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ATTITUDES OF PARENTS AND TEACHERS TOWARDS MATHEMATICS EDUCATION IN THE CONTEXT OF STEAM EDUCATION

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Abstract. *The pre-school period is valuable in itself. It is at this age that the child's most important personality traits, his or her perception, thinking, communication, etc., develop. STEAM goes hand in hand with the development of 21st century skills and should be included as early as possible in the curriculum. Children's early experiences with science, technology, engineering and mathematics and the arts influence their future success in these areas. When teachers give children early opportunities to learn maths and science in an interactive environment that builds communication and collaboration skills, children are more confident and competent in these subjects. This not only makes higher education more accessible to children but also contributes to a well-prepared society. Survey of 116 teachers and 104 parents identified that parents of pre-school children are more accurate in identifying the disciplines that STEAM education integrates, they perceive that the teacher's background in mathematics and science influences children's mathematical and science education, and that young children can apply early mathematical concepts. Parents identified advantages and barriers to the successful implementation of STEAM in pre-school education.*
Keywords: *child, mathematical skills, parent, pre-school age, STEAM, teacher.*

Introduction

The Ministry of Education, Science and Sport of the Republic of Lithuania in its Plan for Improving Mathematics Teaching and Learning 2023-2027 (Lietuvos Respublikos švietimo, mokslo ir sporto ministerija, 2023) states that mathematics achievement of pupils in grades 4 and 8 remains insufficiently high, the results of the mathematics national mathematics matriculation exams have been declining year by year, and the performance of Lithuanian pupils in the period 2006-2018 has remained stable - close to, but not reaching the OECD countries average (Lietuvos Respublikos švietimo, mokslo ir sporto ministerija, 2023). This document also points out that only few children in Lithuania reach the highest levels of achievement in mathematical and scientific literacy. This shows that children have only the most basic skills - reconstructing knowledge, explaining simple phenomena, drawing direct conclusions - while their skills in analysing, interpreting and evaluating information in mathematics and science are

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significantly weaker than OECD countries. All this suggests that too little attention is paid to individualised mathematics education, which would not only provide basic knowledge but also facilitate the achievement of higher skills. Hassan et al. (2019) argue that mathematics for three- to six-year-olds is vital for the future foundation of mathematics learning. It is essential to introduce mathematics education to children from the age of three. It helps them understand real situations and build a successful - solid foundation - in primary schools. Aubrey (2006), in a study on early mathematics education and their impact on later achievement, also argues that it is important to develop the mathematical skills of pre-school children (3-5 years). The results of the study show that children with low mathematical knowledge at the beginning of their formal education perform poorly in primary school. It is likely that performance will not improve in the future. The aim of the study is to investigate the attitudes of parents and teachers towards mathematics education in the context of STEAM education. The object of the study is the development of mathematical skills in pre-school children using STEAM education. The methods of the research are analysis of scientific literature, survey of teachers and parents (quantitative research).

Advantages of STEAM education in pre-school education

Quality pre-school and pre-primary education must contribute to sustainable development and STEAM development, as must the entire national education system. In Lithuania, as in the rest of the world, these areas of innovative pedagogical practices are receiving considerable attention. Analysis of foreign experiences has shown that many foreign countries have national strategies for the development of sustainable development and STEAM from pre-school to higher education and are developing specific models and practices to implement these strategies (Monkeviciene et al., 2018).

Smith, Samarakoon (2017), Heinecke (2019), who have studied the positive impact of STEAM on children's education, argue that STEAM makes the education process much more enjoyable for children. Children are more enthusiastic and make meaningful connections to STEAM activities. They report that STEAM comes from a place of mad curiosity, enthusiasm and opportunity. STEAM encourages them to try and look at failure in a different way - to see its benefits.

According to Chatzopoulos et al. (2019), in STEM interactions, children are encouraged to express ideas creatively, are motivated by curiosity in activities, are encouraged to think outside the box, are encouraged to work in teams and to develop a sense of community and are taught to learn from and with others. Children are taught new skills such as technological literacy, they are trained to be competent problem-solvers, innovative, conscious and intelligent thinkers. The

integration of STEAM helps to strengthen children's engagement in the educational process (Ng, Kewalramani, Kidman, 2022).

An integrated approach to STEAM fosters the development of human thinking, enabling complex knowledge and understanding of the world, responsible decision-making and future pathways. There is unanimous agreement that integrated action brings benefits to all stakeholders (Slekienė, 2018).

