture. Noise-canceling headphones may also contribute to a sense of control, comfort, and physical and psychological safety. [10, 18, 34]
34	**Fully Remote**	Whenever possible, allow neurodivergent employees to work fully remotely, or substantially reduce requirements for in-person presence, thereby fostering both physical and psychological safety. [18, 32]

cognitive dysfunctions affect SE performance and how individual journeys and various accommodations regulate this effect [19]. Based on these studies and the reviewed literature, 34 neuroinclusive recommendations were identified, compiled, and categorized into three groups (Tables 1, 2, 3): *Agile Practices* (R1–R20), *Communication and Social Interaction* (R21–R28), and *Leadership and Organization* (R29–R34).

The recommendations were derived through a multi stage qualitative process applied to 29 peer reviewed and 21 gray literature sources. Sources were first screened for relevance to neurodiversity, team practices, and the defined scope, then examined for three evidence types: direct recommendations, indirect suggestions from reported challenges, and corroborating findings across sources, resembling multivocal literature mapping. Sources meeting none of these criteria were excluded, with reasons recorded. Semantically similar recommendations were grouped through thematic synthesis and organized into the three categories via deductive coding. The resulting set was independently reviewed by a second researcher (the first author's doctoral advisor), with disagreements resolved through consensus. The process thus combined deductive extraction, semantic synthesis, and consensus based review, rather than following a single named qualitative framework.

Each recommendation was structured using the *Alexandrian Style of Pattern Description* [2, 25], comprising: *Title* (short and memorable); *Context* (recurring problem experienced by individuals with ASD and/or ADHD); *Recommendation* (proposed adaptations or interventions); and *References* (grounding sources) (Figure 3). The catalog also included a *glossary* of psychological terms and a *cheat sheet* summarizing all 34 recommendations on a single page.

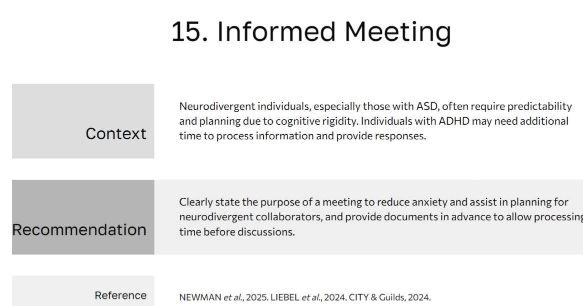

Figure 3: Sample page of the distributed catalog.

3.2.1 Pilot Application in SE Team-Based Learning. The pilot application was conducted in two higher SE education classes: the first with 47 students across 8 teams, the second with 70 students across 9 teams. In total, the sample consisted of 117 students organized into 17 agile teams. The pilot was carried out in five stages:

(1) **Introductory Meeting.** An in-person meeting with researchers and student teams in the classroom setting, presenting the catalog, instructions for the pilot, and a Q&A session.
(2) **Initial Questionnaire.** Students read the catalog recommendations and mapped those already in use by their teams, using an online survey form.
(3) **Workflow.** Teams applied the recommendations during two sprints, each lasting 15 days, while following their regular teamwork routines.
(4) **Final Questionnaire.** Teams reported which recommendations were used (or not) during the pilot application, again through an online survey form.
(5) **Interviews.** Four students were interviewed (two from each class), including one neurotypical and one neurodivergent student per class (Table 4) to further investigate issues raised in the responses to the final questionnaire.

Table 4: Interviewees Profile

Id	Gender	Condition	Class	Role	Team Size
S01	F	ASD+ADHD	1	UX/UI Designer	5
S02	F	Neurotypical	1	Project Manager	6
S03	M	ADHD	2	Product Owner	8
S04	F	Neurotypical	2	Scrum Master	8

Data collection was conducted by two neurodivergent researchers, one diagnosed with Level 2 ASD, another with Level 1 ASD and ADHD, who disclosed their conditions from the first contact with students. Both questionnaires were administered electronically (*Google Forms*), reducing respondents to 43 for the initial and 17 for the final questionnaire. Semi-structured interviews were conducted remotely (*Google Meet*), recorded, and transcribed using an AI tool (*Supernormal*). Qualitative analysis was performed using the in vivo coding technique [39], yielding seven codes: *Applied Recommendations*, *Benefits of Application*, *Challenges of Application*, *Perceptions of Application*, *Personal Experiences*, *Catalog Language*, and *Revision Suggestions*.

