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Creation of Didactic Materials at an Art Academy for Children with Developmental Disabilities Involved in Equine-Assisted Learning Interventions

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This paper presents a practice-based exploratory project focused on the codesign and evaluation of didactic materials for children with developmental disabilities participating in equine-assisted learning interventions. The project was conducted during the 2022/2023 and 2023/2024 academic years through a collaboration between the Art Education Department of the Academy of Fine Arts in Zagreb, the Don Kihot Association and partner organisations. Ten graduate students participated as part of their coursework in the subjects Pedagogy, and Methodology of Fine Arts. The primary aim of the project was to integrate theoretical instruction with artistic practice through project-based learning and gamification, while preparing future teachers to design inclusive didactic materials adapted to the needs of children with developmental disabilities. A secondary aim was to explore how such codesigned materials function in practice during equine-assisted learning sessions. The study adopted a qualitative, practice-oriented approach. Data were collected through student portfolios, teachers' and collaborators' reflective notes, and structured evaluation forms completed by practitioners during the application of the didactic materials with three child participants. The project resulted in ten original didactic toys and games. The findings indicate that student engagement and intrinsic motivation increased through real-world, socially relevant design tasks. Practitioner evaluations suggest that the usability and acceptance of didactic toys depend strongly on the child's specific type of developmental difficulty as well as on task complexity, thus highlighting the importance of adaptability and individualisation. The study contributes to practice-based research in inclusive art education and equine-assisted learning by offering empirically grounded reflections on the design and use of didactic materials.

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Priprava didaktičnih gradiv na umetniški akademiji za otroke z motnjami v razvoju, vključene v oblike učenja s pomočjo konj

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Ta članek predstavlja praktično-raziskovalni projekt, osredinjen na sooblikovanje in evalvacijo didaktičnih gradiv za otroke z motnjami v razvoju, ki sodelujejo v oblikah učenja s pomočjo konj. Projekt je potekal v študijskih letih 2022/23 in 2023/24 v sodelovanju med Oddelkom za likovno vzgojo Akademije za likovno umetnost v Zagrebu, društvom Don Kihot in partnerskimi organizacijami. V projektu je sodelovalo deset podiplomskih študentov v okviru predmetov Pedagogika in Metodologija likovne umetnosti. Glavni cilj projekta je bil povezati teoretično poučevanje z umetniško prakso prek projektnega učenja in igrifikacije, hkrati pa pripraviti bodoče učitelje na oblikovanje inkluzivnih didaktičnih gradiv, prilagojenih potrebam otrok z motnjami v razvoju. Drugi cilj je bil raziskati, kako takšna sooblikovana gradiva delujejo v praksi med učnimi urami s pomočjo konj. Študija je uporabila kvalitativni, v prakso usmerjen pristop. Podatki so bili zbrani na podlagi študentskih portfeljev, refleksivnih zapiskov učiteljev in sodelavcev ter strukturiranih ocenjevalnih obrazcev, ki so jih izpolnili učitelji med uporabo didaktičnega gradiva s tremi sodelujočimi otroki. V okviru projekta je nastalo deset izvirnih didaktičnih igrač in iger. Ugotovitve kažejo, da sta se vključenost študentov in notranja motivacija povečali prek nalog iz oblikovanja gradiv, ki so bile realistične in družbeno relevantne. Ocene učiteljev kažejo, da sta uporabnost in sprejemljivost didaktičnih igrač močno odvisni od specifične vrste razvojnih težav otroka ter od zahtevnosti naloge, kar poudarja pomen prilagodljivosti in individualizacije. Študija dopolnjuje v prakso usmerjeno raziskovanje na področju inkluzivne umetnostne vzgoje in učenja s pomočjo konj, saj ponuja empirično utemeljene refleksije o oblikovanju in uporabi didaktičnih gradiv.

Ključne besede: otroci s posebnimi potrebami, učenje s pomočjo konj, didaktično gradivo, igrifikacija, projektno učenje, inkluzivno izobraževanje

Introduction

Practice-based learning, as a form of experiential learning, responds to the demands of the twenty-first-century workplace (Huggins, 2017). Accordingly, contemporary higher education in teacher studies should integrate theory and practice, adopt interdisciplinary learning and be grounded in problem-based approaches. The need for additional education of future teachers to work with children with special educational needs and improve their inclusion in the education system has been recognised and is addressed by many researchers. Kavkler et al. (2015) write that teachers experience communication challenges and fail to recognise pupils' strengths, so it is necessary to encourage future teachers to shift their focus from deficits to identifying and developing pupils' strengths, thus promoting success despite ongoing learning difficulties. According to Šmid (2016), teachers' awareness of the actual abilities of pupils with special educational needs is key to making inclusion more effective. Kink-Hampersberger et al. (2023) have developed teacher training that includes *habitus reflexivity*, which helps future teachers to recognise inequality and power imbalances, and to adapt to changing educational contexts, as effective practice is rooted in solid theoretical understanding. For better inclusion of children with developmental disabilities in mainstream education, in accordance with the Salamanca Statement and the Framework for Action on Special Needs Education (UNESCO, 1994), a project was conducted at the Art Education Department of the Academy of Fine Arts in Zagreb. The project involved ten second-year graduate students of the teacher training programme Fine Arts Culture and was carried out within the integrated coursework of the subjects Pedagogy, and Methodology of Fine Arts Education during the 2022/2023, 2023/2024 and 2024/2025 academic years.