According to literature, the main advantages of STEAM education are related with children's motivation, making process more enjoyable, developing creativity and higher order thinking, sense of community.

Barriers of STEAM education in pre-school education

Mervis (2011) identifies underqualified teachers as one of the barriers. Asghar et al. (2012) also suggest that internal barriers to interdisciplinary STEM education include issues related to teachers' beliefs, abilities, knowledge and skills. Research shows that young children can acquire and practice early mathematical concepts, but many teachers have not received adequate mathematical training themselves and are not well equipped to understand children's development of mathematical concepts (Stone - MacDonald et al., 2011). Tucker (2012, cited in Chatzopoulos et al., 2019) and Ejiwale (2013) argue that the problem with STEM implementation is the education system as a whole, and that new education programmes such as STEM education will not deliver the desired results.

Ejiwale (2013), Chiu et al. (2015), Howard - Brown, Martinez (2012) point to several other barriers to STEM implementation. According to Ejiwale (2013), these include: lack of investment in teachers' professional development; lack of connection with learners; poor content preparation, delivery and assessment methods; poor laboratory facilities and teaching aids; and lack of hands-on teaching of children. According to Chiu et al. (2015), another barrier faced in STEM implementation is that of teacher collaboration. Collaboration can help teachers to understand children's preconceptions or misconceptions and make decisions about adapting instruction. The authors also emphasize that life in the 'real world' is not related to a specific topic. Teacher collaboration is a step towards the integration of disciplines, better reflecting what actually happens outside the classroom.

Monkeviciene et al. (2018) point out that not all areas of STEAM are given equal attention in pre-school institutions, and that the development and implementation of innovations is fragmented. According to the authors, technological and natural science research tools and activities are the most commonly used in pre-school educational institutions, while mathematical and engineering research tools and activities are used much less frequently.

Summing up, the main barriers are related to teachers' qualification, background, motivation, collaboration and beliefs.

Mathematics education in pre-school institutions in a STEAM education context

According to Burskaitiene (2019), mathematics in STEAM education is mathematical understanding or mathematical skills that gradually evolve from basic sorting and classification skills to logical, rational understanding of the world. Children enter pre-school from different economic and social backgrounds. They enter education with significant differences in their knowledge of mathematics and science, and these differences persist or even increase over time. However, the authors point out that gaps in mathematics and science knowledge can be narrowed by introducing STEAM in pre-school education (Hassan et al., 2019). Kermani and Aldemir (2015) conducted a study on preparing children for success: 'Integrating science, mathematics and technology in pre-school education'. The findings indicate that deliberate learning of mathematics and science, supported by technology and its integration into the pre-school curriculum, significantly improved mathematics and science outcomes for children from socio-economically disadvantaged backgrounds. STEAM promotes learning across content areas such as mathematics, science and technology (Ng et al., 2022). Hassan et al. (2019) argue that this integration allows children to learn science and mathematics concepts in STEAM education by applying technology and engineering in a tangible, realistic and meaningful way. This approach allows children to explore mathematics and science in a more personalised context while helping to develop critical thinking skills (Kennedy, Odell, 2014). Hassan et al. (2019) also suggest that children's early experiences with science, technology, engineering and mathematics influence success in these areas in the future. High-quality STEM experiences can provide children with engagement, confidence, curiosity, and understanding of integrated STEM disciplines. In STEAM, children learn content by doing, using mathematical logic. They go beyond one subject but develop skills that transcend boundaries through a wide range of skills. Ongoing mistakes and failures are a necessary, integral process, as it allows children to reflect and continuously make corrections, attempts, failures, revisions and explorations until success. In this way, children develop patience, tolerance for disappointment and learn to be responsible for themselves (Chen et al., 2021). Laboy-Rush (2011) points out that there are many ways in which an educational institution or classroom can improve the teaching of mathematics and science, but all too often teachers address these topics in isolation from other subjects. When teachers give children early opportunities to learn mathematics and science in an interactive environment that builds communication and collaboration skills, children are more confident and

competent in these subjects. This not only makes higher education more accessible to children but also contributes to a well-prepared society.

Research methodology

Survey organisation. The survey was conducted in October 2023. The general population was composed of teachers living in Lithuania and parents who take their children to pre-school education institutions. The data was collected through various social networking groups, considering the activity of parents, so the results may not reflect the views of all parents. The findings of the study were only applicable within the defined sample.

