

Readiness of State-, Private- and Church-Run Kindergartens to Use STEM Education

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Abstract

Between 2022 and 2023, the authors conducted a nationwide survey of kindergarten teachers across all regions of Slovakia to analyse their readiness to implement STEM education into early childhood activities. The representative sample of randomly selected respondents included an appropriate distribution of state, private, and church-run kindergartens. This article presents key findings from a comparative analysis of teacher readiness across these different school types. Specifically, the findings relate to three survey items: the lack of information regarding STEM as a possible barrier to implementation; teachers' responses to the statement: "I find it difficult to explain why and how STEM experiments work"; and the self-assessed adequacy of their knowledge within individual STEM areas.

Keywords: STEM Education, Pre-Primary Education in Kindergarten, Comparative Study

1 Introduction

International research into the application of STEM education within pedagogical practice confirms the diverse benefits of this concept; furthermore, it highlights the necessity of implementing this approach across all educational tiers, beginning with preschool and primary education (Larkin, & Lowrie, 2023; Penprase, 2020; Donmez, 2020; Akcay, 2018; DeJarnette, 2018; Kelley, & Knowles, 2016; Zollman, 2012). Regarding the requirement to introduce STEM

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education as early as preschool education (MacDonald, et al. 2020; Cunningham et al., 2018; DeJarnette, 2018; Tippett & Milford, 2017; Cluver et al., 2013), we conducted research focused on assessing the professional readiness of the pre-primary education environment in Slovakia for the application of integrated STEM education strategies (Brečka et al., 2025). The partial tasks of the research were:

- identify the level of teachers' familiarity with the concept of STEM education,
- identify which factors act as obstacles to the implementation of STEM education in kindergartens,
- identify which factors act as motivators for the implementation of STEM education in kindergartens,
- identify what specific teaching methods (organizational forms, teaching aids, and procedures) teachers use in this (as well as traditional) education,
- identify the level of teachers' competence in relation to selected activities necessary for effective STEM education.

A key factor in selecting a research sample representative of the population of kindergarten teachers in Slovakia was:

- ensuring an objective assessment of the researched phenomena about which respondents were consulted.

This objectivity is significantly influenced by the professional experience teachers acquire throughout their careers. Consequently, when selecting a representative sample of questionnaire respondents while maintaining a predominantly random selection process, it was essential to ensure the inclusion of experienced teachers with a sufficient length of service.

Further factors included:

- ensuring the representation of all regions within Slovakia;
- ensuring an adequate proportion of state, private, and church-run kindergartens.

Ultimately, the representative survey sample comprised 372 respondents. At the initial stage, the research data were evaluated for the entire sample without distinguishing between different groups. Subsequently, results were compared across individual subgroups, which were categorised according to segmentation factors: length of teaching experience, highest level of professional education, the region in which this education was acquired, and the type of school (state, private, or church-run). Finally, the results recorded within these categories were compared, and the statistical significance of any identified differences was tested.

The type of kindergarten in which respondents were employed emerged as a highly significant segmentation factor; specifically, significant differences were identified when comparing the responses of teachers from state, private, and church-run kindergartens (StK, PrK, and ChK).

To illustrate the most notable findings, a comparison of the results across these three categories is presented below for three specific survey items:

- Item 1 focused on assessing the lack of information regarding STEM as a potential barrier to implementing STEM education in kindergartens;
- Item 2 examined teachers' responses to the statement: 'I find it difficult to explain why and how STEM experiments work';
- Item 3 focused on the perceived adequacy of their knowledge within individual STEM areas.

2 Perception of the Lack of Information about STEM as a Potential Barrier to its Broader Implementation

Figure 1 illustrates the assessment of a lack of information regarding STEM as a potential barrier to the implementation of the STEM concept in kindergartens. The results are presented for three distinct categories: teachers from state kindergartens (StK), private kindergartens (PrK), and church-run kindergartens (ChK).

Teachers evaluated the lack of information as a potential obstacle to the broader integration of STEM within the kindergarten environment using a five-point scale:

- 1 - I completely disagree,
- 2 - I rather disagree,
- 3 - I don't know,
- 4 - I rather agree,
- 5 - I completely agree.