3.2.2 Lessons and Limitations of the Catalog Format. The pilot confirmed the practical applicability of the recommendations, but it also revealed important limitations of the catalog format. Several students reported that reading time was insufficient to assimilate the full catalog before beginning the sprint, and the 30-day application period was considered too short by several participants. The introductory meeting focused primarily on technical instructions, leaving limited space for raising awareness about neurodiversity and the importance of collective engagement. Concerns were also raised about the catalog's language and accessibility. Technical psychology terms related to executive functions posed challenges for less experienced readers, and some recommendation titles were not immediately intuitive without reading the full text. Students also suggested that certain recommendations were overly prescriptive, indicating a need for greater flexibility to accommodate alternative tools and techniques that preserved the intended benefits. These limitations motivated a redesign of the artifact: transforming the catalog into a more actionable, portable format that could reduce adoption friction and improve comprehensibility.

3.3 Second Iteration: Card-Based Toolkit

Based on the findings from the pilot study and discussions with participants, the necessary text adjustments were made to the 34 recommendations and the catalog was subsequently transformed into a card deck [44]. The toolkit was designed as a physical card deck with each card structured as follows: the front features the card number, title, recommendation text, category (top left), and whether the practice is individual or collective (top right); the back details the context where that recommendation applies, as illustrated in Figure 4 (the version applied to students was originally in PT-BR).

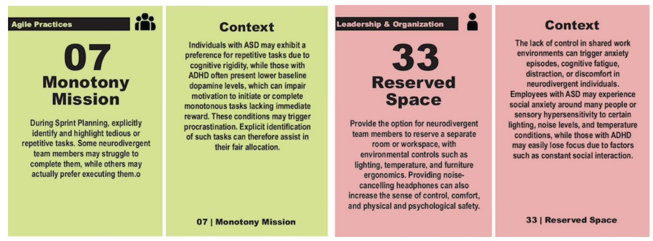

Figure 4: Sample cards (front/back) from our toolkit [29]

3.3.1 Card Toolkit Validation Sessions. The card deck was validated through two evaluation rounds (Figure 5), collecting feedback from 14 students in two groups: G1 — 10 students (1 ADHD, 5 neurotypical, 4 self-identified with neurodivergent traits); and G2 — 4 students (1 ASD, 1 ADHD, 2 with co-occurring ASD and ADHD). The validation procedure was carried out in three stages:

(1) **Introduction.** Researchers presented the objectives of the *Catalog of Neuroinclusive Recommendations for Agile Software Engineering Teams* and the card deck to participants.
(2) **Card Discussion.** Participants were instructed to discuss which cards would be useful to pick and apply in a real project or sprint context.
(3) **Feedback Collection.** Participants anonymously completed the USE questionnaire [31], which encompasses four constructs *(Usefulness, Ease of Use, Ease of Learning*, and *Satisfaction*), rated on a 7-point Likert scale (*1 = Strongly disagree, 7 = Strongly agree*) as illustrated in Figures 6 and 7. An open-ended question was also included to capture additional comments, suggestions, and critiques.

4 Preliminary Results

4.1 Catalog Pilot

The initial questionnaire, answered by 43 of the 117 participating students, revealed that a substantial portion of the neuroinclusive catalog recommendations were already being practiced intuitively by agile student teams. Among the most frequently pre-adopted recommendations were Out of the Box (R19), cited by 30 students; Baby Steps (R1), Stable Routine (R10), and Optional Camera (R26), each cited by 29 students; and Friendly Question (R18), cited by 27 students. This pattern suggests that several neuroinclusive practices align naturally with effective team dynamics, even in the absence of explicit awareness of neurodivergent inclusion. In total, 61.7% of the 34 recommendations were marked as desirable for adoption by

