Teacher Mediation in Coding Activities: A Case Study Using an Inclusive Research Approach in Early Childhood Education

Mediazione dell'insegnante nelle attività di coding: uno studio di caso con approccio di ricerca inclusiva nella formazione e cura dell'infanzia

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ABSTRACT

This study explores how teachers mediate and adapt a coding toy activity within an Early Childhood Education and Care (ECEC) setting to ensure the inclusion of all children, employing an inclusive research approach. Coding activities not only develop fundamental computer science skills but also enhance children's critical and computational thinking. Research highlights the importance of fostering collaboration and problem-solving among preschoolers through the use of coding tools. Inclusive research methodologies have demonstrated effectiveness in improving educational practices for all children, regardless of neurodevelopmental differences. This case study involved two teachers and eight 5-year-old children, two with developmental disabilities, in a problem-solving activity using a screen-free coding robot. Data collected from teachers' field notes focused on how they mediated children's engagement and cooperation. Thematic analysis identified three key themes: teacher planning, teacher mediation, and the role of the artifact. The discussion also reflects on the connection to Feuerstein's theory of mediated learning and the value of inclusive research in promoting engagement for all children.

Questo studio esplora come gli insegnanti mediano e adattano un'attività con un giocattolo di coding in un contesto di formazione e cura dell'infanzia per garantire l'inclusione di tutti i bambini, utilizzando un approccio di ricerca inclusiva. Le attività di coding non solo sviluppano competenze fondamentali in informatica, ma potenziano anche il pensiero critico e computazionale dei bambini. Le ricerche evidenziano l'importanza di promuovere la collaborazione e la risoluzione dei problemi tra i bambini della scuola dell'infanzia attraverso l'uso di strumenti di coding. Le metodologie di ricerca inclusiva hanno dimostrato la loro efficacia nel migliorare le pratiche educative per tutti i bambini, indipendentemente dalle differenze neuroevolutive. Questo studio di caso ha coinvolto due (2) insegnanti e otto (8) bambini di 5 anni, di cui due con disabilità dello sviluppo, in un'attività di problem solving con un robot di coding senza schermo. I dati ottenuti dagli appunti di campo degli insegnanti si concentrano su come costoro hanno mediato il coinvolgimento e la cooperazione dei bambini. L'analisi tematica ha identificato tre temi principali: pianificazione dell'insegnante, mediazione dell'insegnante e il ruolo dell'artefatto. La discussione riflette anche sul legame con la teoria dell'apprendimento mediato di Feuerstein e sul valore della ricerca inclusiva nel favorire il coinvolgimento di tutti i bambini.

KEYWORDS
Teacher's mediation, Technology, ECEC, Inclusive research, Feuerstein, Inclusive education
Mediazione docente, Tecnologia, Sistema Zerosei, Ricerca inclusive, Feuerstein, Educazione inclusiva

Citation: Granone, F. (2024). Teacher Mediation in Coding Activities: A Case Study Using an Inclusive Research Approach in Early Childhood Education. *Formazione & insegnamento*, *22*(3), 54-61. https://doi.org/10.7346/-fei-XXII-03-24_07

Conflicts of interest: The Author(s) declare(s) no conflicts of interest.

DOI: https://doi.org/10.7346/-fei-XXII-03-24_07

Submitted: October 10, 2024 • **Accepted**: December 3, 2024 • **Published**: December 31, 2024

Pensa MultiMedia: ISSN 2279-7505 (online)

Acknowledgements: The author would like to express sincere gratitude to the teachers and children who participated in this study for their time, enthusiasm, and insights. Special thanks are extended to the co-researcher, whose invaluable contributions and unique perspective greatly enriched the research process and the design of the activities.

