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FOLK DANCE AND MATHEMATICS

KNOWLEDGE FROM EXPERIENCE*

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Abstract

The optional *Dance and Movement curriculum framework* for the *2020 National Core Curriculum* considers folk dance and folk games as fundamental pillars of dance education. Meanwhile, they can also play a role in developing mathematical thinking. Our study examines how the integration of folk dance into lower-grade mathematics education can support students' creative problem-solving skills and their attitudes towards the subject. Our theoretical basis is movement-based learning and the flow experience, which connect folk dancing with the experiential foundation of mathematical concept formation. We present the organic connections between folk dance and certain mathematical topics (e.g., shapes, fractions, and number properties). In our action research, we conducted mathematics and folk dance lessons in a first-grade class of 26 students, along with related input and output assessments and supplementary classroom observations. Our results show that the students' creative rule-making improved significantly, and the movement tasks increased the observed students' willingness to participate. In other words, folk dance, as a complex environment and activity, can effectively support the development of mathematical thinking and positive student attitudes. Future studies are needed.

Keywords: mathematics and folk dance, activity-based learning, creative problem solving, engagement, emotional attitude towards mathematics

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1 INTRODUCTION

This study analyzes the connection between folk dance and mathematics, specifically the pedagogical potential of folk dance in developing the mathematical abilities and thinking of elementary school students. Today's educational environment presents teachers with dynamic challenges, particularly as a result of the learning habits and needs of the digital generation. In this context, folk dance is not only an artistic activity, but also a complex, experiential learning channel that supports children's physical and mental health, social skills, and creative problem-solving abilities. The literature clearly highlights that dance and movement-based learning motivates and maintains students' active participation through the concept of the *flow experience* (Csíkszentmihályi, 1991).

Recognizing and practicing the basic motifs, rhythms, and movement sequences of folk dance also develops children's spatial orientation, attention, and logical thinking. This pedagogical effect is confirmed by empirical evidence (e.g., Hajdú, 2012; Kocziha et al., 2005; Hajdú, 2012; for more details, see Hajdú's chapter *on Literature and Background*) showing that students developed pattern recognition and creation skills through play.

The aim of this article is to present an example of how folk dance can be integrated into lower grade mathematics education in a way that improves student motivation, reduces anxiety, and promotes cognitive development, while also keeping Hungarian folk traditions alive. The results highlight the complex, multi-level developmental role of folk dance in mathematics learning, offering a new perspective on the interaction between the arts and the natural sciences.

2 LITERATURE AND BACKGROUND

The flow experience was first described by Mihály Csíkszentmihályi, a leading figure in positive psychology. According to Csíkszentmihályi's (1991) definition, the flow experience is characterized by complete immersion in an activity as well as high levels of happiness and satisfaction due the feeling that one's efforts are paying off. Games, music, and dance are typically listed among sources of flow (Csíkszentmihályi, 1985). In this context, folk dance can play a prominent role as a particularly experiential and polyphonic genre which provides opportunities for complex cognitive development (Sándor, 2006). The polyphony of folk dance is evident in several areas at once: the individual movements of a dancer, the different possible rhythms and characteristics of the arms and legs as well as their coordination, the relationship between different dancers (pairs) during free dance, and the choreography danced in pairs or groups. It also appears in the coordination of movements with music and in the harmony between the singing that often accompanies the dance and music. Even when focusing solely on movement, there are many positive effects and opportunities that can be mentioned. Based on the exploratory research of Balogh and Makra, Viktor Csonka (2021) posits a positive relationship between regular physical activity and cognitive abilities at all ages, regardless of gender.

The *2020 National Core Curriculum for Physical Education and Health Promotion* highlights the development of learning competencies as the first of the key competencies developed by students, indicating that learning various forms of movement has a significant impact on cognitive development, especially in the early stages of primary school. The document also highlights the development and planning of thought models and problem-solving thinking based on creative task solutions, which students need for physical education classes, sports, games, and mathematical problem-solving (Physical Education Curriculum Framework for Grades 1-4, 2020).