A project was designed in which students connected theoretical knowledge with its practical application in the development and implementation of new didactic materials. The project was conducted in collaboration with the Croatian Association of Multiple Sclerosis Societies (a non-governmental, non-profit, social organisation that includes 21 county member associations, thus covering the entire territory of the Republic of Croatia, https://sdmsh.com.hr) and the Don Kihot Association for equine-assisted therapy and (re)habilitation of children with developmental disabilities and persons with disabilities (https://www.donkihot.hr). The Croatian Association of Multiple Sclerosis Societies engaged a paediatrician to familiarise students with approaches to children with developmental disabilities. The students then visited the ranch of the Don Kihot Association, and after the visit, they conceptually designed didactic

materials, created sketches, discussed their ideas and developed them using computer software. Based on the resulting designs, didactic toys were produced using appropriate materials and available production techniques (CNC, 3D printing, silicone moulding). The designed didactic toys and games were evaluated by the association with children undergoing equine-assisted therapy.

Equine-Assisted Activities and Therapies

According to Stojnović (2015), equine-assisted therapy is a specialised therapeutic practice involving interaction with horses according to predefined goals, methods and didactic materials, carried out by professionals such as pedagogues, teachers, special educators, sociologists, psychologists and physiotherapists who have additional training in equestrianism and equine therapy (specialisation level). Various subtypes of equine-assisted therapy exist, including hippotherapy, which focuses on improving neurological and sensorimotor functions. Hippotherapy or physiotherapy with horses (Hallberg, 2017) impacts mental and cognitive abilities through complex sensorimotor stimuli and is used for a broad range of difficulties such as cerebral palsy, autism, speech, reading and writing disorders, hearing and vision impairments, emotional disorders, behavioural problems, educational neglect and more. Therapeutic riding helps address motor coordination issues (Tomašek, 2023) and stimulates tactile sensations through touch, balance systems and sensory input (Šaban & Kosinac, 2014). As part of equine-assisted therapy, special education riding (therapeutic-pedagogical riding or vaulting) is aimed at developing children with difficulties by fostering their individual and social development through interaction with horses. It is based on knowledge from pedagogy, special education, social pedagogy, psychology and occupational therapy, and is implemented as a comprehensive, goal-oriented approach to working with children with developmental disabilities and individuals with disabilities (Stojnović, 2015). This therapy aims to improve coordination, concentration and attention, and to reduce aggression, overcome fears, boost self-confidence and foster a sense of support (Šuvak, 2004). It can be conducted individually or in groups and includes the development of motor skills, socialisation and improved concentration. Intervention goals include reducing behavioural disorders and developing communication skills and self-confidence (Tatković et al., 2018). Learning is often integrated into horseback activities, making it more engaging and effective.

New Didactic Materials (Toys and Games) for Equine Therapy and Equine-Assisted Learning

Play is increasingly used in learning due to its significant impact on the development of social, moral, emotional and interpersonal skills. The content of the game must be clearly defined with set rules and learning outcomes. Depending on their purpose, didactic games can be *perceptual-motor games*, aimed at sensory development and distinguishing objects by shape, size and characteristics; *attention and reaction games*, developing accuracy and speed; *memory games*, reinforcing knowledge through mental activity; or *puzzles*, helping children sort by colour, shape or quantity (Grm, 2021, p. 327). These games aim to develop sensory perception, concentration, memory, socialisation and character. They can include physical movement, recognising colours and textures, inserting shapes into matching slots, understanding comparative relationships, contrasts in colour and form, rhythm recognition and spatial awareness. With this foundation, didactic toys and materials were designed to develop the visual and sensory abilities of children with developmental disabilities.

Creativity as an Integral Part of the Teaching Process and Content Transfer

Play is a central element of human culture and creativity (Huizinga, 1950) and is closely linked to creative expression in artforms such as dance, drama and visual arts (Read, 1943, 1956). Structured activities such as games and performances can bring about a *flow state* with therapeutic value (Csikszentmihalyi, 1988). Creativity and play share qualities like process orientation, openness to uncertainty, exploration, divergent thinking, choice and creation (Duffy, 1998, 2006). Creativity is often defined as original thinking resulting in new ideas or products, involving ideation and feasibility testing, relying first on imagination and later on learned skills (Petrović Sočo, 2000).

At the Academy of Fine Arts in Zagreb, the Art Education Department encourages combining imagination, ideas and skills through interdisciplinary links between theory and practice. Students are encouraged to transfer their creative processes into learning and teaching, aligning with the concept of *teaching creatively* and *teaching for creativity* (Jeffrey & Craft, 2004). Assignments are derived from life experiences (Ames, 1992, in Palmer, 2005), prompting students to engage in real-world action (McGonigal, 2011). One such assignment was the present project. Through guided cognitive, intuitive and exploratory activities, students developed new didactic toys, improved their making skills with new technologies and gained independence in project execution. Tarr (1996)

outlines six key areas of the creative process in artists and educators: free exploration with materials, concepts and ideas; external stimulation; specific skills and techniques; a supportive work environment; reflection; and presentation. These align with the *incubation model* of teaching (Torrance, 1995): problem identification, confirmation, alternative solution creation, evaluation, and implementation planning. The project-based teaching was framed through gamification. Benefits in higher education include informal learning from digital environments so that new cognitive skills emerge, as well as visual-spatial representation and multitasking (Greenfield, 2009). Gamification fosters intrinsic motivation, collaboration, friendly competition and experimentation without fear of failure (Gee, 2008; Lee & Hamer, 2011, as cited in Koutropoulos & Porter, 2020), resulting in *flow*, which is common to both games and the creative process. The present project featured dual gamification. The students first went through the same process experienced by participants in equine-assisted interventions, and then, based on that experience, designed games that function as a combination of two types of gamification: content gamification (modifying content to adapt it to the principles of a game) and structural gamification (applying game elements to guide users through content that remains unchanged) (Kapp, 2012). The designed games will benefit children involved in the treatment on two levels: introducing them to visual arts (and other) content and providing gameplay with a therapeutic effect. In this process, extrinsic and intrinsic motivation are combined, arising from the use of an allusive base of meaning (Broudy, 1987, 1999) through which children think and feel. Motivation operates during the learning of skills, concepts and attitudes both directly, through the immediate perception of information, and indirectly, through associations. The application of the designed games involves gestures, behaviour and actions, thereby activating the emotional brain (Chabot & Chabot, 2004).