Figure 5: First evaluation round of the card toolkit.

at least half of the respondents. Monotony Mission (R7) stood out as the recommendation generating the strongest new interest, cited by 79% of students, reflecting a widespread recognition that the explicit identification and negotiation of tedious or repetitive tasks within a sprint is a gap in typical agile practice. Among the recommendations least favored were End-of-Day Focus (R14), cited by 18 students as undesirable; 1:1 Daily (R13), with 10 citations against; and Written Daily (R12) and Social Bridge (R27), both with eight. The final questionnaire, completed by 17 students after two 15-day sprints, confirmed broad adoption across the catalog. The most frequently applied recommendation was Plain Speech (R22), used by 11 students: 9 of whom reported positive effects, 1 a negative effect, and 1 no perceived effect, reflecting how much teams valued clear, jargon-free communication as a baseline condition for inclusive collaboration. Stable Routine (R10) and Written Reinforcement (R23) each followed with 8 uses, reinforcing the finding that predictability and documentation of communications were among the most impactful adaptations for mixed neurodivergent-neurotypical teams. In total, 33 of the 34 recommendations were applied by at least two respondents; Monotony Mission (R7) was the only exception, a notable contrast with its strong initial interest, likely reflecting the difficulty of introducing structured task-preference conversations within the short application window.

4.1.1 Interviews Analysis. Data from the four student interviews provided rich accounts of the experiences of neurodivergent and neurotypical students working together within the same agile team during the Catalog Pilot. Qualitative analysis was performed using the in vivo coding technique [39], which assigns labels directly from participants' own words, ensuring that analytical categories remain close to the vernacular terms used by students and preserve meanings and expressions grounded in their lived experiences. This process yielded seven higher-level codes (Applied Recommendations, Benefits of Application, Challenges of Application, Perceptions of Application, Personal Experiences, Catalog Language, and Revision Suggestions) which structured the thematic analysis below.

Applied Recommendations. The interviews confirmed the application of 22 recommendations across the teams (64.7% of the catalog). Of the 12 recommendations not applied during the interview-reported phase, 8 belonged to the *Agile Practices* category: Test First (R3), Focused Batch (R5), Monotony Mission (R7), 1:1 Daily (R13), Informed Meeting (R15), Rechargeable Battery (R16), Mandatory Stop (R17), and Out of the Box (R19); 3 to *Communication and Social Interaction*: Straight to the Point (R25), Optional Camera (R26), and No Pressure (R28); and 1 to *Leadership and Organization*: Results-Oriented (R30). Notably, Monotony Mission (R7) was the only recommendation absent from both the interviews and the final questionnaire responses, suggesting it was the least operationalized practice across all data collection instruments during the pilot.

Benefits of Application. Reports highlighted benefits related to productivity, organization, task predictability and initiation, communication clarity, social interaction, empathy, and collaboration. The practices also showed potential to support team dynamics when adapted to different situations and the needs of neurodivergent students:

"One that helped a lot was the Dynamic Duo (20). I particularly like having someone I call 'my duck.' I say, 'I need a duckling,' when I can't solve something and ask, 'How do you think I can solve this?'. I found that really cool." – S02

"The recommendation that helped me a lot was Baby Steps (1). Before, the tasks were too broad and generic, and I didn't know where to start. Another practice I liked was Flexible Roles (9). Especially towards the end, everyone needed to collaborate across different fronts." – S03

Challenges of Application. Students reported challenges related to applying some recommendations, working in noisy environments, and especially dealing with limited collective engagement and time constraints for certain practices:

"Fast and Effective (11) didn't work. But not because of the recommendation itself—it was due to the lack of respect for time limits and team collaboration." – S01

"Some people liked End-of-Day Focus (14) because it was already time to leave the lab and go home. Others felt lost —sometimes I did too. I won't say it didn't work, because it did, but there was this issue of people getting a bit lost after the weekend and forgetting what they were doing. In those cases, it would be better to have a meeting at the beginning of the day to get back on track." – S02