In the first stage of number concept development, children gather a range of sensory experience (higher, lower, longer, shorter, more, less, etc.; Neményi, 2012). In many situations, "(...) children experience height through the movement of their bodies and muscles" (p. 9), such as through jumping and other movements. The sensory experience of concepts related to length (longer, shorter, thicker, thinner, wider, narrower, etc.) is also linked to movement, primarily large movements. For example, a child becomes more tired during a long walk than after a few steps, or they can jump over a narrow puddle but not a wider one.

"According to the natural science and cognitive theory approach of Waldorf education, counting is nothing more than movement" (Kocziha et al., 2005, p. 8.). Kocziha and his co-authors found that children derive abstract concepts from movement and rhythm. They write – in line with the views of Tamás Varga and Zoltán Dienes on teaching mathematics (Klein et al., 2023; Varga, 1975) – that in order for children to be able to understand mathematics and mathematical systems in an abstract way in later stages of learning, they need to gain substantial experience, "real experiential experience" (p. 8.), through tangible logical systems. "Counting, rhythmic repetition, and the world of numbers provide ample opportunities for this" (Kocziha et al., 2005, p. 8). In his recommendation of the book by Kocziha et al., Tamás Vekerdy emphasizes that the approach described in the book, which links counting, movement, and rhythm, may be particularly suitable for the development of students who are labeled as "disadvantaged," but who often simply come from a different subculture.

It is important to note that, in addition to the growing number of children with special educational needs or difficulties with integration, learning, and behavior among schoolchildren today, the needs and thinking of "average" children are also changing as a result of lifestyle and environmental influences. Children and young people currently in public education have grown up in a world saturated with digital technology, where instant access to information and rapid communication are fundamental expectations. This is also reflected in the educational environment and has fundamentally changed learning habits: students demand environmental polyphony and a large number and variety of stimuli, making dance a particularly promising learning context within the wider range of movement forms. In the framework curriculum for the optional *Dance and Movement* subject linked to the *2020 National Core Curriculum*, dance education is based on the language of movement, folk games, folk dance, and traditions. It highlights the musical and community-building power of dance, emphasizing the gradual expansion of local folk traditions and the joy of movement, singing, and play. In this framework, folk dance can be seen as a complex art education tool that enables experience-centered, playful learning that promotes physical and mental health, social skills, and creative problem-solving, while also representing cultural value. The latter is not mere bias: the *csárdás*, as a living tradition of Hungarian folk dance, has been included by UNESCO in its Representative List of the Intangible Cultural Heritage of Humanity (UNESCO Hungarian National Commission, 2024), while the *dance house method* is included as a highlighted preservation practice, representing a Hungarian model for the transmission of intangible cultural heritage, as is the approach to preserving folk music heritage conceptualized by Kodály (UNESCO Hungarian National Commission, n.a.).

A comprehensive review of the rich literature on the general developmental and transfer effects of folk dance would exceed the scope of this article; thus, the present paper highlights some of the most relevant works from the perspective of the project focused on the development of mathematical thinking. Kiss (2014) emphasizes that folk games and folk dance activities can be used to develop key competencies necessary for learning, such as self-image, responsiveness, spatial orientation, tactical skills, memory, collective thinking, attention, physical fitness, patience, and community building, and that games teach children to explore their abilities and become familiar with themselves, thereby developing their self-esteem and self-confidence (Kiss, 2014). Folk games and dances play an important role in socialization and in forming relationships with peers and other age groups, partly through interaction with other dancers and partly through interaction with the band. As a result, children who learn and practice folk dance also develop their ability to adapt (Furákné & Kun, 2016; Sándor & Ónodi, 2023). It is important to note that anxiety related to mathematics (i.e., math anxiety) is a phenomenon defined and researched in the field of psychology (Carey et al.2019; Haase et al., 2019), noting its negative impact on the performance and mental health of learners. In light of this, increasing self-confidence and adaptability in general and reducing anxiety, for example through the aforementioned effects of dance, are also crucial for learning mathematics, provided that these characteristics can be effectively transferred.