1. Introduction

Recent research has emphasized that children's engagement with digital technology, such as coding toys, can help them develop diverse competencies, including problem-solving skills (Granone & Reikerås, 2021; Turan & Aydo du, 2020). It is essential to recognize that technology alone is not sufficient (Granone & Reikerås, 2023; Quintana et al., 2018; Reiser, 2018; Shumway et al., 2021). Instead, the synergy between educators and technology drives children's educational progress (Plowman et al., 2010), with the teacher's crucial role being particularly significant in subjects like mathematics (Niess, 2005, 2006). Moreover, the literature highlights the im-portance of offering learning opportunities to all children through technology. OECD Education Working Paper No. 299 states, "The literature shows the importance of supporting inclusive learning through specific resources such as technology" (Gottschalk & Weise, 2023). This is especially relevant in Norway, where a primary aim in ECEC institutions and schools is to ensure that every child, regardless of their neurodevelopment, is included in mainstream education and receives a satisfactory education. However, the Norwegian Inclusive Community report indicates that inclusive education provision is still not satisfactory, particularly in mathematics and technology (Nordahl et al., 2018). One of the main reasons has been identified in teachers' perception about how to design activities for engaging all the children, and a new method has been suggested through inclusive research approaches (Granone et al., 2023; Granone & Knudsen, 2024; Østby & Haugenes, 2019).

This study aims to investigate teachers' mediation in an activity involving a coding toy in ECEC settings, with a specific focus on including all children, regardless of neurodevelopment. For increasing the understanding of what could be important for adapting an activity with a coding toy to all children, this case study uses the inclusive research method, where a co-researcher with intellectual disabilities participates in the conception and design of the activity.

2. Background

2.1 Teacher mediation

Among the many theories and contributions relevant to Early Childhood Education and Care (ECEC), such as those of Montessori (1912), Malaguzzi (1993), Piaget (1964), and Vygotsky (1978), this study is primarily grounded in Vygotsky's concept of mediated learning, emphasizing the teacher's role in scaffolding children's development through cultural tools and collaborative activities.

In the context of Vygotsky's theory of mediation (Mariotti, 2009; Vygotsky, 2012), the artifact serves as a pivotal tool that bridges external tasks and the internal learning process. According to the theory of Semiotic Mediation (Bartolini Bussi & Baccaglini-Frank, 2015; Bussi & Mariotti, 2008) artifacts act as instruments through which children can explore complex cognitive tasks, such as programming or problem-solving (Granone & Reikerås, 2023). The artifact, as for example a coding toy as in the present study, can be used for linking the physical manipulation of the artifact to abstract mathematical and programming concepts (Shumway et al., 2021). This process allows for a deeper engagement with the mathematical concepts by turning abstract ideas into tangible experiences. The teacher's role is crucial in guiding the process of semiotic mediation. Teachers are not just passive observers; they actively shape the learning experience by designing tasks that exploit the semiotic potential of the artifact (Bartolini Bussi & Baccaglini-Frank, 2015). The teacher acts as a cultural mediator, helping children move from their initial, often intuitive understandings to more formalized mathematical knowledge by interpreting and guiding the process. Teachers scaffold the learning experience by planning the activity and by supporting children's experience with the artifact. Semiotic mediation has also been analysed in literature in relation to Feuerstein approach (Abdul Rahim et al., 2009), where mediation can be articulated in 12 different criteria (Feuerstein et al., 1991).

2.2 Inclusive research

Research suggests that employing inclusive research methodologies can enhance inclusive practices for all children, regardless of neurodevelopment (Nind, 2014; Seale et al., 2014). Inclusive research aims to increase the participation of individuals with intellectual disabilities to gain deeper insights into their challenges (Østby & Haugenes, 2019). This approach has developed relatively recently in Norway, particularly in early childhood education (ECE) research (Granone et al., 2023; Granone & Knudsen, 2024), but has a long tradition in England and Australia (Johnson & Walmsley, 2003). Inclusive research involves the active participation and contribution of individuals with intellectual disabilities throughout the research process (Johnson & Walmsley, 2003; Walmsley et al., 2018), emphasizing collaboration and shared decision-making. Terms like 'co-researcher' are used to highlight collaborative involvement based on unique perspectives and conditions (Walmsley & Team, 2014). Understanding the practical implementation of inclusive research methods is crucial, with key characteristics including ownership, interest, collaboration, control and availability (Østby & Haugenes, 2019). These principles promote a participatory approach, recognizing the expertise and needs of co-researchers in the research process.