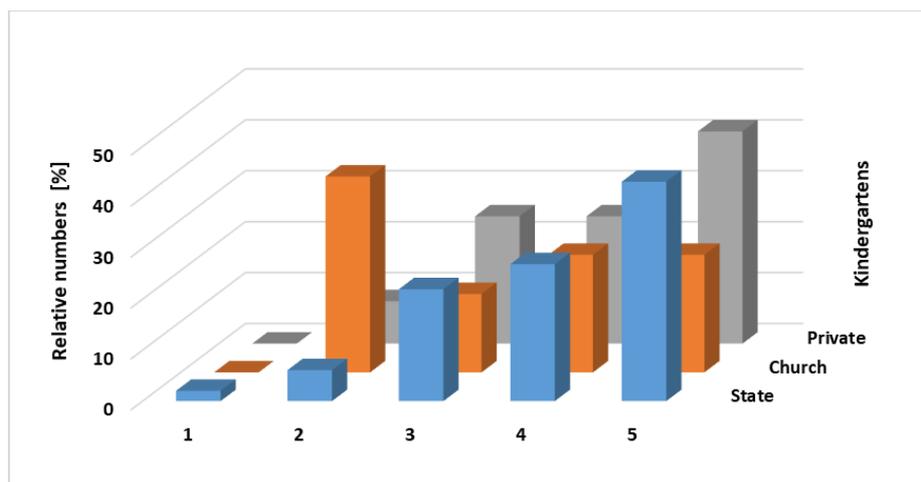


Figure 1: Perception of the lack of information about STEM education as a barrier to its implementation in practice. (Own research).

As the figure 1 shows, the highest number of respondents with insufficient information are in state and private kindergartens (StK - 43%; PrK – 42%). Teachers (respondents) from church-run kindergartens fare better – only 23% of teachers feel they lack information, while as many

as 38% disagree that they have little information. There are several reasons why kindergarten teachers may lack information about STEM, including the availability of educational programs, school curricula, technological equipment, and support from school management. One of the significant reasons is the limited range of educational programs available to teachers, especially in state and private kindergartens.

If schools do not organise systematic training courses and seminars focused on STEM education, teachers lack sufficient opportunities to acquire the necessary knowledge and skills. In state schools, this issue may be exacerbated by a lack of financial resources and administrative obstacles related to participation in educational activities. Although private schools can organise tailor-made training, the emphasis is not always on STEM, as these institutions may prioritise alternative educational approaches. Another significant factor is the variation in school curricula and educational philosophy across different types of kindergarten. Church-run kindergartens often have fewer staff and can provide a more individualised approach to education, which is also reflected in better teacher awareness. In state schools, there is greater pressure to adhere to centrally set curricula; this may leave less room for new educational approaches and innovations such as STEM.

Although private kindergartens have more freedom to create their own curricula, without clear guidance and support, teachers may feel uncertain about how to effectively implement STEM in pre-school education. Another significant factor is the availability of technological equipment and its practical application. If teachers lack access to modern technologies, digital tools, and methodologies suitable for STEM education, both their awareness and their willingness to incorporate technology into teaching decline. State kindergartens often face limited budgets for technological innovation, which can prevent teachers from developing their digital skills. In contrast, private kindergartens may have better financial resources to purchase technology; however, if methodological support is lacking, the mere availability of equipment is insufficient to improve the relevant knowledge and skills of the teaching staff.

The final key aspect is the support provided by school management and educational institutions. If leadership does not place sufficient emphasis on STEM education or offer teachers opportunities for professional development, awareness levels remain low. In church-run schools, management may be more actively involved in supporting staff; this may explain the lower level of perceived lack of awareness compared to the state and private kindergartens.

3 Teachers' Self-Reflections on Their Ability to Explain Why and How STEM Experiments Work

Figure 2 presents the responses of individual categories of teachers (differentiated according to the segmentation factor of kindergarten type) to the statement "I find it difficult to explain why and how STEM experiments work." Teachers were asked to assess their potential

problems with performing this professional activity using the same 5-point scale as was given at the previous item.