The relationship between folk dance and movement coordination, motor skills, and rhythm-related abilities is perhaps quite obvious. In this regard, it can be emphasized that eye-hand, eye-foot, and eye-hand-foot coordination are excellent examples of dividing attention and the simultaneous retention of multiple aspects, while the imitation of movement patterns during the process of learning dance and games is a special case of pattern recognition and imitation, in which the instructor demonstrating the pattern and the continuous perception of one's own body position play an important role. In addition, spatial orientation and the use of space are natural consequences of movement activities. This is significant from a research perspective as spatial thinking skills are correlated with mathematical abilities and performance in several areas of mathematics (Krisztián et al., 2015; Mix, 2019). In the theoretical part of their study, Pálinkás-Molnár and Bernáth (2020) claim a strong connection between mathematical and spatial abilities, positing a demonstrable connection between dance and spatial abilities. They emphasize that:

> Although dance has been used for a long time to develop mathematical skills, its impact assessment is included in very few studies. One of them is the research in Hajdú's (2012) thesis in which he held weekly folk dance sessions for first graders throughout a year. When compared to the mathematical achievement of children participating only in P.E. lessons the former group showed better results by the end of the year. (Pálinkás-Molnár & Bernáth, 2020, p. 27)

In the practical phase of their research, Pálinkás-Molnár and Bernáth (2020) conducted creative children's dance and movement drama pedagogy activities with first-grade children over a period of one month and measured the children's knowledge before and after the activities using a series of tasks measuring mathematical and spatial abilities. Based on the findings, mathematical abilities improved slightly as a result of the development, while there was no change in spatial abilities. The authors emphasized that the results should be treated with caution due to the small degree of improvement, but they also discussed factors that may have reduced the expected effect.

Lastly, creativity can also be included as a general skill that is important in both folk dancing and mathematics. "Children develop their creativity and improvisation skills unnoticed and effortlessly in folk dance classes, without us placing any particular emphasis on this" (Kiss, 2014, p. 79.). As Fejes (2025) puts it:

> Whether it is a free dance, i.e., an improvisational presentation of familiar motifs and figures, or a choreography, i.e., a structured, composed presentation, planning and the ability to think ahead are essential. When children dance improvisationally, their logical thinking also develops, as it is not always possible to simply 'put one thing after another'; the dancer must take into account the support structure of the motifs, the location and movement of the gesturing leg, and the musical sequences. Logical thinking is also aided by the structure of Hungarian folk dance. The dance order of each region and the dance sections themselves are based on a logical, expanding, and fulfilling structure. (Fejes, 2025, p. 9)

There are also extensive methodological guidelines for the conscious development of logical thinking and creativity in traditional dance activities (Pignitzkyné Lugos & Lévai, 2014). Methods based on (folk) dance motifs, including those that use geometric shapes as a sign system and instructions, can provide an explicit link between folk dance and mathematics that is clearly visible to children without a need for further explanation.

Due to the complexity of folk dance, developmental disorders, perceptual problems, learning difficulties, behavioral disorders, and other difficulties can be addressed in a complex and simultaneous manner with the help of children's folk games and dance. However, it is also important for folk dance teachers to be aware of any dysfunctional disorders that children may have (Kiss, 2014).

In light of the findings above, combining mathematics with movement, music, and dance can have a beneficial effect on learners' mathematical thinking, attitudes toward mathematics, and emotional responses (Helsa & Hatono, 2011; Herawaty et al., 2020; Madusise, 2022; Palarao et al., 2024).

3 MOTIVATION AND RESEARCH QUESTIONS

The possibilities listed in the literature review justify, under appropriate circumstances, the application of the multifaceted positive effects of folk dance to ensure effective, complex development and enjoyable mathematics education, despite the limitations indicated by Pálinkás-Molnár and Bernáth (2020) such as the limited number of studies and noticeably small developmental effects in the available studies that point to the need for further research. The two limitations mentioned above provide sufficient motivation for the present study, in addition to an experience-based consideration by the authors of the study: several of the authors have experienced the flow state described in the literature since childhood and have had experienced moments of inspiration during their own folk dance activities thanks to the connections between dance and mathematics. Due to their significance, we will discuss these connections in more detail below.

