



# Navigating STEAM Education and Inclusive Practices: A Needs Analysis of Primary Educators in Greece

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## Abstract

This paper addresses the intersection of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education and inclusive practices in primary education, specifically focusing on the Greek primary schools. Through a needs analysis, the study explores in-service Greek primary teachers' knowledge, attitudes, needs and challenges in effectively implementing STEAM practices and fostering inclusivity within their classrooms. Employing a survey-based approach, the study revealed several key findings: an initial stage of STEAM approach adoption in Greek primary schools, limited teachers' knowledge about the STEAM educational approach, and varied results of teachers' knowledge regarding Inclusive Education. The findings showed positive attitudes among teachers towards STEAM and Inclusive education but also indicated a range of training needs in the Inclusive STEAM education approach. Additionally, the analysis revealed a lack of support and adequate training for teachers in these areas. Those findings provide insights to enhance pedagogical practices and facilitate effective teachers' professional development in Greek primary schools.

## CCS Concepts

• Surveys and overviews; • Education; • Professional topics;

## Keywords

Inclusive STEAM Education, Greek primary teachers, challenges, needs

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## 1 Introduction

In today's rapidly evolving world, the adoption of Science, Technology, Engineering, Arts and Mathematics (STEAM) education at all educational levels has emerged as an important approach to equipping students with the necessary competences that can make them thrive in the future workforce and societies [1, 2]. STEAM education, an evolution of the STEM model, integrates the arts into science, technology, engineering, and mathematics to foster creativity and enhance students' understanding of cultural and societal contexts, offering a more holistic and enriched learning experience [3]. By transcending the traditional teaching methods [4] and disciplinary boundaries [5, 6], STEAM education puts students' development of creativity, collaboration, critical thinking, and problem-solving skills [1, 7] in the foreground, promoting innovation [8, 9] and complex real-world problems understanding [10]. On the other hand, Inclusive Education, as a transformative approach to teaching and learning [11], aims to provide equitable access to education for all students, regardless of their abilities and backgrounds [12, 13]. By embracing diversity in all its forms during the educational process [14] and creating a sense of empathy [15, 16] and belonging for all [17], Inclusive Education equips students with mindsets and skills that can lead to a more democratic society [18].

Due to the advantages of both Inclusive [19, 20] and STEAM Education [21, 22] with regards all students' multidimensional development, the combination of their knowledge, practices, and instructional methodologies has started to gain ground in international literature under the name of Inclusive STEAM Education approach [23–27]. This newly formulated approach still lacks a widely accepted definition. However, for the sake of our research, we have identified critical elements from Inclusive STEAM Education literature [23–27] to provide an initial conceptualization and understanding of the term. Consequently, starting from its main components, Inclusive STEAM Education has as a starting point the integration of possibly all STEAM disciplines and students' talents, interests, and needs. In this context, Inclusive STEAM Education aims, through the combination of such components, to foster and guide all students' inquiry, dialogue, critical thinking diversity, and disability awareness by providing and continuously ensuring their

equitable access, participation, engagement, and success in STEAM education interventions.

However, it is essential to identify teachers' specific challenges and needs in Inclusive STEAM Education to understand their mindsets and intentions in implementing it [4]. This comprehensive identification will provide insights into the support and resources required for effective Inclusive STEAM Education teaching in mainstream primary classrooms with students with Special Education Needs (SEN), specifically Mild Disabilities (MD).

SEN students form a heterogeneous group of students due to their non-typical learning modes that require specially designed instruction [28]. The SEN students to whom we focus on the current study are those with Mild Disabilities (MD), which include Learning Disabilities, Mild Intellectual Disability, Attention Deficit/Hyperactivity Disorder, and Mild Emotional/ Behavioral Difficulties. MD students are quite academically intriguing [29], as identifying and addressing their needs require teachers' previous experience and knowledge [30]. To support teachers' knowledge in including MD students in STEAM classrooms, we initially identified characteristics of successful STEAM Education practices on MD students or other SEN students implemented in mainstream classrooms or resource rooms of general schools.

We identified several common characteristics by exploring the preK-6 international literature referring to those STEAM practices. At first, the teachers or researchers involved tended to identify learners' needs, abilities, and motivators [23–25] and review learners' disability diagnosis [24]. They also tended to identify and integrate learners' prior knowledge in the educational process [23–27]. In addition, they appeared to combine, during the implementation of STEAM practices, STEAM teaching methods with Inclusive/ Special Education teaching methods [23–27]. Moreover, they used different modes of instruction (1-1 and 1-small group) [24, 26] and different assessment methods for the ascertainment of all students' academic progress [23–27]. Furthermore, they used appropriate resources and tools according to learners' needs [23–26]. In addition, they designed STEAM curricula and adapted them to learners' needs [23, 25, 27], designing and adapting activities to learners' needs [23, 25, 27]. Finally, they collaborated with other educators and/or special education staff [23, 24, 26, 27].