Purpose of the Project and the Study

The project was designed as an educational and co-creative intervention in higher art education. Its primary aims were to provide students with opportunities for practice-based learning that integrates theory and practice, problem-solving and interdisciplinarity, in order to facilitate the transfer of their creative processes from art courses to the development of didactic materials for children with developmental disabilities, and to foster the development of empathy and inclusive attitudes among students.

In contrast, the study is positioned as an empirical, practice-based qualitative investigation. Its overarching research aim is to examine how the

co-creative design and application of didactic materials within equine-assisted learning contexts influences students' learning, and how practitioners and children with different developmental profiles engage with and respond to the newly developed materials.

Problem and Objectives

Despite increasing emphasis on inclusive education and experiential learning in higher education, opportunities for art students to engage in practice-based, interdisciplinary projects that connect artistic processes with socially relevant applications remain limited. At the same time, equine-assisted learning environments, which are increasingly used to support children with diverse developmental profiles, often lack specially designed didactic materials.

Consequently, there is a need for educational initiatives that simultaneously support inclusive practices, foster empathy and social awareness among students, and explore innovative ways of developing and applying learning materials for children with developmental disabilities.

The research objectives are:

1. to assess how the process influenced the students (i.e., how participation in a project-based and gamified design process supports art education students in developing competencies for inclusive didactic material design);
2. to explore how practitioners and children with different developmental disabilities perceive and use the newly designed didactic toys during equine-assisted learning sessions;
3. to identify which design features (e.g., complexity, adaptability, materiality) appear to facilitate or hinder the usability and acceptance of equine-assisted learning, and the inclusive participation of children in it.

Research Questions

Guided by these objectives, the current empirical analysis addressed the following research questions:

1. In what ways does participation in a practice-based, project-based and gamified design process shape students' motivation, perceived preparedness and understanding of inclusive didactic material design for children with developmental disabilities?
2. How are the newly designed didactic materials used and experienced by

practitioners and children with different developmental profiles during equine-assisted learning sessions?

3. Which specific design features of the didactic toys appear to support or constrain children's participation, engagement and task completion in equine-assisted learning contexts?

Method

The study is designed as a practice-based exploratory qualitative study embedded within a pedagogical project conducted in higher art education. The methodological approach is aligned with the aims of practice-oriented and intervention-based research, focusing on systematic reflection on design processes, implementation contexts, and practitioner and user responses.

The methodological framework integrates elements of qualitative project documentation, reflective practice and practitioner-based evaluation, allowing for an in-depth examination of the educational and applied dimensions of the project.

Participants

The research sample consisted of two interconnected participant groups:

(a) Ten graduate students enrolled in the university master's programme Fine Arts Education: eight female students and two male students, aged 23–26 years. During their previous studies, the students had attended art workshops at the following institutions: Special Hospital for Children with Neurodevelopmental and Motor Disorders, Zagreb; Rehabilitation Centre Zagreb for children with special needs; Autism Centre in Zagreb. The student participants were second-year graduate students attending the compulsory courses Pedagogy, and Methodology of Fine Arts Education. Participation in the project formed part of their regular coursework and assessment. All of the students completed the full project cycle, from conceptual design to prototype development and reflection.

(b) Three children with developmental disabilities participating in equine-assisted learning sessions at the Don Kihot Association.

The child participants were purposefully selected by practitioners at the Don Kihot Association based on their regular participation in equine-assisted learning programmes and their ability to safely engage with the newly designed didactic materials. The sample included:

- a 7-year-old child with cerebral palsy attending a mainstream programme with individualised support;
- an 8-year-old child with intellectual disabilities, delayed speech-language development and motor planning difficulties, attending a customised programme;
- a 12-year-old child with autism spectrum disorder participating in a specialised programme.

Instruments

Multiple qualitative data sources were used to document and reflect on the project process and its outcomes:

1. Teachers' and collaborators' reflective notes, recorded throughout all project phases, focusing on student engagement, decision-making processes, collaboration and emerging challenges.
2. Student portfolios, comprising conceptual sketches, written reflections, design rationales and documentation of material choices and production processes.
3. Didactic toy prototypes, analysed as artefacts of the design process and as functional tools during equine-assisted learning sessions.
4. Structured evaluation forms, completed by practitioners at the Don Kihot Association during and after the application of the didactic toys with child participants. The forms focused on usability, acceptance and adaptability, observing responses across cognitive, motor, social and emotional domains.
5. Case-based observations, documenting individual child–toy interactions during equine-assisted learning sessions.

The instruments were developed specifically for the purposes of this project, in close collaboration with practitioners, and were intended to support systematic reflection rather than standardised measurement.

Research Design

Project Process

The project was conducted in three interrelated phases, each corresponding to specific pedagogical and research objectives:

- Phase 1: Familiarisation and Conceptual Design

  The students were introduced to the characteristics and needs of

children with developmental disabilities through a guest lecture delivered by a paediatrician and through a field visit to the Don Kihot Association. During this phase, they observed equine-assisted learning sessions, explored the physical environment and available equipment, and engaged in guided discussions. Based on these experiences, the students developed initial concepts and sketches for didactic toys, which were discussed and refined through peer and mentor feedback.

- Phase 2: Prototype Development and Exhibition
  In the second phase, the students translated their conceptual designs into functional prototypes using contemporary production techniques, including 3D modelling, CNC processes and additive manufacturing. The completed prototypes were presented at the final exhibition of the Art Education Department in June 2024. Following the exhibition, the didactic toys were donated to the Don Kihot Association for practical use.