Perceptions of Application. Overall, the catalog was perceived as useful, with positive effects on productivity and work relationships. However, students noted that its effectiveness strongly depended on team engagement and the work environment:

"I consider the recommendations applicable; I had no difficulties in understanding or applying them. Some worked well, such as Written Daily (12) and Written Reinforcement (23). But others did not work because the team did not collaborate." – S01

"I found the catalog very good. I had never stopped to think about this; it is rarely discussed. I don't think such material exists, not even for neurotypicals. I liked it so much that I changed my research topic for the final graduation project." – S02

Personal Experiences. The personal experiences consisted of remarkable episodes and collective factors, either positive or negative, faced during the pilot application. Some of these were:

"When the environment was very noisy, sometimes the auditorium was made available for those who needed it. But the culture was to keep everyone together in the same space. This made things difficult for me, because I needed silence. When I tried to raise this issue, a colleague did not respect it and took it as personal and even professional criticism. It was a bad experience." – S01

"He had just received an ADHD diagnosis and was a bit apprehensive, really insecure with that. He was afraid people would look down on him, think he wasn't good enough because he had some difficulties. At the beginning, only a few people on the team knew he had ADHD, three or four at most, out of eight. But during (the catalog application) he gradually became more comfortable, and eventually the whole team knew." – S04

Catalog Language. Although generally considered clear, the catalog's language raised doubts regarding some titles and terms, suggesting the need for revisions to promote greater accessibility:

"For me, it was not difficult to understand the texts, but I believe younger people with less vocabulary might have difficulties." – S01

"Yes, it was difficult with TDD (Test Driven Development) because I didn't know the acronym, I thought it meant something else. I researched it and then understood. I think a more complete glossary including technical computing terms would help a lot." – S02

Revision Suggestions. The revision suggestions focused on improvements to the catalog's language and categorization of recommendations, expansion of the glossary, inclusion of additional tools, and greater flexibility in recommendations that were perceived as overly specific:

"I found 2x2 Matrix (6), limited. I preferred applying the MoSCoW technique (Must-have, Should-have, Could-have, Won't-have), which works better for me. I think the catalog could suggest using 'a prioritization technique' without restricting it to just one." –S01

"The catalog could include more keywords (Glossary) and more specific categories to make visualization easier. This would help separate management practices from behavioral ones." – S03

Therefore, the dataset obtained from both the questionnaires and interviews guided the revision of the catalog into its v2.0 version, whose texts were later used in the card-based toolkit.

4.2 Cards Toolkit

Both groups responded positively across all four USE dimensions (*Figures 6 and 7*), with ratings concentrated at the upper end of the scale for most items, confirming that a card deck format is viable for translating neuroinclusive guidance into actionable prompts for team-based learning. Both groups converged on the toolkit's overall value. However, comparing their response patterns reveals differences that directly inform the next catalog revision.

Usefulness was the strongest dimension across both groups. Participants broadly agreed that the recommendations were realistic and applicable to actual sprint contexts, with Group 2 expressing particularly high confidence that the toolkit meets neurodivergent needs. Mental Offload (R4), Stable Routine (R10), and Informed Meeting (R15) were recurrently cited as high-value practices across both groups, with participants noting that advance access to meeting topics reduces uncertainty and cognitive overhead (perceived as beneficial even by neurotypical students). This universal design effect suggests an opportunity for the catalog revision to explicitly flag recommendations with team-level applicability, helping teams prioritize high-leverage adaptations benefiting all members.

Ease of Learning was similarly strong in both groups, suggesting that the card format effectively lowers the cognitive threshold for engaging with inclusion content without requiring prior expertise. However, qualitative comments from Group 2 indicated that