After such identification, we exploited teachers' challenges and needs in including MD students in Greek STEAM primary classrooms. In this way, we investigated whether their needs and challenges referred to the characteristics identified above or not. In addition, we examined teachers' attitudes towards and knowledge about including MD students in STEAM activities or projects in general classrooms. Through this action, we aimed to put Greek primary teachers in the foreground as they are the pillars of the success of any educational intervention [4].

The findings of that investigation were limited as only two studies were found referring straightforwardly to Greek primary teachers. The first was an article describing an eTwinning Inclusive STEAM project implemented through synchronous and asynchronous activities in K2 students by four teachers (3 Greeks and 1 Belgian) [23]. In this article, the teachers perceived the Inclusive STEAM process in online environments as challenging and demanding. In addition, teachers presented challenges associated with class schedules, course load, and the design of students' self-assessment

and peer assessment rubrics. The second study was a Greek post-graduate study [31]. This study revealed that teachers presented positive attitudes towards Inclusive STEAM Education, a lack of knowledge about the STEAM approach, and a significant need for professional development in the Inclusive STEAM Educational approach.

Due to the limited findings in Inclusive STEAM Education for Greek primary teachers, the present study aims to investigate their attitudes, knowledge, challenges, and needs regarding implementing its fundamental components, including those of Inclusive and STEAM education. By investigating these parameters, we aim to stimulate discussions about adopting Inclusive STEAM Education in Greek primary schools and the parameters that can lead to its proper future implementation. Through this process, this research seeks to highlight existing gaps and areas for improvement and aims to provide actionable insights and recommendations for enhancing Greek primary teachers' pedagogical practices. Ultimately, our goal is to support the development of more effective teacher professional development programs, thereby fostering a more inclusive and innovative STEAM educational environment in Greek primary classrooms.

The structure of this paper is as follows: After this introduction, Section 2 provides a literature review on Inclusive and STEAM Education with a focus on Greek primary teachers. Section 3 details the methodology employed in the study, including the survey design and data collection procedures. Section 4 presents the findings and analysis of the survey results. Section 5 discusses the implications of these findings for teacher professional development and educational practices. Finally, Section 6 offers conclusions and recommendations for future research and policy development.

## 2 Literature Review

In Greece, as in other European countries, the promotion of the rights of SEN and, consequently, MD students to be educated in mainstream classrooms has been a tradition for almost forty years (Law 1566/1985). Through all those years, the efforts of the Greek Ministry of Education to facilitate the education of SEN and MD students in general classrooms of all educational levels became apparent.

On the other hand, the introduction of STEM Education appeared in the Greek educational reality in 2021 by establishing and integrating a new framework of activities among the preK-9 classrooms. More specifically, STEM education, focusing however only on the topic of educational robotics, was added as an optional course in the Skills Laboratories initiative in preK, K1, K4, K5, K7, and K8 grades, according to the associated Ministerial Degree (FEK 3567/2021). Furthermore, the lack of a legislative framework to support the participation of SEN and MD students in STEM education suggests that Inclusive STEAM Education, similar to other countries [32], is not yet widely adopted. Nevertheless, it is crucial to examine the roles of Greek primary teachers in Inclusive and STEAM settings. This examination will provide deeper insights into their mindsets, knowledge, and the challenges and needs they face in each approach. Understanding these factors is essential for developing effective strategies to support and improve their teaching practices.

Regarding STEAM education in Greek primary schools, limited studies have been conducted. In such studies, a positive tendency can be seen on Greek primary teachers' attitudes towards STEAM Education [34, 35], or its implementation [33]. In addition, teachers appeared to have adequate knowledge about the STEAM approach in some studies [34, 35], while other gave them a general understanding of the approach [33]. Moreover, concerning their needs, the need for appropriate training in the STEAM Education approach was apparent in one study [33] and suggested by another [35]. Finally, concerning their challenges, the lack of educational resources for STEAM education [33, 34], their difficulty in understanding the methodological principles of the STEAM approach [34], the limited school infrastructures, the time parameter, the lack of support from or collaboration with experts/ professionals/ teachers from the Science field [33], and the limited support by policymakers and advisers [34] was revealed. This recognition is substantiated by studies examining the challenges and needs of STEAM educators in Greece, including primary and other teachers [36, 37].