The development of numerical concepts mentioned earlier also appears in dance activities during the later stages of the concepts' development: both numerosity and measurement can be significant in that they are organically necessary for dance, for example, in counting beats, measures, and rows (measuring number) or even the number of motifs danced. Among numerical properties, parity (even-odd properties) is of particular importance in pairing and partner-swapping games. Games of this type can be consciously used in first grade to make students aware of the number of participants in their group and whether they can pair up.

Geometric concepts are also an integral part of folk dancing: children can encounter such concepts in folk games when they form circles or parallel rows/ columns. In choreography or performance (especially in higher grades), the following shapes may appear: circles, squares, rhombuses, parallelograms, isosceles triangles, deltoids, trapezoids, etc. When the choreographer or teacher sets up these activities, the children can gain experience of these shapes and their properties, and even precise mathematical concepts can be discussed in the case of an upper-grade class.

Due to the close relationship between music and dance, dancers usually adjust to musical lines based on the number of motifs they dance. Children's games also prepare them for this, as changes in activity are linked to the end of the lines in the children's songs used in the associated games. In most cases, this can also be observed in improvisational dance, during which children change motifs at the turn of musical phrases, thus creating a regularity also seen in an open-ended series. When children dance a choreographed routine, they consciously change motifs according to predetermined rules, dancing a sequence determined by the teacher.

By adapting to musical sequences, children gain experience with fractions and proportions. Students first learn about half , quarter, and eighth notes, accordingly; folk music, which usually has a quarter or eighth note beat, can provide an excellent experiential basis for learning and teaching fractions. When dancing, children can gain experience with fractions by adapting to musical sequences and dancing different motifs in varying quantities under a single melody. Folk dance can also help in establishing helping students to understand the different names of numbers and fractions, as well as simplification and expansion. Through movement, children can experience that a quarter is equal to two eighth or four sixteenth notes. They can experience this, for example, through exercises in which they count how many turns they can make in two bass drum beats (i.e., two measures) or how many eighth notes they can step. They can then conclude that twice as many steps with a faster rhythm are needed to fill the given time interval as steps that last twice as long. With this exercise and conclusion, students gain experience not only with fractions but also with inverse proportionality. Another possible direction for further development is, for example, the mathematical elaboration of the relationship between the characteristic 6, 7, or even 9-beat motifs in the dances of Vajdaszentivány and in eight-beat music.

In addition to the above, positive impacts on motivation are evident in well-known examples in which folk dance (and other branches of folk art) have been incorporated into education. According to Horváth (2020), children who receive arts education often perform better than their peers in non-artistic areas, as well. For example, at the Kenderke Art School in Tata, children who regularly participate in arts classes that include folk dance, folk songs, and folk music as part of the Fürkész program performed 10-20% better than their peers in the control group in a survey covering cognitive abilities, emotional intelligence, and social skills at the end of the third grade. The experiences at the Búzaszem School in Göd are similar, although they cannot be expressed in percentages, as the entire school's education is based on a timetable and teaching methods that incorporate folk art, so there is no control group.

Since it is not feasible in most schools to integrate folk dance into the curriculum and timetable to the same extent as in the aforementioned institutions, we chose the lower grades of a school where, like many other institutions in Hungary, folk dance is taught for one hour per week.

During the research, we tested the validity of the following hypotheses:

1. Folk dance helps in the teaching and learning of mathematics and can be used to develop creative problem-solving skills among first graders in the subject area of sequences.
2. With the help of folk dance, mathematical content can be conveyed through folk dance tasks, making it easier for children to grasp and focus their attention and improving their attitude towards mathematics.