Study sample. Taking into account the problem, aim and objectives of the study, convenience sampling was used to select the group and sample. In order to investigate the features of mathematical education in the context of STEAM education from the point of view of teachers and parents, the sample consisted of teachers from pre-school institutions and parents of pre-school children attending pre-school education institutions. The survey received 116 questionnaires from teachers and 104 from parents, for a total of 220 respondents, the number of respondents chosen to obtain more accurate survey results.

Analysis of survey data. The quantitative data obtained from the questionnaire statements were processed using statistical methods such as MS Excel, which is used for graphical representation, grouping and comparison of data in figures, tables and summaries, and the chi-square statistic for comparison.

Research results

Teaching pre-school child's mathematical skills through STEAM education has a positive impact on their development, achievement and academic success. The study started with the aim of finding out whether parents and teachers understand what the basis of a pre-school child's personal development is.

When comparing the data provided by parents and teachers, a statistically significant difference was found (chi-square $p=0.005<0.05$), indicating that parents and teachers have different views on the basis of the child's personal development. In summary, it can be stated that teachers lack knowledge about the basis of development of pre-school children, as only 75.9% of teachers answered that the basis of pre-school children's development is both adults and the child's relationship with the environment. In this respect, it can be noted that parents of pre-school children have a deeper knowledge of this issue, as 91.3% indicated that adults and the child's relationship with the environment are the basis for the child's development.

The study sought to find out the parents' and teachers' views on the principles that STEAM activities in kindergarten should follow (Table 1). This gives an overview of teachers' and parents' understanding of STEAM activities.

Table 1 ***Results on principles that STEAM activities in kindergarten must comply with*** *(compiled by authors)*

	Percentage		
Principles	**Parents**	**Teachers**	**Chi-square p**
Interdisciplinary teaching and education	49%	37,1%	0,08>0,05
Contextualisation	33,3%	18,1%	0,01<0,05
Interest/engagement	77,5%	66,4%	0,07>0,05
The process, not the outcome, is what matters	48%	64,7%	0,01<0,05
Don't know	8,8%	2,6%	0,05=0,05

Statistically significant differences were found when comparing the opinions of parents/guardians and teachers on the principles that STEAM activities in kindergarten should follow, p= 0.01 <0.05, indicating a disagreement between parents/guardians and teachers on the importance of process rather than outcome and contextualisation in educational activities.

It was also sought to find out the views of parents/guardians and teachers on the benefits of STEAM in pre-school (Table 2).

Table 2 ***Advantages of STEAM in pre-school education*** *(compiled by authors)*

Statements	**Parents' answers**			**Teachers' answers**			**Chi-square p**
	Agree	**Partially agree**	**Disagree**	**Agree**	**Partially agree**	**Disagree**	
Making the education process more enjoyable	76,5%	22,5%	1%	87,2%	12,8%	0%	0,02<0,05
Children are more enthusiastic	76,5%	21,6%	2%	74,6%	25,4%	0%	0,10>0,05
Encourages children to see failure as success - to see its benefits	60%	35,3%	4,9%	61%	31,4%	7,6%	0,63>0,05
Motivates children to think at a high level	72,5%	24,5%	2,9%	64,4%	32,2%	3,4%	0,42>0,05
Encourages creative	83,3%	14,7%	2%	87,3%	11,9%	0,8%	0,62>0,05

expression of ideas							
Develops a sense of community	68%	30,1%	1,9%	82,2%	16,9%	0,8%	0,06>0,05
Develops new skills in children	85,3%	13,7%	1%	88,2%	11,8%	0%	0,4>0,05
Children learn to practise real problem-solving skills	71,6%	27,5%	1%	78,8%	20,3%	0,8%	0,45>0,05
Critical thinking is developed	66%	33%	1%	82,9%	24,6%	0,9%	0,01<0,05
Increases interest in science	66,7%	28,4%	4,9%	73,7%	24,6%	1,7%	0,29>0,05
Engineering, design and mathematical thinking are developed	73,1%	26,9%	0%	84,6%	13,7%	1,7%	0,02<0,05
Promotes the development of higher level thinking skills	70,6%	29,4%	0%	70,9%	29,1%	0%	0,99>0,05
Developing a complex understanding of the world	76,5%	21,6%	2%	76,1%	22,2%	1,7%	0,98>0,05

Statistically significant differences were found when comparing parents' and teachers' views on the benefits of STEAM in pre-school education. $p= 0.02 < 0.05$, indicating a discrepancy between parents' and teachers' views on STEAM making the education process more enjoyable. $p= 0.01 <0.05$, indicating a disagreement between parents and teachers on the fact that STEAM activities develop critical thinking. $p= 0.02 <0.05$, indicating a disagreement between parents and teachers on the fact that STEAM activities develop engineering, design and mathematical reasoning. 26.9% of parents/guardians and 13.7% of teachers agree that STEAM helps to develop these skills.