- Phase 3: Application and Practitioner Evaluation
  In the final phase, practitioners at the Don Kihot Association integrated selected didactic toys into equine-assisted learning sessions with the child participants. Each child engaged with 3–6 toys over five sessions conducted between 30 June and 29 September 2024. Practitioner evaluations were recorded using structured forms (evaluation criteria: cognitive development, motor development, social interaction and participation, emotional functions, usability, user acceptance, overall user satisfaction) and reflective notes.

After the research was completed, the didactic toys were returned to the students and to the artistic associate of the Academy of Fine Arts (who is also a volunteer of the Don Kihot Association) for refinement and production using environmentally friendly materials.

Data Analysis

Data analysis followed a qualitative, interpretative approach. Project documentation, portfolios and practitioner evaluations were subjected to iterative thematic reading. Patterns related to student learning, toy usability, child engagement, task complexity and adaptability were identified and compared across cases.

The analysis focused on cross-case synthesis and analytical reflection, which is consistent with the exploratory and practice-based orientation of the

study. The analysis sought to address the research questions by linking observed patterns to design features and contextual factors within equine-assisted learning environments.

Results

The results are presented in relation to the three research questions and are organised thematically. The findings synthesise practitioner evaluations and observations of child engagement across cases. Detailed descriptions of individual toys, materials and student authorship are provided in the supplementary materials.

Student Learning Outcomes and Engagement (RQ1)

Analysis of student portfolios, reflective notes and mentor observations indicates that participation in the practice-based design project had a positive impact on the students' motivation, engagement and perceived preparedness for working with children with developmental disabilities.

The students demonstrated increased intrinsic motivation, particularly after direct exposure to the equine-assisted learning context during the field visit. Engagement was further strengthened through gamified project structures, peer collaboration and the opportunity to design artefacts intended for real-world use. The students' reflective notes reveal a shift from initial uncertainty and fear of "doing something wrong" towards greater confidence in adapting artistic ideas to diverse learner needs.

The iterative design process – moving from conceptual sketches to functional prototypes – supported the students' understanding of inclusive design principles, such as simplicity, adaptability and material safety. The students also reported improved competence in using contemporary production technologies (e.g., 3D modelling and printing) as tools for pedagogical problem-solving rather than purely technical skills.

Usability and Acceptance of Didactic Materials (RQ2)

The practitioner evaluations indicate that the usability and acceptance of the didactic toys varied across the children and were closely linked to task complexity, motor demands and cognitive load. Toys that allowed gradual progression, clear rules and immediate sensory feedback were generally more readily accepted.

Across all cases, the children responded positively to toys that integrated movement, tactile stimulation and visual cues within the equine-assisted learning

sessions. The combination of riding-related bodily engagement and hands-on manipulation of objects appeared to enhance focus and sustained participation.

In contrast, toys involving multiple simultaneous demands – such as complex bilateral coordination, abstract rules or many elements – were initially met with hesitation or frustration, particularly by children with intellectual disabilities or autism spectrum disorder. However, practitioner support and task simplification often led to improved engagement over repeated sessions.

Child-Specific Interaction Patterns (RQ3)

Cross-case analysis highlights distinct interaction patterns linked to the children's developmental profiles:

- *Child with cerebral palsy (age 7):*
  This child accepted all of the selected toys with minimal adaptation. Toys supporting balance, proprioception and gross motor control were particularly effective. The possibility of varying task difficulty contributed to sustained engagement and increased confidence.
- *Child with intellectual disabilities (age 8):*
  Acceptance was strongly influenced by task simplicity and clarity. Toys with straightforward goals and demonstrative instructions were most successful. More complex tasks initially elicited resistance, but performance improved with guided support and encouragement.
- *Child with autism spectrum disorder (age 12):*
  Familiar shapes, colours and predictable structures facilitated engagement. Toys with excessive visual or functional complexity led to frustration. Gradual introduction of challenges and reduction of elements improved task completion and emotional regulation.

These patterns suggest that adaptability and modularity are key design features for didactic materials used in equine-assisted learning, allowing the practitioners to tailor activities to individual needs.

The practitioners emphasised that effective didactic toys should allow for immediate modification during sessions, including simplification of tasks, adjustment of material resistance and reduction of sensory input. The ability to combine or separate game elements was identified as particularly valuable.

Overall satisfaction with the designed materials was high, with the practitioners noting their potential for repeated use across sessions and for integration into individualised learning plans. At the same time, evaluations highlighted the need for further refinement of several toys in terms of size, weight and number of elements.

The results indicate that:

1. practice-based, gamified design projects can effectively support student learning and motivation in inclusive art education;
2. the acceptance and effectiveness of didactic materials in equine-assisted learning depend on the alignment between toy design and individual developmental profiles;
3. adaptable, modular and sensory-responsive designs are particularly suitable for diverse equine-assisted learning contexts.

Discussion

The findings of this practice-based exploratory study provide insight into the potential of codesigned didactic materials within equine-assisted learning contexts, particularly when developed through interdisciplinary collaboration between art education, inclusive pedagogy and practitioner expertise. The discussion interprets the results in relation to the research questions, relevant theoretical frameworks and existing literature. While the broader project functioned as an educational and design intervention in higher art education, the present paper specifically reports on the empirical, qualitative analysis of student learning processes and the use of codesigned didactic materials in equine-assisted learning sessions.

Contribution to Inclusive and Practice-Based Education

The results support existing research emphasising the importance of preparing future teachers for inclusive practice through authentic, context-based learning experiences (Kavkler et al., 2015; Šmid, 2016). By engaging students in the real-world design of didactic materials for children with developmental disabilities, the project enabled a shift from deficit-oriented perspectives towards recognising individual strengths and adaptive possibilities.