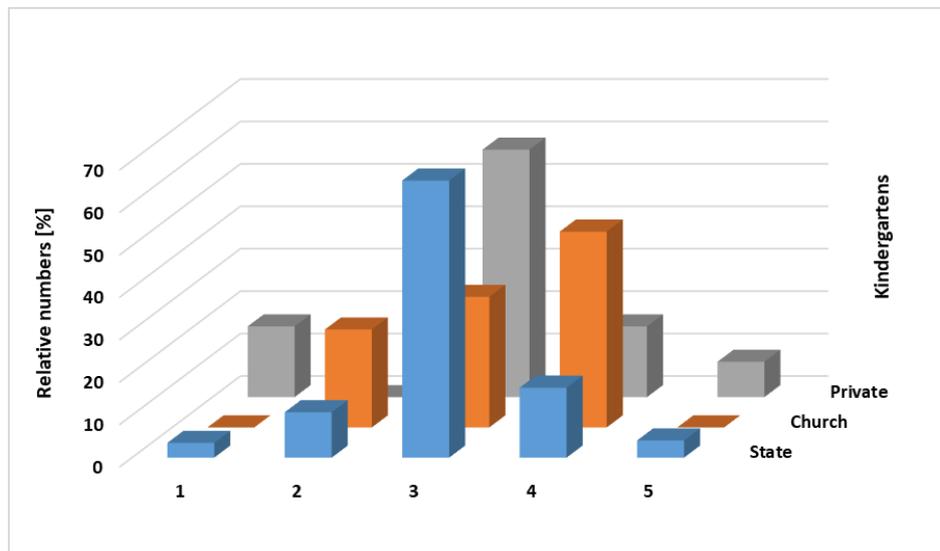


Figure 2: Self-assessment of teachers' professional readiness to explain why and how experiments work. (Own research)

As the figure 2 shows, the greatest uncertainty while assessing the severity of problems they have in explaining how STEM experiments work was reported by respondents working in state and private kindergartens (value 3 "I don't know" of the used scale: StK – 65% of the respondents, PrK – 58% of the respondents). This essentially indicates a general lack of preparation among teachers for STEM teaching.

The highest level of agreement with the statement that they have problems while explaining how STEM experiments work on the used scale (4 - "I rather agree, i. e. I think that I find it difficult to explain why and how STEM experiments work") was recorded in case of the respondents from church-run and private kindergartens (ChK – 46%; PrK – 17%). Conversely, the highest number of teachers who have no problem explaining STEM experiments was in case of the respondents from church kindergartens (23% of them rather disagree that they would find it difficult to explain why and how STEM experiments work). As already mentioned, these results may be related to insufficient teacher training or limited material and technical equipment - if schools do not have enough tools for experimentation, teachers may have problems with practical demonstrations. Low confidence in their own abilities may also play a role here, as STEM is not traditionally a dominant area in pre-primary education, and teachers may be concerned about their explaining phenomena correctly. Teachers working at church-run kindergartens feel more confident than the others, what may be related to better methodological support or a different approach to education.

4 Teachers' Self-Reflection on Their Knowledge in Individual STEM Areas

Figure 3 presents an overview of the responses of individual categories of teachers (differentiated according to the segmentation factor of kindergarten type) to the statement "I have sufficient knowledge of individual STEM areas" using the same scale of 1 – 5.

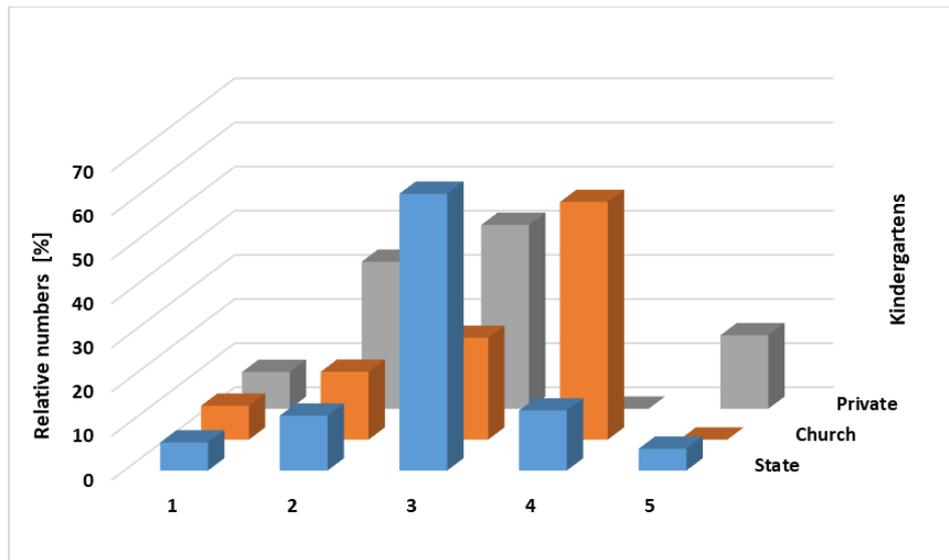


Figure 3: Self-assessment of teachers' sufficient knowledge in individual STEM areas. (Own research)