4 METHODOLOGY

The hypotheses were tested through action research involving a first-grade class (children aged 7–8) and classroom observations. The sample was selected using convenience sampling based on availability. Participation in the experiment was voluntary, and the parents of all participating children filled out a consent form (Eötvös Loránd University, n.d.). From the perspective of folk dance, it was fortunate that the number of boys and girls among the 26 participants was equal. The children were students taking part in a complex arts program at a primary school in the capital and an arts high school affiliated with a primary school. This meant that they had two singing lessons per week instead of the usual one, as well as one drama lesson and one folk dance lesson per week, which were already incorporated into the timetable in the first grade (the school year covered by the project).

For the action research component of the project, the children's pattern recognition and creative problem-solving skills and numerical concepts were developed through creative folk dance and movement drama pedagogy tasks related to sequences. At the beginning of the project, the participants took an entrance assessment (Appendix 1), which was followed by a mathematics and a folk dance lesson on sequences. Both sessions were held by the class's after-school teacher as part of a 45-minute math and physical education class. Afterwards, the sequences were informally used in two or three movement and math tasks during after-school sessions on an optional basis in line with the children's initiatives. Another element of the project was to observe the children's attention and activity during a traditional 45-minute lesson on natural numbers and a 45-minute lesson based on movement and folk dance. The traditional lesson was held by the class teacher and observed by the after-school teacher, while in the case of the folk dance lesson, the roles were reversed. The output measurement (see Appendix 2) took place in the second week following the series of mathematics and folk dance lessons and afternoon activities.

4.1 Description of the activities

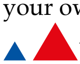
Even before the project, it was common to implement tasks related to sequences from time to time in the class under study, and on these occasions both the class teacher and the after-school teacher evaluated creative solutions and proposed different rules in a positive way. It is important to note that lower grade children do not learn theoretical material related to sequences, but they do create and examine sequences, continue sequences that have been started, or complete incomplete sequences (Neményi, 2011). During this process, it is methodologically sound and useful to emphasize that some elements do not yet clearly represent the rule of the sequence.

During the input measurement, the children were allowed to use tools that are often utilized in mathematical activities to help them solve problems, such as counting sticks, discs, and logic set cards. The input measurement was followed by a math class on sequences, where, also using the aforementioned tools, the children solved tasks in the way described above, looked for continuation rules for the sequences they had started, and then used symbols to indicate the rules of the sequences. In the folk dance class, tasks and exercises similar to those in the math class were presented, only in physical form. As a warm-up, the students performed the previously learned Moldavian penguin dance (Így tedd rá! program, 2020). Like most Moldavian chain dances, this dance consisted of the periodic repetition of a specific motif sequence, which provided a suitable basis for changing the rules of the sequence. This was followed by the creative continuation of a series consisting of other motifs (e.g., leg swings) and the creation and dancing of series described with signs, assigning motifs to geometric shapes.

The second part of the project, lesson observation, was carried out with the active involvement of the participating class's teacher, as mentioned above. Thus, both the teacher and the after-school teacher, albeit in different roles, observed both lessons and were able to reflect on them, thereby reducing potential distorted perceptions. Based on their previously experienced learning difficulties, four students (three boys and one girl) were selected by the teachers to be observed during the two lessons included in this study. One of the boys was a child with certified integration, learning, and/or behavioral difficulties as abbreviated in Hungarian, referred to as "learning difficulties" in the following) who, according to expert opinion, required special attention. According to the teacher's description, the other two boys and the girl also have difficulty concentrating and are less involved in activities, and are thus characterized as representing those for whom the developmental effects of folk dance and movement are particularly useful. The selection and observation of students with learning difficulties provided an opportunity to test this assumption.

Traditional math classes also included games (e.g., the warm-up game "Which number am I?") and interactive activities (e.g., counting together in pairs, counting on their fingers, or counting with discs), but to a lesser extent than in the subsequent folk dance class. In the latter case, almost all tasks were related to movement, including warm-up, frontal tasks (e.g., "How many times did I clap / stomp?", "Clap more / less!", "Wave 13 times, adding more!") or later exercises (e.g., clapping / stomping / waving more / less than the specified amount, one / two / five more / less, etc.), which took place partly in pairs.

Table 1 provides an overview of the activities.