The practice-based nature of the study aligns with contemporary approaches to intervention-oriented and design-based educational research, where knowledge and skills are generated through reflective engagement with practice rather than through experimental control (Mann et al., 2020). This positioning addresses critiques regarding the applicability of research findings to complex educational settings and supports calls for more evidence-informed yet context-sensitive practices in inclusive education.

Creativity, Gamification and Learning Design

The integration of creativity and gamification played a central role in

both student learning and the functionality of the designed didactic materials. Consistent with theoretical perspectives on creativity and play (Huizinga, 1950; Csikszentmihalyi, 1988; Jeffrey & Craft, 2004), the project demonstrated how structured, yet open-ended design tasks can foster intrinsic motivation, experimentation and sustained engagement. Gamification supported learning on multiple levels: it provided students with experiential insight into equine-assisted learning processes and informed the design of games that combine educational content with embodied interaction. This dual-layered gamification resonates with Kapp's (2012) distinction between content and structural gamification, and contributed to the emergence of flow experiences observed among both the students and the child participants.

Implications for Equine-Assisted Learning Practice

The study contributes to the growing body of literature on equine-assisted learning by highlighting the role of didactic material design as a mediating factor in therapeutic and educational engagement. Rather than focusing solely on the horse–rider interaction, the findings suggest that carefully designed artefacts can extend and structure learning opportunities within sessions. Practitioner evaluations underscore the importance of adaptability, modularity and sensory responsiveness in didactic toys used with children with developmental disabilities. These findings are consistent with research emphasising individualisation and accessibility in inclusive interventions, supporting the shift from standardised activities towards flexible, child-centred approaches (UNESCO, 1994; UNESCO, 2016).

Importantly, the results also reinforce critical distinctions between equine-assisted therapy and equine-assisted learning. While therapeutic outcomes were not formally measured, the observed benefits relate primarily to engagement, participation and learning processes, rather than clinical change, thus supporting the appropriateness of framing the project within equine-assisted learning rather than therapy. Recent systematic and scoping reviews of equine-assisted activities and therapies for neurodevelopmental populations similarly highlight improvements in social engagement, communication and participation, while stressing the need for individualised, flexible approaches tailored to developmental profiles such as autism spectrum disorder, intellectual disabilities and cerebral palsy (Trzmiel et al., 2019; Cleary et al, 2024; Zoccante et al., 2024). These syntheses underscore the importance of adapting task demands, sensory input and interactional structures to support differential responsiveness among children, which is consistent with the design patterns observed in the present study.

Cross-Case Insights and Individualisation

The differences observed across the child cases highlight the necessity of individualised design strategies. The child with cerebral palsy benefited from activities emphasising balance and proprioception, while the children with intellectual disabilities and autism spectrum disorder required clearer structures and reduced complexity. These findings align with inclusive education principles that advocate for multiple pathways to participation and learning and resonate with the framework of Universal Design for Learning, which emphasises multiple means of engagement, representation, and action and expression to reduce barriers and support learner variability (CAST, 2018; Novak, 2021). The ability to adjust task difficulty, reduce sensory overload and scaffold engagement emerged as critical factors in sustaining motivation and preventing frustration. This reinforces the importance of practitioner mediation and iterative design refinement in applied educational contexts.

Conclusion

This practice-based exploratory study examined the design, implementation and evaluation of didactic materials developed within an interdisciplinary art education project for use in equine-assisted learning contexts. The findings highlight the value of integrating creative design, gamification and real-world engagement into teacher education as a means of fostering inclusive pedagogical competencies. The current study makes three main contributions. First, it demonstrates that project-based and gamified learning approaches can effectively enhance student motivation, confidence and preparedness for working with children with developmental disabilities. Second, it provides empirically grounded insights into how codesigned didactic materials function in equine-assisted learning sessions, showing that acceptance and effectiveness depend on the alignment between toy design, task complexity and individual developmental profiles. Third, the study contributes to practice-based research by articulating key design principles – such as adaptability, modularity and sensory responsiveness – that support inclusive engagement in equine-assisted learning environments.

Several limitations must be acknowledged. First, the small sample size and single-context setting limit the generalisability of the findings. Second, the study relied primarily on practitioner observations and reflective evaluations rather than standardised outcome measures. Third, the absence of a comparison or control condition restricts causal interpretations of observed effects. These limitations are inherent to exploratory, practice-based research and

should be considered when interpreting the findings. The study is therefore best understood as a pilot exploration that generates hypotheses and design insights rather than definitive evidence.

Future research could build on this exploratory work by involving larger and more diverse samples, incorporating longitudinal designs and combining qualitative reflection with standardised assessment tools. Comparative studies across different equine-assisted learning contexts or cross-institutional collaborations could further strengthen the evidence base and support the development of transferable design principles. Additionally, participatory research approaches involving children and practitioners as co-researchers could provide deeper insight into user perspectives and contribute to more inclusive knowledge production.

Ethical Statement

The study was conducted in accordance with ethical standards for pedagogical and practice-based research. The parents of the participating children were fully informed about the procedures of the project and provided written informed consent in line with the Don Kihot Association's protocols. Child assent was obtained in an age-appropriate manner during the sessions. Participation was voluntary, data were anonymised and all of the materials were used exclusively for research and educational purposes. The authors declare that the research was carried out following ethical standards for pedagogical research. The research study was approved by the Academy of Fine Arts in Zagreb Ethical Research Committee.

Data Availability Statement

Due to ethical and privacy considerations, the datasets generated during this study are not publicly available but may be obtained from the corresponding author upon reasonable request.