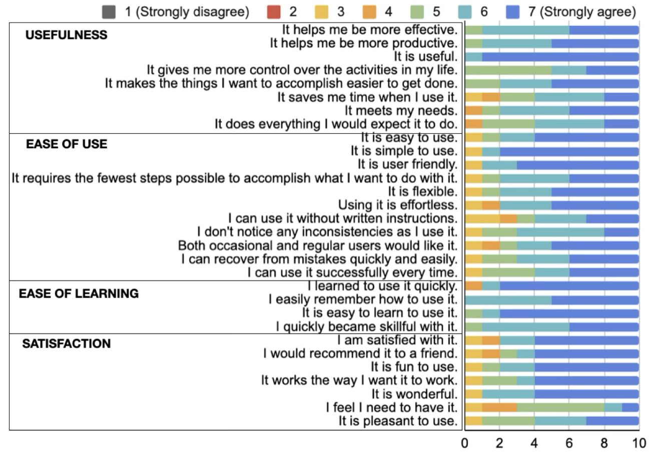

Figure 6: Respondents from group G1 (*n*=10).

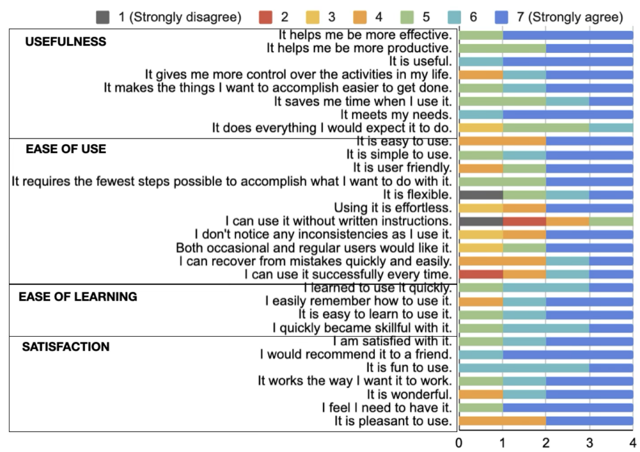

Figure 7: Respondents from group G2 (*n*=4).

individual cards are learnable, but understanding how to sequence or combine recommendations across a sprint was less intuitive. This points to a catalog-level improvement: future versions could benefit from structural cues indicating relationships between recommendations, such as groupings by sprint phase, neurodivergent profile, or implementation effort, helping teams build coherent adoption paths rather than selecting cards in isolation.

Satisfaction was high in both groups, with notable convergence on Written Reinforcement (R23) and Informed Meeting (R15) as robust, high-priority recommendations (strong candidates for a "core set" that the revision could highlight as a starting point for teams new to neuroinclusive practices). Group 1's top selections further emphasized communication clarity and structured workflows, favoring Written Daily (R12), Plain Speech (R22), and Optional Camera (R26), while Group 2 additionally highlighted Rechargeable Battery (R16). Conversely, End-of-Day Focus (R14) received negative qualitative feedback in Group 1, perceived as awkward and poorly integrated into sprint rhythms, signaling that this recommendation needs to be reframed or supplemented with concrete implementation examples.

Ease of Use was the sharpest point of divergence between groups. Group 1 maintained high agreement across most usability items, while Group 2 showed markedly higher variability, with mid-scale ratings concentrated on items related to autonomous use. The ability to use the deck without written instructions received the lowest endorsement of the entire evaluation in Group 2, and perceived flexibility also scored comparatively low, suggesting that neurodivergent users, particularly those with ASD, may find open-ended card selection cognitively demanding without clear facilitation. The catalog revision should therefore include structured facilitation protocols covering step-by-step session guidance, role assignments, and decision-making criteria. Some recommendations may also benefit from tiered variants offering lightweight and more intensive implementation options, such as graduated versions of Stable Routine (R10), so teams can match adaptation levels to their actual constraints. These needs also motivate the development of a digital companion providing layered support, filtering by profile or sprint phase, embedded glossary terms, and contextual examples, while preserving the accessible character of physical cards.

Finally, both groups flagged the *Leadership and Organization* category as underpowered. While Empathic Management (R29), Reserved Space (R33), and Fully Remote (R34) were selected as relevant, participants called for recommendations with greater organizational reach addressing managerial accountability, workload policies, and structural inclusion conditions, rather than adaptations that place the burden on individual developers. The catalog revision should expand this category to engage team leads, Scrum Masters, and engineering managers more directly, covering areas such as inclusive sprint planning facilitation, accommodation disclosure processes, and neurodiversity-aware performance evaluation. Taken together, the evaluation findings provide a concrete agenda for the next iteration: consolidating a high-priority core set, improving facilitation guidance, introducing profile- and phase-based navigation, refining low-performing recommendations, and extending organizational coverage.