Session, in chronological order	**Teacher conducting the session**	**Tasks (examples)**
1. Math lesson on sequences	Daycare teacher	- Warm-up task: movement pattern demonstrated by children (e.g., clap-step-clap-step…), formulation of rules for the others - Continue the sequence!  What was the rule? – No one said there was a rule; there are several possible rules. Continuing the sequence according to your own rules. -  What rule could we use to continue the sequence? Practicing formulating rules, discussing several ideas. - Giving rules with pictures
2. Folk dance lesson about sequences	Daycare teacher	- Penguin dance – dancing a familiar sequence of movements at an increasing tempo - How can we change the rules of the dance motif sequence so that it still fits the music? Brainstorm different directions and orders, then try out a few. - Pulling and swinging motifs – Continue the sequence you started in several different ways - Marking movements and motifs with shapes. Setting rules with shapes, then reading them with movement.
3. Natural number concept – traditional math class	Class teacher (present as an observer: after-school teacher)	- Which number am I? - Listing the days of the week, counting in twos - Workbook exercises - Counting on fingers or with discs

4. Natural number concept – folk dance math class	Daycare teacher (present as an observer: class teacher)	- How many times did I clap/stomp/…? - Jump/dance the bas de basque motif/… more/less! - Clap/jump/... more/less! - Wave your arms to make it 13! - Pair exercise - Hit the palm of the person opposite you as many times as your number! Find a partner whose number adds up to 13 with yours!

The output measurement took place in the second week after the series-related mathematics and folk dance lessons and the afternoon activities that followed. The input and output measurement tasks were similar but not identical. The structure of the two worksheets was the same: the first two tasks were designed to examine how students continued open-ended sequences with no given rules, where only the first few elements were known; in the third task, they had to continue the series they had started based on a given rule, but the rule did not encompass all the potential options, so here too the children had the opportunity to express their creativity (for example, by coloring the shapes).

5 RESULTS

When evaluating the input related to sequences-related thinking and creative problem-solving skills, the most important criterion for Tasks 1 and 2 was whether the children repeated the sequence consisting solely of the given elements or whether they (also) applied a creative rule. In Task 3, the correctness of the solution (creating a sequence corresponding to the markings) was more relevant, but creativity remained the primary criterion. The results of the assessments support the first hypothesis. In the initial assessment, none of the children provided a creative solution for the first task—one solution differed from what was expected but did not follow any rules. In the second task, a total of eight children continued the sequence according to an alternative rule, 15 provided the standard solution, and three were unable to solve the task. In the third task, 21 students followed the rule based on the diagram; two students also drew the shapes according to the rule but colored the shapes in different colors on the diagram indicating the rule, so when they drew the elements of the series according to the rule they had added, they also assigned the corresponding colors to the shapes. (The two students sat next to each other while solving the tasks, so it can be assumed that one of them initiated the creative idea and the other simply followed their example.) One student was unable to complete the series of tasks within the given time, including the third task; one student was unable to follow the given rule, and another student did not understand the task and drew the diagram illustrating the rule several times in a row. Looking at the three tasks together, a total of 10 students, or 38.5%, showed some form of creativity in this measurement. Creativity was defined as a participant continuing the series in a way that differed from the simple repetition of the few elements given at the beginning of the series in at least one task, (i.e., they created a rule that included their own idea instead of the rule provided).

During the output measurement of the series, 17 students developed their own rules in the first task, resulting in a wide variety of solutions based on different approaches. Judging by the solutions, the second task proved difficult for many students: four did not even attempt the task, and six students did not discover any rules. Only two students considered the few predefined elements to be a sequence, while the remaining 14 students continued the series according to a rule that could be considered creative (e.g., they considered only some of the properties of the given elements to be rules, or they created other unique rules). In the third task, 23 students followed the given rule, but three of them discovered that the rule did not apply to every case: since there were no restrictions regarding the shape of the elements, they did not follow any such pattern when continuing the series. Three students were unable to continue the series based on the given rule (more than in the first survey), so it is possible that they wanted to show their creative approach, but in doing so, they did not focus on following the given rule. Based on the analysis of the output, it can be seen that 21 of the 26 students provided at least one creative solution to one of the tasks, which is 11 students more than in the input measurement. Thus, as a result of the two lessons and the exercises that took place during some of the free-time activities, 81% of the students, instead of 38% of the class, experimented with different, creative solutions. This provides support to the first hypothesis.