Disclosure Statement

The authors declare that there are no conflicts of interest in connection with this pedagogical research. The study was conducted exclusively for academic and scientific purposes, with no commercial or financial interests influencing the research process or its outcomes. The authors have no conflict of interest to declare.

When preparing this article, the authors used Perplexity Pro on 10 March 2026 with the following prompt: "Proofread the attached paper in standard English" for the purpose of checking and correcting grammatical and spelling errors in the text, in accordance with the rules of the English language. The authors subsequently reviewed and edited the output as necessary and accept full responsibility for the content and integrity of the publication.

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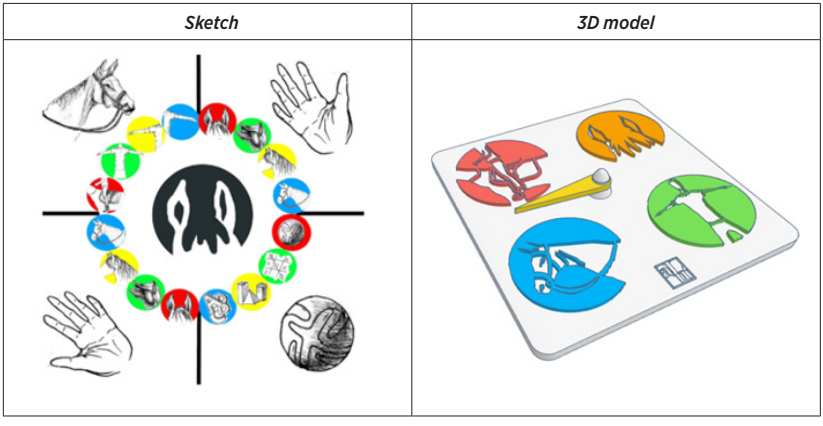
Appendix

New Didactic Games

For each didactic toy/game, the name of the student who designed and created it is provided, along with the name of the newly designed didactic toy, the material and technique used for its creation, as well as its contribution.

Student: Antonela Beli
Name of didactic toy: *Pathpony* (Figure 1)
Technique/Materials: 3D printing (FDM), PLA (plant-based plastic), acrylic spray, Posca marker
Contribution: The emphasis is on the development of motor skills while simultaneously thinking about the given challenge. The child is given an opportunity to improve motor skills, to learn through hands-on experience by performing the assigned task, and to engage in social interaction and communication through cooperative play.

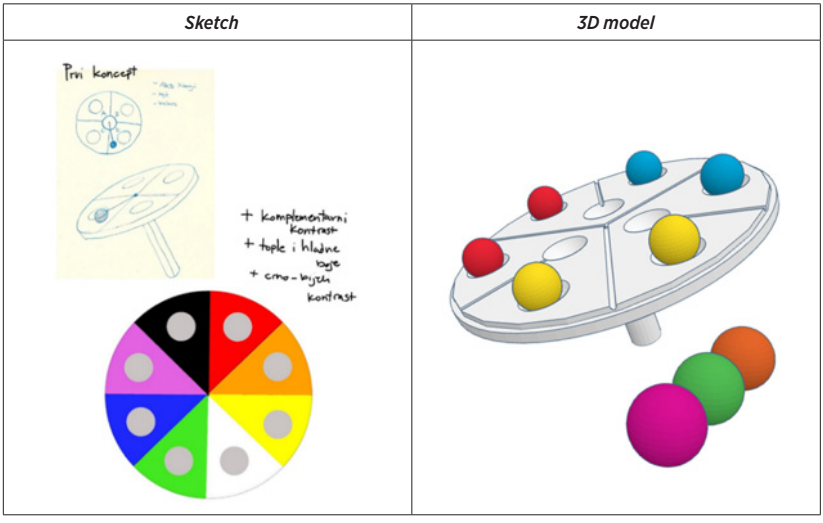
Figure 1
Pathpony



Note. This educational toy is a horseback-adapted version of Twister, featuring a cardboard mat with a spinner and 16 fields divided into four quadrants. Two quadrants focus on tactile tasks involving touching the horse or its gear with either hand, one quadrant includes balance challenges, and the last quadrant incorporates other games, such as ball play. It can be played solo or by multiple children to encourage cooperation and communication.

Student: Lea Krmpotić
Name of didactic toy: *Colour Carousel* (Figure 2)
Technique/Materials: 3D printing (DLP), resin, acrylic spray, Posca marker
Contribution: Introduction to colours: chromatic and achromatic; complementary contrast; warm-cool contrast; black-and-white contrast; colour-to-colour contrast; light-dark contrast. Development of motor skills and hand-eye coordination: balancing with the hand and placing the ball into the colour indentation that has been assigned.

Figure 2
Colour Carousel

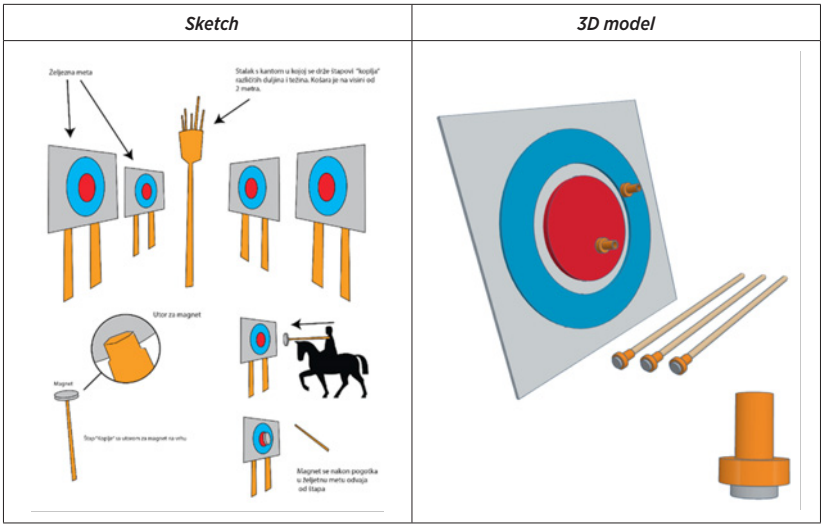


Note. The didactic toy *Colour Carousel* consists of three parts: a handle with a vertically mounted colour disc featuring eight indentations, and a ball attached to a string at the centre. The goal is to balance the toy by hand and make it land in the indentation of the specified colour.