4.3 Remaining Challenges

Across both iterations, challenges also emerged. In the catalog pilot, main difficulties arose from neurotypical members' lack of awareness about their neurodivergent peers' needs, resistance to consistent application of recommendations, environmental factors such as noise in shared spaces, and the limited pilot duration. One student described advocating for a quieter workspace being taken as personal criticism by a colleague, reflecting cultural barriers to full adoption. End-of-Day Focus (R14) presented the most mixed results across both cycles: most associated with negative effects in the catalog pilot (4 of 6 users) and described as "awkward or not functional" in the card toolkit evaluation; while it helped some pilot students, others felt disoriented upon returning from weekends. In the card toolkit evaluation, Ease of Use was more sensitive for Group 2, suggesting the card format alone does not guarantee independent uptake and requires stronger scaffolding, including onboarding, facilitation scripts, and contextual examples. Students also suggested that the Leadership and Organization category would benefit from higher-impact organizational recommendations.

5 Lessons Learned

Beyond the specific findings on catalog content and card usability, the two cycles together produced a set of lessons (L1-L7) that should guide adopters of this toolkit, or anyone interested in developing or enhancing neuroinclusive practices in SE team-based learning. Worth noting, the card deck was not designed to improve classroom learning activities *per se*, but rather to foster a better internal working environment within agile student teams and, as a consequence, to support learning through improved collaboration.

L1: Neuroinclusive Practices Require Operational Representations. The first cycle revealed that a text-based catalog is informative but placed significant cognitive and temporal demands on students. This motivated the transformation of the catalog into a card-based toolkit, using a physical deck format to externalize recommendations as short, tangible prompts that reduce adoption friction. The second cycle confirmed that this translational design process from the catalog to a card-based toolkit improved perceived learnability (Ease of Learning reaching 6.53/7 for Group 1), demonstrating that the format of an intervention matters as much as its content. Future representations should further reduce onboarding burden by providing embedded glossaries and contextual filtering.

L2: Physical Artifacts Foster Discussion and Collaborative Reflection. Both cycles demonstrated that artifacts designed for team use (first the catalog cheat sheet, then the physical card deck) functioned not only as reference guides but as conversation starters. In the pilot, reviewing the catalog prompted teams to surface previously unspoken communication needs and negotiate adaptations collectively. In the card toolkit validation, participants' organic ranking and discussion of cards revealed priorities that would not have emerged from individual questionnaires alone. Card-based toolkits can serve as translational design tools that bridge research evidence and practice by encapsulating recommendations into short, actionable prompts [44].

L3: Predictability-Related Practices Generated Strongest Resonance. Across both cycles and all participant groups, the recommendations most consistently highlighted as impactful were those addressing predictability, cognitive load reduction, and communication clarity: Baby Steps (R1), Mental Offload (R4), Stable Routine (R10), Informed Meeting (R15), Written Reinforcement (R23), and Plain Speech (R22). This pattern reinforces findings in the broader literature that predictability and reduced cognitive uncertainty benefit team collaboration regardless of neurodivergent status [18, 19]. Having meeting context available in advance was repeatedly described as reducing unnecessary mental effort, and was seen as beneficial even for neurotypical students, suggesting that neuroinclusive practices may yield broader team-level improvements.

L4: Facilitation Remains Important. Both cycles revealed that tool availability alone is insufficient without adequate facilitation. In the catalog pilot, the introductory meeting offered limited space for raising awareness about neurodiversity and the importance of collective engagement. This gap was reflected in personal experiences such as conflicts when neurotypical peers were unprepared to accommodate neurodivergent colleagues' needs. In the card toolkit evaluation, both groups (especially Group 2) indicated that autonomous use was the weakest dimension, and qualitative comments directly requested facilitation scripts and onboarding support. Future applications should include dedicated awareness-raising sessions and facilitation guidance.