As the figure 3 shows, the vast majority of respondents working in state kindergartens expressed uncertainty about the level of their STEM knowledge. This uncertainty may be related either to a genuine lack of education in individual areas or to insufficient practice in the STEM implementation. Overall, as many as 63% of the respondents cannot assess if their knowledge in individual STEM areas is or is not sufficient (rating 3 on the scale - „I don't know whether I have or have not sufficient knowledge in individual STEM areas“), which ultimately means that most kindergarten teachers (regardless of the type of the kindergarten at which they work) are unsure of their STEM knowledge or of sufficiency of their STEM knowledge.

Teachers working in church kindergartens manifested the highest level of teacher selfconfidence in STEM knowledge, which may be due to their better professional training, but in our opinion, it is more likely a result of the greater emphasis placed in these kindergartens on innovative teacher training (whether in the form of self-education or further formal education). It is precisely the group of respondents working in church-run kindergartens that, unlike the groups of respondents working in either state or private kindergartens, consider their knowledge in STEM areas to be sufficient (up to 54% of teachers working in church -run kindergartens rated themselves on a scale value of 4 – „I rather agree, i. e. I think I have sufficient knowledge of individual STEM areas“). The greatest variability in responses was recorded in case of the teachers working in private kindergartens.

It is interesting to compare results recorded in case of the subgroups of respondents working in church-run and private kindergartens. In both subgroups, a relatively high percentage of respondents were unable to assess the adequacy of their knowledge in individual STEM areas. However, a significantly higher percentage of such respondents (almost twice as many) was found in the subgroup of respondents working in private kindergartens. In both subgroups, a relatively large number of respondents (especially compared to the subgroup of respondents working in state kindergartens) declared that they probably or definitely have this knowledge (stating the scale value of 4 – „I rather have, i. e. I think I have sufficient knowledge“, and 5 – „I completely agree, i. e. I definitely have sufficient knowledge“). However, while a relatively high number of respondents from church-run kindergartens are unable to assess their knowledge (31%), several times higher relative number of respondents from church-run kindergartens "modestly" state that they think they have sufficient knowledge (scale value 4 – „I rather agree, i. e. I think I have sufficient knowledge, 46% of the respondents), the situation is the opposite within the subgroup of teachers working in private kindergartens. In addition to a significantly higher relative number of respondents who are unable to assess their knowledge (58%), there is a significant, but not very large, group of respondents who "confidently" assess themselves as definitely having the necessary knowledge (rating 5 of the scale – „I completely agree, i. e. I definitely have sufficient knowledge, 8% of the respondents). Potential differences between various types of kindergartens may be attributed, for example, to the more rigid and less flexible systems within state kindergartens; this can inhibit innovation, including within STEM education. Conversely, church-run kindergartens often benefit from greater methodological support and smaller class sizes, allowing for better individualisation of learning. Private schools exhibit greater variability in teacher quality; while some educators are highly prepared, others may possess minimal STEM-specific training. This analysis indicates that STEM education in kindergartens has room for further improvement, particularly regarding teacher training. Church-run kindergartens demonstrate the highest levels of teacher confidence in STEM knowledge, whereas state and private kindergartens exhibit greater uncertainty and lower levels of confidence in this area.

5 Conclusion

The results presented, which compare three selected aspects of the readiness of teachers in state, private, and church-run kindergartens to implement the STEM concept within the pre-primary education environment, represent only a small portion of the research undertaken (Brečka et al., 2025). The overall research results confirm that while the implementation of STEM education in Slovak kindergartens possesses significant potential, it simultaneously faces several challenges. Kindergarten teachers demonstrate an interest in developing their STEM competences; however, they frequently encounter a lack of information, an absence of continuing professional development, and limited material or technical resources. These

findings highlight the need for systematic support for teachers, addressing not only their professional and technical skills but also the development of their pedagogical competences and their ability to apply innovative teaching methods. Consequently, a key factor for the successful implementation of STEM is the availability of high-quality methodological support and educational materials.

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