3. Materials and methods

3.1 Participants

This case study is part of the "DiCoTe" research project (DiCoTe, 2024), which aims to enhance professional digital competence in early childhood teacher education by enriching and supporting children's play with coding toys. This project addresses significant societal challenges by defining activities that enhance and support children's play using technology in ECEC

settings. Specifically, the primary objective is to involve children aged 3-5 years in collaborative programming activities with coding toys, enabling them to provide logical instructions to a robot through direct interaction with the toy, without the use of a screen. The development of these resources has been a collaborative effort involving ECEC teacher educators, ECEC preservice teachers, ECEC teachers, ECEC institution administrators, researchers and co-researchers.

Thirteen ECEC institutions were involved in the whole project. For the case study presented in this article, two institutions were chosen, because each teacher was working with a group of children where a child with developmental disability was included. Additionally, both teachers had declared before starting this case study that they didn't menage to include all the children in the activities when they used the coding toy. Therefore, the participant involved in the project were two teachers from two different ECEC institutions, and each teacher developed the activity with four children aged five years old. In each group of children were included a child with developmental disability.

3.2 Ethics

Conducting research involving children requires careful ethical considerations (Fine & Sandstrom, 1988). Informed consent was obtained from both teachers and parents. Given their familiarity with the children, the teachers were responsible for explaining the study to them in a manner appropriate to their understanding. The children were informed that they could let the teacher know if they did not wish to be observed at any point during the project. To comply with ethical guidelines set by the Norwegian Agency for Shared Services in Education and Research, which approved the project, children's names were anonymized. Data, including field notes, were securely stored on a server, with access restricted to the project leader and involved researchers.

The co-researcher involved in this project had previously worked in a research project and was familiar with concept of informed consent. Additionally, a visual consent form had been developed, and it was discussed with the co-researcher in presence of a contact person.

3.3 The artifact: a coding toy

In this study, each ECEC teacher encouraged children's play by introducing a problem-solving activity involving a coding toy that they could collectively program by intuitively providing logical instructions through direct interaction. The coding toy, named KUBO (2024), is a small robot that can be programmed without screens by arranging various tactile tiles with arrows drawn on them. As an educational tool, KUBO provides stimuli to the children that the teacher can utilize to scaffold their skills (Bussi & Mariotti, 2008).

3.4 Procedure

The activity was developed in cooperation with a co-researcher with intellectual disability and discussed with the researchers to agree on the goals, and on the important elements that the activity should offered to the children. To adhere to all the elements necessary for realizing a genuine inclusive research method, the goal of the activity was suggested by the co-researcher (ownership) with the aim of including all the children (interest) and was discussed collaboratively with the researcher. Subsequently, the activity was designed and described to be understandable for everyone (availability), and the details of the design were decided by the co-researcher (control).

The activity is a storytelling centered on the coding toy and the images reported in the board card related to the robot. It was prepared by the co-researcher and discussed jointly by the co-researcher and the researchers.

"Bob's Adventure to the Park. Today, Bob is going on a trip. He is going to enjoy a campfire. At the park, he gets off the bus. First, he needs to go to the kiosk to buy sausages and hot cocoa. Then, he continues to the campfire site. The fire is ready."