The results of the classroom observations were as follows: of the four students observed in the traditional math class (including the child with learning difficulties) – only one actively participated in the warm-up game "Which number am I?", while the others drew, played with their toys, or talked. During the workbook counting tasks, all of the students worked slowly and lacked sustained concentration. In contrast, in the folk dance class – exactly one week later with the same students – all four children actively participated in the first set of frontal movement tasks, volunteered, demonstrated exercises, and worked together with their peers. Tasks based on folk dance motifs proved particularly effective in teaching quantitative comparisons and completion tasks, with 100% participation by the students in the frontal phase. Activity decreased in pair work: only one student actively worked together with their partner, while two copied; the student with learning difficulties did the exercise alone. Overall, the learners performed better than in a traditional lesson.

Observations showed that movement and dance tasks significantly increased student engagement. Particular benefits were noted for the student with learning difficulties, who worked with more consistent attention due to the treatment, confirming the inclusive potential of the method employed. These empirical findings are consistent with flow experience theory and research examining the cognitive effects of physical activity, supporting the validity of the second hypothesis.

6 DISCUSSION

The results of the present study and the positive effects observed are consistent with literature on flow experience theory and with research investigating the cognitive effects of physical activity. The relationship between regular physical activity and cognitive abilities, highlighted by Csonka (2021), was evident in the present research in that the involvement and sustained attention of the students observed—including those with integration, learning, and / or behavioral difficulties and attention deficit disorder—improved dramatically in the movement-based folk dance class compared to the traditional class.

These results are closely related to those of the few empirical studies on the integration of dance and mathematics. In a one-month program for first graders examined by Pálinkás-Molnár and Bernáth (2020), mathematical abilities improved slightly as a result of the program, while there was no change in spatial abilities. The authors emphasized that the results should be treated with caution due to the small degree of improvement observed. The short intervention used in the present study focused not on performance but on creative rule-making and engagement, but the findings are similar: dance as a learning context can support multiple aspects of mathematical thinking, while further impact studies need to be carried out.

Flow theory and research on math anxiety also provide a framework for interpreting the results. Play, music, and dance are typical sources of flow, while the negative effects of math anxiety on performance and well-being are visible (Carey et al., 2019). Previous findings from international contexts indicate that combining mathematics and dance in the educational process can have a positive effect on students' motivation to learn mathematics and their ability to connect it to other contexts (Werner, 2001). Similar experiences can be observed domestically in institutions that organically integrate folk dance into the educational process, such as the Kenderke School in Tata and the Búzaszem School in Göd (Horváth, 2020). Although this connection took place during a short phase of the learning process in the present research, the perceived tendencies are similar. The higher level of attention and joyful participation observed in folk dance classes, especially among students prone to anxiety and difficulties with involvement, suggests that folk dance can potentially have a protective effect against mathematical anxiety.

The perspective of ethnomathematics may offer an alternative framework for interpreting the findings of the present study. Ethnomathematics refers to a pedagogical approach that places mathematics in the context of real community life, drawing on cultural practices that incorporate mathematical elements (Setiyadi et al., 2022). Studies have shown that the dances of certain ethnic groups can also aid in the understanding of mathematical concepts. For example, the traditional dance of the Tswana people living in the northwestern province of South Africa, the *tswana*, and the traditional dance of the Acehnese people living in the city of Banda Aceh in Indonesia, the *rapa'i geleng*, both feature repetitive number patterns that lead to sequences in both dances, although the dances are performed in different contexts (Madusise, 2022; Musawwir & Suryadi, 2021). Furthermore, the mathematical content of the *Andun* dance from the Bengkulu culture in Indonesia can help clarify the concept of functions (Herawaty et al., 2020). According to a recent bibliometric study (Setiyadi et al., 2025), ethnomathematical research related to dance conducted between 2023 and 2025 mostly emphasized the analysis of the characteristics of dance movements as representations that express mathematical concepts. They concluded that by using elements of traditional dance, such as patterns, symmetry, and rhythm, mathematical concepts that are considered abstract can be presented in a more tangible and relevant context, thereby promoting deeper and more intuitive understanding among students. The results of their analysis show a significant increase in the number of related studies. This reflects a growing recognition of the importance of context-based and culture-based education, and that this approach not only enhances student motivation and engagement on a cognitive, emotional, and kinesthetic level, but also contributes to strengthening their cultural identity, the development of pride in local heritage, and the creation of an inclusive learning environment. These findings are consistent with the results and observations made during the present research project.