L5: Neuroinclusive Practices Benefited Neurotypical Students Too. A recurring finding across both cycles was that neuroinclusive recommendations were not perceived as relevant only to neurodivergent participants. Neurotypical students reported that practices such as Written Reinforcement (R23), Plain Speech (R22), Informed Meeting (R15), and Baby Steps (R1) improved their own communication and task management. One neurotypical pilot participant articulated this explicitly: after intervening to clarify task instructions for a neurodivergent colleague, they reflected, *"I thought: I wish someone had done that for me before."* This reinforces the universal design perspective underlying the catalog: adaptations that reduce barriers for ND individuals often improve the working environment for all team members.

L6: The Intervention Encouraged Broader Reflection on Collaboration and Inclusion. Beyond immediate sprint activities, the intervention prompted students to reflect on communication, psychological safety, and inclusion within agile teamwork. One student reported changing their final graduation project topic after engaging with the catalog, while another described feeling progressively more comfortable disclosing their ADHD diagnosis to teammates during the intervention. Neurotypical participants also reported reconsidering communication difficulties as issues of clarity and collaboration rather than individual limitations.

L7: Start with a Small Core Set of Practices in Sprint Planning. Participants responded more positively to recommendations related to predictability, communication clarity, and cognitive load reduction, such as Stable Routine (R10), Informed Meeting (R15), and Written Reinforcement (R23). Future applications should prioritize introducing a reduced "core set" of recommendations during Sprint Planning before expanding adoption of the full toolkit.

6 Limitations

This study presents some limitations. In the catalog pilot, neurodivergent interviewees preferred being interviewed by the researcher who was also their course professor, likely reflecting the need for predictability and familiarity common among individuals with ASD and ADHD; a dual evaluation during data analysis mitigated this threat in the second student group. In the card toolkit evaluation, the small sample (n=14) and short duration restrict the strength of claims and the stability of observed perceptions over time. In both cycles, the authors' social and cultural assumptions may have influenced interpretation: two of the three researchers are neurodivergent, work in SE education or industry, and actively contributed to the *corpora*. While these experiences may have shaped interpretations, they also supported rapport with neurodivergent students and aided sense making of the data; to balance these perspectives, analyses were additionally reviewed by the third researcher, a neurotypical cognitive psychology professor, providing a complementary clinical lens. Finally, both studies are positioned within agile SE teams in higher education and do not claim generalizability to other teamwork methodologies, educational levels, or knowledge domains.

7 Conclusion

This experience report documented two iterative Action Research cycles aimed at operationalizing neuroinclusive agile practices in SE team-based learning. In the first cycle, we piloted a catalog of 34 recommendations with 117 students across 17 agile teams, confirming their feasibility in real-world academic SE projects. In the second cycle, the catalog was transformed into a physical card-based toolkit and evaluated with 14 students (neurotypical and neurodivergent), showing high perceived usefulness and learnability, particularly for practices that reduce cognitive load and increase predictability. Together, the two cycles demonstrate that practice-oriented tools for neuroinclusive agile collaboration are feasible, learnable, and relevant to both neurodivergent and neurotypical participants, though challenges remain regarding facilitation, onboarding, and stronger organizational-level recommendations.

A digital version of the card deck is under development to address these needs, offering embedded filtering, a glossary of agile, project management, and neurodiversity-related terms, and facilitation guidance. Planned features include filtering recommendations by ASD/ADHD, category, or executive function, selection for individual or group use, example use cases, and an LLM-based chatbot to identify recommendations for specific needs.

Future work will incorporate revisions from both cycles into a v.03 version of the recommendations and extend the evaluation to professional agile teams with larger, longitudinal samples, examining effects on team dynamics, productivity, and the well-being of developers with ASD and/or ADHD in industry settings.

Artifact Availability

The Catalog of Neuroinclusive Recommendations for Agile Software Teams (v.01 and v.02) and Card Deck Toolkit for printing are available online [29]. This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND): it cannot be derived, as it is still undergoing validation and development of its final version.

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