After 4 meetings and brainstorming among researchers, co-researchers, practitioners and special educators who were the contact persons for the co-researcher, different elements were outlined as relevant: a multimodal approach, that means the use of a combination of verbal communication, visual support through images and prepared ASK card (*Alternativ og supplerende kommunikasjon* [AAC, Augmentative and Alternative Communication]; Statped, 2024) for the coding toy, body language, and other modes (e.g., sign language) to support diverse communication needs; the creation of a common knowledge background, that means to involve children in activities based on familiar stories or commonly understood rules to create a shared foundation for learning; the important of working in small groups, for fostering communication and collaboration, making it easier for children to find common solutions; the relevance of adapting the activity to children's needs that means for example to allow sufficient time for each child to participate, think, and respond in a way that accommodates their individual abilities; the necessity of defining clear and focused goal, that means ensuring that the learning objective is clear, simple, and attainable for all children; the use of humour, because it reduces stress and create an inviting and inclusive atmosphere; the use of repetition and reinforcement, that indicate the repetition of activities or similar tasks to help children strengthen their skills and build competence over time.

The activity was initially prepared in Norwegian by the co-researcher and then translated into English by the author.

Each teacher presented the activity to a group of four 5-year-old children who had previously engaged in other activities with the coding toy and had developed an understanding of the coding toy's functionality. In each group one child had participated to the activities passively without being engaged. This raised uncertainty about whether he had fully understood

the coding toy's functionality. The teacher observed the activity and documented field notes immediately afterward. These notes comprised a collective observation of the children's responses to the activity, instances where children encountered challenges or were disengaged, and descriptions of how the teacher mediated children's participation and cooperation in those situations. Teachers were encouraged to provide notes that were as precise as possible using a pre-prepared observation tool. The teachers had to report notes about the number of children (and their age), the duration of the activity, the description of the activity, reflections about what was good and what could have been better, and additional important information.

3.5 Data Analysis

Thematic analysis (Braun & Clarke, 2006) was carried out by the author and discussed afterwards in collaboration with other researchers who have previously worked on inclusive research projects. While these researchers were not directly involved in this specific project, they provided feedback to ensure the reliability and availability of the identified themes.

The first step of the analysis involved familiarization with the data collected. Multiple readings were conducted, and notes were taken throughout this process. The data was then coded using an inductive approach, acknowledging that a purely inductive analysis is difficult to achieve, as researchers inevitably bring their own perspectives to the data analysis.

After conducting the initial coding, the author identified common keywords and content. These were then grouped into main themes, which were further refined. Although the ECEC teachers were not involved in the coding process, the themes were discussed with them to ensure the identified themes were relevant and accurately represented their experiences.

4. Results and discussion

The data collected through the field notes can be organised in three main themes: teachers' planning of the activity, teacher's mediation, the role of the artifact.

4.1 Teachers' planning of the activity

In line with semiotic mediation theory, both teachers stressed the importance of planning and structuring the activity to support children's understanding. T1 reflected on how starting with a familiar story helped contextualize the activity: "I began the activity by telling a story that connected KUBO's movements to a real-world scenario, like navigating through a city." Bartolini Bussi and Mariotti (2008) suggest that contextualization through narrative helps children relate the semiotic potential of an artefact (such as KUBO) to everyday experiences, making abstract concepts more tangible. T2 emphasized the role of visual aids in supporting children's understanding: "I used directional arrows, grid maps and pictures to help the children visualize KUBO's path and understand the concept." This use of visual aids can be interpreted through the lens of semiotic mediation, as the teacher intentionally mediates the relationship between the artefact and the mathematical concepts it represents. The use of multimodal materials—such as cards, arrows, and grids—further helped engage children with different learning preferences, illustrating how the artefact itself serves as a semiotic tool that supports the construction of knowledge. Both teachers also highlighted the importance of breaking the activity into manageable steps. T1 mentioned, "I broke down the programming steps into smaller tasks," while T2 described, "I started with simple movements and gradually increased complexity." This structured mediation aligns with the idea that artefacts, when paired with guided instruction, can facilitate cognitive development by allowing children to gradually internalize complex concepts (Mariotti, 2012).