7 LIMITATIONS

Based on the findings above and in line with the literature, there is significant potential in combining mathematics and folk dance. However, it is important to treat the results with caution and take into account the limitations of the research.

The first limitation is that during the project, it was not possible to exclude the effect of the teacher (e.g., the positive influence of the teacher's personality and enthusiasm) or the effect of the experiment (e.g., the enthusiasm generated in the participants by the fact that they were taking part in an experiment). In addition, practice may have made the children more relaxed and reduced their anxiety, which may have contributed to them producing more creative answers in the output measurement. As a continuation of the research, we plan to investigate the effect of practice with a matched active control group in the future.

In addition, the duration of the intervention, (i.e., the time between lessons and the output measurement), was relatively short, which may also have had a distorting effect. An interesting and important area of research could be to examine the longer-term effects of similarly short interventions. However, in order to conduct more comprehensive studies, it would also be important to implement the combination of mathematics and folk dance in longer-term projects, while monitoring short-, medium-, and long-term effects where possible.

In this observation-based study, attempts were made to control for observer subjectivity; however, it would have been preferable if the same person, or ideally the same people, collected observations in different sessions, further reducing the chance of bias due to the observer's subjective perception.

Furthermore, the relatively small number of participants, due to the nature of the project and the ad hoc measurement tool, raises the question of how generalizable the findings are to other similar contexts, and whether the task set is truly suitable for the desired measurement. Both the implementation of similar projects with other classes and the wider testing of the tasks used for measurement, as well as the potential optimization of the task set, could contribute to confirming the results.

8 CONCLUSIONS AND RECOMMENDATIONS

This study described in detail a project that involved first-grade students and examined the possibility of combining folk dance and mathematics within the framework of school lessons. In a class of 26 students, pre- and post-assessment were conducted before and after a pair of lessons consisting of one mathematics and one folk dance lesson on the topic of sequences. By observing traditional and folk dance lessons based on natural numbers and movement, the hypotheses (that folk dance helps in teaching and learning mathematics and can be used with first graders to develop creative problem-solving skills in the subject of sequences) were confirmed. Furthermore, with the help of folk dance, mathematical content can be conveyed more effectively through folk dance tasks, children's attention can be focused, and their attitudes towards mathematics can be improved.

The research confirms the theoretical assumptions and results known from the literature, supporting the idea that the integration of folk dance and mathematics can be an effective tool for developing cognitive skills and attitudes towards mathematics, while also pointing to the possibility and necessity of further research.

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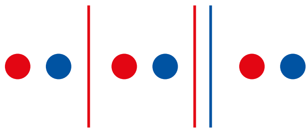
Appendix 1. Input measurement task set

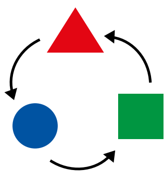
1. Continue the sequence!

2. Draw the pattern further!



3. Continue the sequence according to the rule!

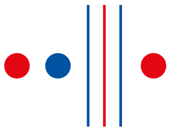
Rule:



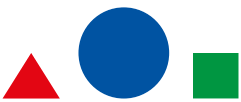
Appendix 2. Output assessment tasks

1. Continue the sequence!

2. Draw the pattern further!



3. Continue the sequence according to the rule! (Use the logic blocks to help!)



Rule: