DOI: 10.15170/ACEP.2024.01.02

Zoltan Paul Dienes: A legacy of educational philosophy and playful learning

Zsolt, Nemeskéri[1]

[1] University of Pécs, Faculty of Cultural Sciences, Education and Regional Development; E-mail: nemeskeri.zsolt@pte.hu

Abstract

Zoltan Paul Dienes's contributions to educational philosophy and mathematics pedagogy emphasize the significance of playful, experiential learning. His games serve as tools to enhance mathematical understanding by fostering active engagement, creativity, and conceptual development. This study explores the philosophical and pedagogical foundations of Dienes's approach, particularly its alignment with constructivist theories and child-centered education. Drawing on the works of Piaget, Vygotsky, Dewey, and Matthews, the research highlights how structured play supports cognitive growth, problem-solving, and intrinsic motivation. The findings suggest that integrating Dienes's methodology into contemporary education fosters deeper learning and innovation in mathematics instruction.

Keywords: playful learning, constructivist pedagogy, mathematics education, experiential learning

The adventurous life of Zoltan Paul Dienes came to an end on January 11, 2014, at the age of 97, in Nova Scotia, Canada. Eight months later, two suitcases arrived in Pécs, containing a portion of Dienes' legacy—books, studies, documents, photographs, and, of course, original games. The battered suitcases, which had traveled the globe multiple times, captivated the university staff. From the scattered fragments, the image of Zoltan Paul Dienes emerged as a teacher, educator, and professor dedicated to his fellow human beings (Zádori et al., 2021).

Dienes believed in the power of playful, experiential learning and in mathematics and logic as universal languages—transcending age, geography, and culture—that often serve as a prerequisite for effective communication. The Faculty of Adult Education and Human Resource Development, and later the Faculty of Cultural Sciences, Education, and Regional Development at the University of Pécs, proudly undertook the stewardship of the renowned professor's intellectual

legacy. Dienes's connection to Tolna County is through his mother, Valéria Dienes, who was born in Szekszárd. An elementary school in Szekszárd bears her name, and a memorial room dedicated to her is located in the Babits Mihály Memorial House (Klein et al., 2021c).

The Dienes games are playful educational tools associated with Zoltan Paul Dienes that aim to enhance children's mathematical conceptual thinking. The central idea behind these games is that learning should be experiential and exploratory, allowing children to shape their knowledge creatively and freely. The games developed by the professors of the University of Pécs (Klein et al., 2021a; Klein et al., 2021b; Klein et al., 2024a; Klein et al., 2024b) address various mathematical principles, enabling children to draw on their own experiences to understand abstract concepts.

This study aims to illustrate how the philosophy of Dienes games connects to the principles of constructivist pedagogy and child-centered education, how these games facilitate the development of children's cognitive structures, and what philosophical foundations underpin playful learning as an educational method. The "Dienes method" is not merely about the mechanical acquisition of mathematical knowledge; it seeks to foster children's intrinsic motivation and exploratory drive. This approach aligns with modern educational philosophies emphasising the active role of children in the learning process.

Educational Philosophy and Its Connection to Learning Tools

The Dienes games are innovative educational tools designed to enhance children's understanding of mathematical concepts. These games prioritise experiential learning and the joy of discovery, motivating learners intrinsically and fostering their creativity. Zoltan Paul Dienes's educational philosophy aligns closely with the principles of constructivist pedagogy and child-centered education, which emphasize active learning and the unique experiences of students.

Educational philosophy connects to the application of Dienes games in multiple ways, particularly in the development of critical thinking and creativity. John Dewey, a prominent figure in pragmatist philosophy, stressed the experiential basis of learning and the indispensability of children's active participation for genuine education. According to Dewey, play and learning are not sharply distinct, as play develops problem-solving skills and creative thinking in children (Dewey, 1938).

Matthew Lipman also played a pivotal role in the field of philosophy for children, particularly in encouraging their philosophical thinking. Lipman argued that play

and discussion are effective means of fostering critical thinking and community dialogue (Lipman, 1980). Similarly, Dienes games promote children's cooperative skills and reflective abilities. In line with Lipman, Gareth B. Matthews highlighted that children's natural curiosity about philosophical questions is deeply connected to the learning processes experienced through play. Matthews contended that nurturing children's philosophical curiosity is essential as it serves as a fundamental driver of their learning process (Matthews, 1994).

Imre Bús articulated that play, as a central element of children's lives, fundamentally shapes learning and educational processes. The philosophical interpretation of play provides opportunities to develop students' reflective and ethical skills while fostering collaborative thinking and dialogue. This is particularly relevant to Dienes games, which aim to support children's independent thinking and decision-making abilities (Bús, 2022).

The theoretical framework of educational philosophy is closely intertwined with the practical approach of constructivist pedagogy. To understand the foundational principles underlying the functioning of Dienes games, the next section will explore the key concepts of constructivism and their significance in education.

Principles of Constructivist Pedagogy

The roots of constructivist pedagogy trace back to theories such as Jean Piaget's cognitive development theory and Lev Vygotsky's sociocultural approach. Piaget asserted that learning emerges through the interaction between existing knowledge and new experiences, while Vygotsky emphasised the critical role of social interactions and cultural environments in the construction of knowledge (Piaget, 1970; Vygotsky, 1978).

Constructivist pedagogy is based on the premise that learning is not a passive process but an active engagement by the learners themselves. Knowledge is not simply transmitted; rather, it is constructed by students through their experiences and prior understanding. The essential components of this process can be summarised as follows:

- Experiential Learning: Learners develop their understanding through direct experiences.
- Active Participation: Students' active involvement lies at the heart of the learning process.

- Individual and Collaborative Learning: Students grow at their own pace while benefiting from community interactions.
- Reflection and Autonomy: Learners refine their thought processes through feedback and self-reflection.

The principles of constructivist pedagogy align closely with Zoltan Paul Dienes's approach, which underscores the importance of experiential and playful learning. Dienes not only articulated his educational concepts theoretically but also contributed practical tools that revolutionised mathematics education.

Zoltan Paul Dienes and Playful Experiential Mathematics Learning

Zoltan Paul Dienes selected mathematics as a pivotal subject and sought to reform its teaching worldwide (Klein et al., 2023a; Klein et al., 2023b). He believed the prevailing approach to mathematics education was untenable, as described by George Pólya in *How to Solve It* (1945): "Future teachers learn to despise mathematics in primary school; then they return to primary school to teach a new generation to do the same" (Pólya, 2000).

Dienes envisioned mathematics education as a tool for fostering thinking skills, particularly mathematical reasoning. He proposed a learning environment that stimulates students' personal development and social interactions. This required not only a significant reform of the subject matter but also a transformation of teaching and learning methodologies. While he acknowledged the occasional necessity of frontal teaching or individual learning, Dienes placed special emphasis on cooperative small-group activities.

His theories on mathematics learning rest on four key principles:

1. The Principle of Constructivity: Mathematical concepts must be repeatedly constructed. During play, children "see" and discover structures within tools, "reading" the rules from them.
2. The Principle of Mathematical Variability: Abstracting mathematical concepts requires exposure to multiple models.
3. The Principle of Dynamics: Opportunities must be provided for transformations within models and for transitioning from one model to another.
4. The Principle of Perceptual Variability: The same structure should be presented in various ways.

Like other advocates of constructivist pedagogy, Dienes observed distinct phases in mathematics learning (Klein et al., 2023a; Klein et al., 2023b):

- Free Play: This phase introduces children to the elements that later form abstract concepts.
- Rule-Based Play: Games with defined rules are introduced, ensuring the rules are seen as guides rather than rigid constraints.
- Recognition of Common Structures: Children engage in multiple games sharing a common structure.
- Representation of Structures: Representations help highlight the shared aspects of games embodying the same structure.
- Description of Represented Structures: Symbolization introduces mathematical notation.
- Formalization: Progression from axioms to theorems.

While Dienes's method—often referred to as the "Dienes Method"—is theoretically well-founded, its true value is revealed through its practical application, particularly the numerous games he designed. The core of his approach is creating an environment where children learn primarily through personal experience. This contrasts sharply with traditional methods, which often attempt to "pour" pre-digested symbolic content into children's minds and test their ability to produce "right answers" on demand (Klein et al., 2023a; Klein et al., 2023b).

Dienes emphasised integrating the natural environment into the process of mathematical abstraction. However, he also argued that developing structured, playful educational tools was essential for cultivating abstract thinking—a hallmark of mathematics. Among his enduring innovations are tools and games that foster the formation of abstract concepts. "Play is a wonderful thing. It compels activity and makes us forget we are tired. It can draw adult-like effort from a child and awaken the dormant child within an adult. While playing, we can learn difficult concepts joyfully and almost imperceptibly, concepts we might otherwise struggle to grasp or even close our minds to in fear" (Klein et al., 2023a; Klein et al., 2023b).

One of his early works (Holt & Dienes, 1973) explores mathematical games for children aged 4–5, while his later books (Dienes, 2003; Thomas, 2009) offer intellectual challenges for "mature youth" and the young at heart. Throughout his life, Dienes shared his playful ideas with what he described as a "rich nonchalance," many of which found their way into school practices in some countries about 50 years ago. Although much of this has faded from regular use, his pedagogical innovations remain noteworthy for their theoretical grounding and practical implementation. By employing Dienes games, learning becomes a

method grounded in both philosophical and pedagogical principles, offering a playful and experiential approach to education.

The Pedagogical and Philosophical Connections of Dienes Games

The Dienes games uniquely integrate the principles of pragmatist child philosophy and constructivist pedagogy. These games provide children the opportunity to explore mathematical concepts at their own pace, fostering the joy of discovery and experiential learning. For example, the board game "Who Goes to the Castle?" (Klein et al., 2021a) engages children in solving various tasks to advance in the game while intuitively acquiring new knowledge and skills related to logical operations.