4.2 Teacher's mediation

Both teachers highlighted the importance of mediating the activity to promote understanding and engagement, in accordance with what described in Bartolini Bussi and Mariotti's (2008) concept of semiotic mediation, where the teacher plays a key role in guiding children's interpretation of signs and symbols within the learning environment. T1 emphasized, " I guided the children step-by-step as they programmed KUBO, suggesting questions that helped them reflect on their choices." This aligns with the idea that teachers support children in linking external representations (such as KUBO's movements) with internal mathematical concepts (Bartolini Bussi & Mariotti, 2008). T2 described how scaffolding was crucial in the mediation process, saying, "I used guiding questions to help the children think critically about their choices at each step." This reflects how scaffolding can function as a form of semiotic mediation, where the teacher helps bridge the gap between the children's spontaneous interpretations and formal understanding. Both teachers also reflected on the increased engagement from all children, including those who were typically more passive in previous activities. T1 observed, "I noticed that a child who usually stays quiet and disengaged was actively participating in programming KUBO this time. The hands-on nature of the task seemed to really interest him." T2 shared a similar experience, stating, "One child who rarely contributes to group activities with the coding toy was suddenly leading their group, using sign language and body language (pointing), nodding when the other children responded verbally to him. It was rewarding to see such a shift in confidence and involvement.". Feedback and adapting teaching to individual needs was also emphasized. T1 noted, "I provided immediate feedback during the activity, helping children correct mistakes and reinforce accurate steps," reinforcing Bartolini Bussi and Mariotti's claim that teachers facilitate the transformation of artefacts into mathematical signs by providing children with appropriate tools and feedback (Bussi & Mariotti, 2008). T2 focused on individualized learning support, saying, "I adjusted my

support as needed to ensure every child was progressing, particularly one child who often falls behind in previous activities. This time, they were all fully engaged.". Additionally, T2 emphasized peer collaboration, which Bartolini Bussi and Mariotti consider essential (Bussi & Mariotti, 2008): "I encouraged peer-to-peer discussions, allowing children to explain their reasoning to one another." T1 added, "I saw a noticeable change in one child who usually remains on the sidelines during group work. Having the possibility of pointing to pictures that represented the coding toy's movement he could communicate clearly with the others. Children were all actively involved in solving the problem and even tried to share their thoughts with the group during our reflection session.". Lastly, T1 returned on creating a reflective environment: "After each section, I asked the children to pause and reflect on what they had done, encouraging them to share their thoughts and insights with the group." This reflective mediation helps children develop a metacognitive awareness of their problem-solving strategies, and the inclusion of all children in these reflective moments through sign language and images showed a marked improvement in engagement from typically quieter children.

4.3 The role of the artifact

The teachers reflected on how the design of KUBO and the suggested multimodal approach enabled children to engage with abstract concepts in a concrete manner. T1 stated, "KUBO's clear movement and simple commands helped the children grasp the cause and effect of their programming decisions." This reflects the idea that artefacts become mediating tools that link actions (programming KUBO) with underlying mathematical concepts (sequencing and spatial awareness). T2 added, "The tactile nature of placing command tiles on KUBO allowed the children to engage with the programming process in a hands-on way, making it accessible for those with different learning styles." This tactile interaction with the artefact can be seen as a process of semiotic mediation, where children generate meaning through physical manipulation of symbols (Mariotti, 2012). The children's manipulation of KUBO's commands served as an entry point into deeper reasoning about programming and spatial relationships, as the teachers helped them interpret these actions. Moreover, T1 highlighted KUBO's role in providing instant feedback: "KUBO's immediate response allowed the children to see the results of their programming and make adjustments," which is in accordance with Bartolini Bussi and Mariotti's view that feedback loops provided by artefacts support the process through which children convert an external artefact into a cognitive tool. Both teachers underscored the importance of the multimodal approach in fostering inclusivity. T1 observed, "The simplicity of the activity and the multimodal approach made it accessible to all children, allowing everyone to participate," while T2 noted, "The multimodal approach ensured that children with different learning preferences could engage effectively."