Parents and teachers were asked for their views on barriers to successful STEAM implementation (Table 3).

Table 3. ***Barriers to the successful implementation of STEAM in pre-school education*** *(compiled by authors)*

Statements	Parents‘ answers			Teachers‘ answers			Chi-square p
	Agree	Partially agree	Disagree	Agree	Partially agree	Disagree	
Teacher qualifications	71,8%	24,3%	3,9%	52,5%	33,1%	14,4%	0<0,05
Teachers' beliefs, attitudes	83,5%	15,5%	1%	63,6%	28,6%	7,4%	0,01<0,05
Teachers' mathematics and science backgrounds	73,3%	22,9%	3,8%	50,8%	36,4%	12,7%	0<0,05
Teacher motivation	96,1%	2,9%	1%	83,1%	11,9%	5,1%	0<0,05
Preparation time	68,6%	28,4%	2,9%	63,9%	31,1%	5%	0,63>0,05
Lack of connection with learners	71,6%	26,5%	2%	51,2%	38,8%	9,9%	0<0,05
Preparation, presentation and evaluation of content	80,4%	16,7%	2,9%	68,9%	26,9%	4,2%	0,12>0,05
Laboratory facilities and equipment	47,1%	43,3%	9,6%	60,5%	31,9%	7,6%	0,13>0,05
Practical teaching of children	77,1%	19,4%	2,9%	61,9%	32,2%	5,9%	0,04<0,05
Cooperation between teachers	66,7%	30,4%	2,9%	56,8%	41,5%	4,2%	0,32>0,05
Unequal focus on STEAM activities	51,5%	43,7%	4,9%	44,9%	45,8%	9,3%	0,36>0,05

Statistically significant differences were found when comparing the perceptions of parents and teachers on the barriers to the use of STEAM in pre-school education. Parents and teachers disagree on the following barriers to STEAM implementation: teachers' lack of qualifications (p=0 <0.05), teachers' beliefs and attitudes (p=0 <0.05), teachers' mathematics and science background (p=0 <0.05), teachers' motivation (p=0 <0.05), lack of connection with learners (p=0 <0.05), and hands-on teaching of children (p= 0.0 <0.05).

Conclusions

The pre-school years are important and precious, influencing a child's future learning and life. At this age, children are curious about the world, experimenting, and rapidly developing their language and vocabulary. Literature has shown that STEAM enhances children's engagement in the educational process (Ng, Kewalramani, Kidman, 2022), children become more creative Chatzopoulos et al., (2019), and the learning process itself becomes more engaging Smith, Samarakoon (2017); Heinecke (2019). The results of the study revealed that both educators and parents have a positive attitude towards STEAM and see the benefits.

The most frequently observed aspects of the educational process are children's enjoyment, enthusiasm, creativity, and complex understanding of the world. The analysis revealed that educators were more positive about some aspects of STEAM: that STEAM makes the educational process more enjoyable, and that STEAM activities foster engineering, project-based and mathematical thinking, as well as critical thinking.

One of the most common barriers cited by the researchers was the lack of qualifications of educators and lack of mathematical and STEAM knowledge (Ejiwale, 2013, Mervis, 2011). Unmotivated, uncooperative educators do not create the right conditions for STEAM education (Chiu et al., 2015, Howard - Brown, Martinez, Times, 2012, Monkeviciene et al., 2018). Empirical research has revealed that the biggest barriers are the lack of motivation, attitude, training and qualifications of educators. Teachers are more critical of their situation than the parents who participated in the study.

The survey confirmed the findings of the literature analysis that in pre-school education the preparation and motivation of teachers have a significant impact on children's mathematical education, which determines the enjoyment of the educational process, children's enthusiasm for creativity, and the complex understanding of the world in future.

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