Student: Ante Šabić
Name of didactic toy: *METAMAGA – Hit the target with a spear while riding* (Figure 3)
Technique/Materials: 3D printing (FDM), PLA, magnets, acrylic spray, aluminium plate, wood
Contribution: Encouraging the rider to rise, bend and lean, as well as to aim at targets, develops balance and body coordination, the ability to assess proximity and distance, as well as cognitive abilities, logical thinking and the application of knowledge in connecting different target dimensions and pairs of colours.

Figure 3

METAMAGA – Hit the target with a spear while riding



Note. This game involves hitting a target with specially designed lances that have detachable magnetic tips. The lances vary in length, colour and weight, and are stored in a basket accessible to horseback riders. The magnetic tips differ in colour and shape for educational purposes. Played while riding, the game can be used for scoring points or therapy. Variations include free-lance throwing and colour-matching between lance and target.

Student: Lea Plaščar

Name of didactic toy: *Winding Path* (Figure 4)

Technique/Materials: 3D printing (FDM), PLA, acrylic spray, Posca marker

Contribution: Development of fine motor skills by means of the transfer of rings from one end of the stick to the other, cognitive abilities in assessing how to navigate different variations of difficulty and path length, and social skills through cooperative play in pairs.

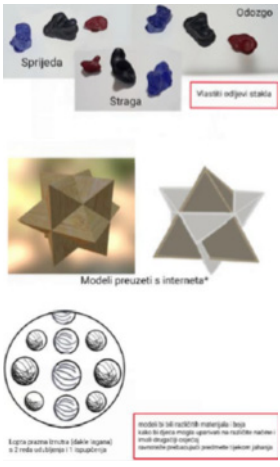
Figure 4
Winding Path

Sketch	*3D model*
	

Note. Winding Path is a two-player game where players use 3D-printed path segments to move a multi-coloured ring from one end of a stick to the other. The path's length and level of difficulty are adjustable. Success depends on coordination and cooperation, as the players must work together to guide the ring by moving their hands.

Student: Lorena Šimić
Name of didactic toy: *Kordata* (Figure 5)
Technique/Material Used: 3D Printing (DLP), FLEX resin, acrylic spray, Posca marker
Contribution: Development of tactile perception through engagement in various sensory activities during play; development of concentration and motor skills through a form of juggling the object from one hand to the other (matching by colour, texture, or weight).

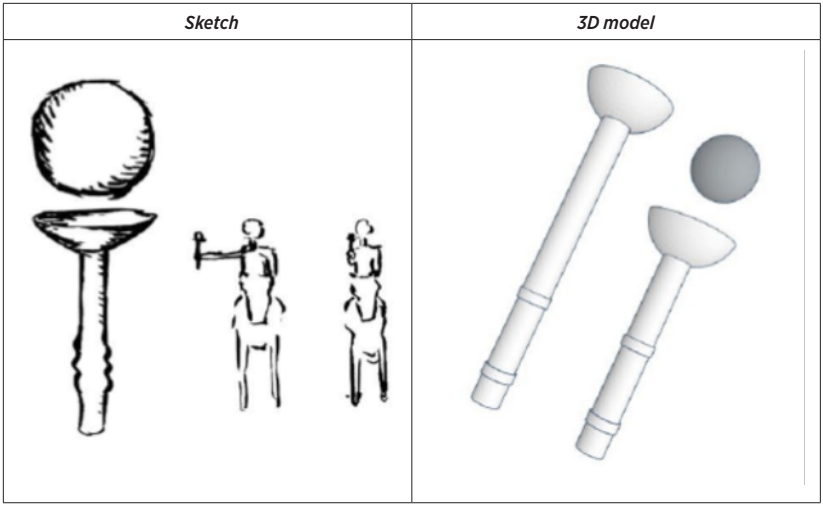
Figure 5
Kordata

Sketch	*3D model*
	

Note. This didactic toy combines tactile stimulation with cognitive tasks. After a few minutes of horseback riding, the child is given objects varying in colour, shape, texture and material to stimulate the senses. The child practises transferring these objects between their hands using different movements (e.g., over the head, across extended arms or around the torso). Later, activities include matching objects, e.g., "match the red ball with the blue bumpy ball".

Student: Antonio Piljek Jagić
Name of didactic toy: *Sceptre* (Figure 6)
Technique/Material Used: 3D Printing (FDM), resin, acrylic spray.
Contribution: The rider practises balance and joint mobility to prevent stiffness (riding with one hand on the horse, while the other holds an aid shaped like a stick with a groove at the top for a ball; the child is given various coordination tasks).

Figure 6
Sceptre

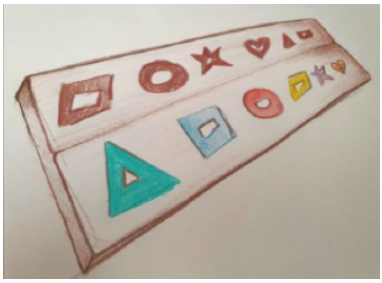
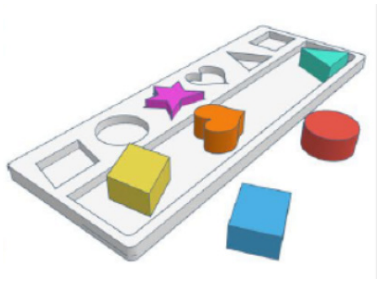


Note. This didactic toy is a lightweight rod with a bowl-shaped top that holds a tennis-sized ball. Designed for use while horseback riding, the child holds the rod in one hand to practise balance and control by keeping the ball steady. Movements involve lifting the rod in front of the face and body, and then extending the arm, all without letting the ball fall.