4.4 Bridging Semiotic Mediation and Feuerstein's Mediated Learning: A Synergistic Approach to Enhancing Engagement

The mediation provided by the teachers aligns closely with Feuerstein's concept of Mediated Learning Experience (MLE), particularly in relation to intentionality, transcendence, meaning, and competence (Feuerstein et al., 1991). Intentionality and reciprocity, indicates the criterium where the teacher deliberately directs the children's focus and fosters reciprocal interaction; transcendence, instead, is the criterium which encourages children to apply skills beyond the immediate task; mediation of meaning, is the one that describes a mediation where the teacher helps make the task personally meaningful for the children; mediation of competence, is the criterium where the teacher supports the children in developing a sense of capability and mastery.

For example, T1 emphasized the importance of guiding children step-by-step, saying, "I guided the children step-by-step as they programmed KUBO, suggesting questions that helped them reflect on their choices." This reflects intentionality and reciprocity, where the teacher intentionally focuses the children's attention on key aspects of the task while creating opportunities for reciprocal communication (Feuerstein, 1991). T2's approach also mirrors this intentional mediation, with a focus on scaffolding: "I used guiding questions to help the children think critically about their choices at each step." By asking reflective questions, T2 mediates not only the task but also the child's thinking process, promoting transcendence—helping children apply learned strategies to broader contexts beyond the immediate activity. Both teachers observed increased engagement from all children, including those who were typically more passive in previous activities. T1 reflected, "I noticed that a child who usually stays quiet and disengaged was actively participating in programming KUBO this time. The hands-on nature of the task seemed to captivate them." Here, T1 is engaging in mediation of meaning, a critical aspect of Feuerstein's MLE. By making the task meaningful and relevant, the teacher helped transform the child's relationship with the learning activity, fostering deeper engagement. T2 shared a similar experience, stating, "One child who rarely contributes to group activities with the coding toy was suddenly leading their group, using sign language and body language (pointing), nodding when the other children responded verbally to him. It was rewarding to see such a shift in confidence and involvement." This also exemplifies mediation of competence, where the teacher's actions help the child feel competent and capable, leading to increased motivation and active participation. Feuerstein (1991) argued that mediators should help children recognize their own potential, and here T2's scaffolding encouraged the child to take on a leadership role, further reinforcing their competence. Additionally, T1 and T2 provided feedback and adapted their mediation based on the individual needs of each child. T1 observed, "I provided immediate feedback during the activity, helping children correct mistakes and reinforce accurate steps." This aligns with mediation of competence, as Feuerstein emphasizes the impor-

tance of helping children develop a sense of control and efficacy over their learning. T2 noted, "I adjusted my support as needed to ensure every child was progressing, particularly one child who often falls behind in previous activities. This time, they were fully engaged." This personalized mediation helps cultivate a sense of competence and mastery in children who might otherwise disengage. T2 also focused on mediation of meaning by facilitating peer collaboration: "I encouraged peer-to-peer discussions, allowing children to explain their reasoning to one another." Feuerstein stresses the role of meaningful interaction, where the teacher mediates not only the task but also the social and cognitive interactions between children. Similarly, T1 described, "I saw a noticeable change in one child who usually remains on the sidelines during group work. Having the possibility of pointing to pictures that represented the coding toy's movement he could communicate clearly with the others. Children were all actively involved in solving the problem and even tried to share their thoughts with the group during our reflection session." This shows that T1's mediation fostered a supportive environment where even children who didn't menage to be engaged were encouraged to participate fully, reinforcing their sense of competence and control over the task.

Finally, T1 reflected on transcendence by encouraging metacognitive reflection: "After each section, I asked the children to pause and reflect on what they had done, encouraging them to share their thoughts and insights with the group." This reflective process extends beyond the immediate task, helping children develop transferable problem-solving skills and encouraging them to generalize their learning to new contexts, which is central to Feuerstein's idea of transcendence.