One remarkable characteristic of Dienes games is their emphasis on encouraging social interactions. Through group activities, children experience the power of collaboration, communication, and collective thinking, which not only develop mathematical skills but also enhance their social competencies. Additionally, the games facilitate reflection, enabling children to revisit their decisions, learn from past experiences, and deepen their understanding. A notable example is the game "Forest Adventures" (Klein et al., 2021b), where children must cooperate and communicate to solve challenges while uncovering set theory and number system concepts. This collaborative activity strengthens their social competencies and provides an opportunity for reflection, fostering a deeper sense of awareness and understanding.

As previously demonstrated, the fundamental aim of child-centered teaching methods is to consider students' individual needs, interests, and abilities. Dienes games perfectly align with this paradigm. Their adaptability to different difficulty levels ensures that each child can progress at their own pace. The exciting and engaging tasks keep students motivated while providing joyful learning experiences. In the game "True(?)Pearls" (Klein et al., 2024a), participants solve logical puzzles with varying levels of difficulty. This allows each child to advance according to their abilities and developmental pace. Meanwhile, the playful environment reduces math anxiety by treating mistakes as natural parts of the learning process rather than as failures. This approach fosters a stress-free environment where children develop confidence along with their logical and problem-solving skills.

The examples and principles presented highlight that Dienes games are far more than simple teaching tools. They are innovative solutions grounded in

philosophical and pedagogical foundations, providing a playful and experiential approach to modern education.

Summary

The pragmatist educational philosophy provides the key theoretical foundation for Dienes games. Dewey and Matthews emphasise the inseparability of play and learning, highlighting curiosity as a vital component in children's development. Dewey's pragmatist approach centers on experiential learning, while Matthews underscores children's natural interest in abstract concepts. These philosophical principles complement the practical application of constructivist pedagogy, where active participation and creativity are central to the learning process.

Zoltan Paul Dienes's legacy, as reflected in the educational tools developed by the professors of the University of Pécs, exemplifies how these principles can be harmonized. These playful teaching tools create a learning environment that supports both individual growth and the communal value of learning.

In our perspective, Dienes games are not merely mathematical instruments but comprehensive pedagogical solutions grounded in a broader educational philosophy. By integrating the core principles of constructivist pedagogy and child-centered teaching, they create a learning environment that fosters creativity, independence, and active engagement. Through making learning an enjoyable experience, these tools lay the foundation for lifelong learning in children.

References

Bús, I. (2022). Chapters from the history of play pedagogy. *Kultúratudományi Szemle [Cultural Science Review], 3–4*, 40–62. https://doi.org/10.15170/KSZ.2022.04.03-04.03

Dewey, J. (1938). *Experience and education*. Macmillan.

Dienes, Z. P. (2003). *I will tell you algebra stories you've never heard before*. Upfront Publishing.

Holt, M., & Dienes, Z. P. (1973). *Let's play math*. Walker and Company.

Klein, S., Klein, B., Nemeskéri, Zs., & Zádori, I. (2021a). *Who Goes to the Castle?* [Board game]. Piatnik Budapest Kft.

Klein, S., Klein, B., Nemeskéri, Zs., & Zádori, I. (2021b). *Forest Adventures* [Board game]. Piatnik Budapest Kft.

Klein, S., Klein, B., Nemeskéri, Zs., & Zádori, I. (2024a). *True(?)Pearls* [Board game]. Piatnik Budapest Kft.

Klein, S., Klein, B., Nemeskéri, Zs., & Zádori, I. (2024b). *AbrakaDabra* [Board game]. Piatnik Budapest Kft.

Klein, S., Kiss, J., Nemeskéri, Zs., & Zádori, I. (2023a). The student-centered school, competency development, and playful, experiential mathematics learning: Theoretical foundations. *Tudásmenedzsment [Knowledge Management], 3*(Special Issue), 260–270. https://doi.org/10.15170/TM.2023.24.K3.23

Klein, S., Kiss, J., Nemeskéri, Zs., & Zádori, I. (2023b). Student-centered school, competency development, and playful, experiential mathematics learning in Hungary. *Acta Cultura et Paedagogicae, 1*, 75–86. https://doi.org/10.15170/ACEP.2023.01.0575

Lipman, M. (1980). *Philosophy in the classroom*. Temple University Press.

Matthews, G. B. (1994). *The philosophy of childhood*. Harvard University Press.

Piaget, J. (1970). *The science of education and the psychology of the child*. Orion Press.

Pólya, G. (2000). *How to solve it*. Akkord Kiadó. (Original work published 1945).

Thomas, M. O. J. (Ed.). (2009). *A concrete approach to the architecture of mathematics: Collected papers of Zoltan P. Dienes*. The University of Auckland.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Zádori, I., & Nemeskéri, Zs. (2021). The legacy of Zoltán Dienes: From the travel suitcase to the virtual museum. In S. Klein, J. Kiss, Zs. Nemeskéri, & I. Zádori (Eds.), *The joy of learning mathematics (The legacy of Zoltán Dienes)* (pp. 200–220). Edge 2000 Publishing.