Student: Ivona Katalinić
Name of didactic toy: *Notice and Insert* (Figure 7)
Technique/Material Used: 3D Printing (FDM), PLA (plant-based plastic), acrylic spray
Contribution: Motor: Coordination development – inserting shapes into a given frame; dexterity. Cognitive: Colour recognition; noticing and identifying geometric symbols; recognising elements of nature.

Figure 7

Notice and Insert

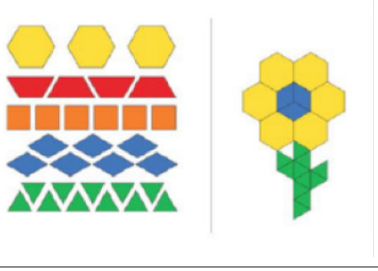
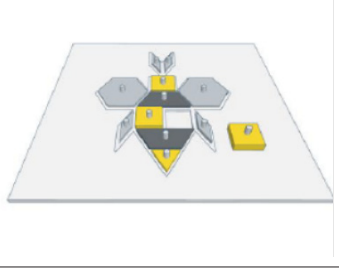
Sketch	*3D model*
	

Note. This two-part game involves a wooden board with colourful shapes and matching signs along a nature trail (e.g., a green triangle on a leaf, a blue square on a flower). While riding, the child matches the shapes on the board to signs seen on the trail by moving them from the bottom to the top row. The shape order changes each time, promoting observation, memory and matching skills.

Student: Marcela Bencek
Name of didactic toy: *Pattern Blocks* (Figure 8)
Technique/Material Used: 3D Printing (FDM), PLA (plant-based plastic), acrylic spray, Posca marker
Contribution: Encouraging the development of spatial thinking, fine motor skills, cognitive skills and creativity. In addition, playing with pattern blocks can help children learn concepts such as colours, shapes, patterns, symmetry, etc.

Figure 8

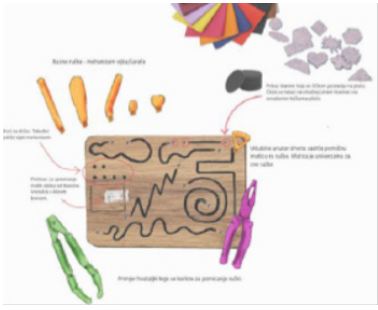
Pattern Blocks

Sketch	*3D model*
	

Note. Pattern blocks are sets of construction blocks that come in various shapes, colours and sizes, allowing children to use their imagination and creativity to build different structures. They feature a variety of patterns, such as geometric shapes, animals, numbers or letters.

Student: Petra Vuković
Name of didactic toy: *Plochko, Fine Motor Skills Device* (Figure 9)
Technique/Material Used: 3D Printing (FDM), PLA (plant-based plastic), acrylic spray, Posca marker
Contribution: Using various hand paths while grasping and moving handles helps train fine motor skills, which can also be practised by twisting the handles into the corresponding grooves. Motor skills are also developed by placing, moving and repositioning small pieces of fabric attached to the board with Velcro. Cognitive skills related to visual language (various types of lines, colours and shapes) are also developed.

Figure 9
Plochko, Fine Motor Skills Device

Sketch	*3D model*
	

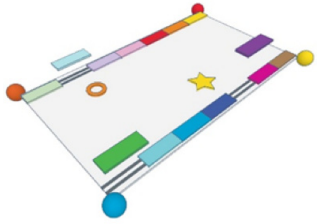
Note. The didactic toy is a wooden board with shaped grooves equipped with screw nut mechanisms for attaching various handles. Velcro patches at the groove ends hold small coloured fabric pieces (primary, secondary, tertiary colours) stored in a locked compartment. It includes three types of grips to enhance motor skills and can be used in different positions (in front, on a horse, or in the lap). The activities involve matching fabrics to grooves, tracing grooves to explore colour mixing, and identifying paths based on specific colour combinations.

Student: Sara Kudrić Smerke
Name of didactic toy: *Hypo Blanket* (Figure 10)
Technique/Material Used: Cotton, felt
Contribution: The balls, which can be added to or removed from the blanket, serve to additionally stimulate motor and tactile abilities, thus also impacting cognitive and emotional processes. While walking, the horse's movement stimulates the rider, who can simultaneously interact with the Hypo Blanket. The rider is familiar with the contents of the blanket and, with therapist assistance, uses lateral torso rotation and/or trunk flexion to direct their

hands towards a targeted element. In doing so, the rider gradually strengthens abdominal muscles, the pelvis and spine, thereby improving the stability of both upper and lower extremities. The goal of the Hypo Blanket is to enhance and develop coordination and balance.

Figure 10

Hypo Blanket

Sketch	*3D model*
	

Note. This game involves tracing lines on a board using handles of different shapes and sizes to develop fine motor skills and grip strength. The level of difficulty can be adjusted by changing handle types. The board features geometric and organic shapes, varied lines and colourful fabrics to support learning visual art concepts through hands-on play.

Biographical note

Renata Burai, PhD, is an associate professor at the Academy of Fine Arts, University of Zagreb, in the Department of Art Education. Her research interests include the fields of pedagogy and didactics. She focuses on teacher competencies, inclusive pedagogy, contemporary teaching strategies, and Croatian language teaching abroad.

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