4.5 Reflections about the role of inclusive research method

The use of inclusive research in developing this activity was crucial to reflect on how to ensure that all children, regardless of their abilities, could be engaged in an activity with a coding toy. By involving a co-researcher with an intellectual disability in both the conception and design of the activity, the project embraced key principles of ownership, interest, collaboration, availability, and control—elements central to inclusive research. The co-researcher's suggestion of a storytelling-centered activity (ownership) helped establish an approach that would engage children's natural curiosity and provide a meaningful context for all participants (interest) (Østby & Haugenes, 2019). For example, the story tied KUBO's movements to familiar, real-world scenarios, as T1 reflected: "I began the activity by telling a story that related KUBO's movements to a real-world scenario the children could relate to, like navigating through a city." This created a shared experience that all the children, regardless of their abilities, could connect with, thereby increasing engagement. The collaborative nature of the design process ensured that the activity was accessible and understandable to everyone involved (availability) (Østby & Haugenes, 2019), while the co-researcher maintained control over critical decisions in the design process, such as focusing on a multimodal approach. T2 highlighted the importance of this approach by saying, "I used visual aids, like directional arrows, grid maps and pictures, to help the children visualize KUBO's path and better understand the concept." The co-researcher's input into this aspect of the activity reinforced the use of different modes of communication, helping children with diverse learning preferences engage more deeply with the task. Additionally, the emphasis on small-group work, adapting the activity to the children's individual needs, and incorporating humour and repetition were all elements suggested or refined through the input of the co-researcher and the collaborative meetings with the research team. T2, for instance, reflected on adapting the activity for all children: "I structured the lesson in small steps, starting with KUBO moving in one direction and gradually increasing the complexity as the children gained confidence." This not only reflected Feuerstein's mediation of competence (Feuerstein et al., 1991), allowing children to feel capable and build confidence, but also adhered to the inclusive principle of giving each child the time and space to succeed at their own pace (Østby & Haugenes, 2019). Similarly, humour played an important role in engaging children who were passive in previous activities, as T2 noted, "I used humour and encouragement to keep everyone engaged and motivated.". By centering the voices of individuals with intellectual disabilities in the research and development process, the project created an activity that was not only inclusive in its goals but also in its very design and execution. The active participation of the co-researcher led to the development of a learning experience that was meaningful, engaging, and adaptable to every child's needs, demonstrating the value of inclusive research in producing genuine educational outcomes.

5. Limitations

This study presents several limitations that should be acknowledged. First, the small number of participants—two teachers and eight children—limits the generalizability of the findings. This is partly due to the fact that few teachers involved in the project had prior experience working with both technology, such as coding toys, and children with disabilities. As a result, the sample size is relatively constrained, which may affect the breadth of insights. Additionally, while the teachers provided detailed field notes, the lack of direct observations limits the data to the teachers' perspectives. This reliance on field notes, rather than real-time observations, may have introduced a degree of subjectivity, reflecting the teachers' own perceptions of the children's engagement and learning. The absence of direct observation may have compromised a deeper understanding of the children's interactions with the coding toy and the nuances of teacher mediation. Lastly, the study was conducted in a specific ECEC context in Norway, and the cultural and pedagogical practices of these institutions may not fully represent other settings. Future research could benefit from a larger sample size, direct observations, and a broader range of participants to offer a more com-

prehensive understanding of teacher mediation and the role of technology in inclusive educational practices.

6. Conclusions

The study highlights the significant role of teacher mediation and inclusive research in supporting the participation and learning of all children, including those with disabilities, in coding activities. The collaborative process, which involved co-researchers with intellectual disabilities, ensured that the activity was designed to be engaging, accessible, and meaningful for all participants. Reflections about the semiotic mediation and Feuerstein's mediated learning theory illustrates how teachers can scaffold children's understanding by bridging abstract concepts with concrete, hands-on experiences. Moreover, the inclusive research approach allowed for the design of activities that not only aligned with educational goals but also promoted active participation from all children, regardless of their learning preferences or abilities. By incorporating multimodal approaches, group work, and humour, the activity fostered a more inclusive and engaging learning environment. This study highlights the value of using inclusive research methods in early childhood education to ensure that all children benefit from engaging with technology, such as coding toys, in ways that enhance their cognitive development and social inclusion.

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