Despite the limited number of studies addressing Greek primary teachers' attitudes, knowledge, challenges, and needs regarding the STEAM approach, many studies were found regarding the inclusive approach [38–49]. Such studies can provide us with general tendencies on teachers' attitudes, knowledge, challenges and needs in Inclusive Education, as they generally do not focus on the Inclusion of MD students. Starting from the attitudes, teachers exhibit positive attitudes [38–40] or slightly positive attitudes [41] towards Inclusive Education or the idea [42] of inclusion, with this trend not to be consistent across all research findings. Some studies revealed negative teachers' feelings towards disabilities [43] or negative teachers' attitudes towards the implementation of inclusion [41, 42], with the presence of neutral [44] or moderately positive attitudes [45] towards the process to be apparent as well.

Concerning Greek primary teachers' knowledge, most of the studies revealed limited knowledge [38] or lack of teachers' knowledge in special/ inclusive education fields [39, 40, 42, 43], with other studies to leave, also significant implications in that direction [46, 47]. Teachers' lack of knowledge was perceived as a parameter hindering Inclusion [41]. The parameter of time was underlined in some studies [41, 43, 46, 48] as challenging, along with the lack of a culture of collaboration among different educators in the inclusive classroom [43, 46] and the limited opportunities in that direction [41]. Teachers perceived, also as challenges, the insufficient support they received from school and the local community [41], their limited experience in inclusion [41], the significant number of SEN students within classrooms [39], their delayed diagnosis [39], the lack of reliable measures of ascertainment of SEN students' progress [39], and the teachers', other students' and other students' parents' attitudes towards the inclusion of SEN students [46]. Moreover, the lack of appropriate resources was referred to as both teachers' challenge [39] and need [46]. Other teachers' needs referred to curriculum modifications [38] and reform [42], collaboration among different educators, special educators, and other staff [38, 41, 46, 48], and effective teachers' professional development in inclusive/special education fields [39, 41, 46–49].

Finally, there was little evidence concerning Greek primary teachers' attitudes, knowledge, challenges and needs in including MD students [39, 41]. Teachers perceived students with mild learning

disabilities as the easiest to accommodate in an Inclusive classroom, with students with ADHD and with challenging behavior and emotional problems to follow [41]. In addition, they seemed to present limited knowledge on the origin of MDs such as ADHD and not be able to make connections between the environmental parameters (families, schools) and students emotional and behavioral problems [39].

Considering the collective findings, it is apparent that further examination of Greek primary teachers' attitudes towards knowledge, challenges, and needs in STEAM Education and Inclusive Education for MD students is necessary, given the limited number of studies found. This examination can provide insights about the possibility of adoption of Inclusive STEAM Education for MD students by Greek primary teachers. It will also provide insights into the parameters that can hinder this adoption. Moreover, the current use of the STEAM approach in Greek primary classrooms should be further investigated because it can hinder this adoption as it is linked with experience. In addition, Greek primary teachers' attitudes towards inclusive STEAM education for MD students should be investigated to support the initial insights. Greek primary teachers' needs for Inclusive STEAM education should also be investigated so that the parameters leading to its proper implementation will be revealed and included in future professional development programs.

### 3 Methodology

Due to all the above, the present study addressed the following research questions:

- 1. What is the level of adoption of the STEAM approach in Greek primary schools?
- 2. What knowledge do teachers possess about STEAM and Inclusive Education for MD students?
- 3. What are the Greek teachers' attitudes towards STEAM, Inclusive and Inclusive STEAM Education?
- 4. What are Greek teachers' training needs in Inclusive STEAM Education?

To gather the necessary data, we constructed a web-based questionnaire with various question types, such as Likert-type, open-ended, multiple-choice, and dichotomous questions, consisting of six parts:

- A. Demographic Information: Participants provided basic personal data (gender, age, level of education) and years of teaching experience in General and Special Education and indicated whether they held degrees in STEAM or Special Education/ Educational Inclusion of students with disabilities.
- B. STEAM/ Inclusive Education Initiatives in Greek primary schools: Participants were asked about their awareness and involvement in STEAM programs in their country or school, the existence and participation (as trainee or trainer accordingly) in training programs for STEAM/Inclusion of MD students, and whether educational authorities promote STEAM and Educational Inclusion for MD students, professional development programs/ activities.
- C. Knowledge and Training Intentions: Participants assessed their knowledge of STEAM and Inclusive Education of MD

students on a 7-point Likert scale and expressed their intentions for future training in specific areas.

- D. Attitudes: Participants were asked to rank their attitudes on a 7-point Likert scale, using specific statements for STEAM and Inclusive STEAM Education for MD students.
- E. Challenges and Needs: Participants evaluated identified challenges and needs from the literature regarding STEAM and Inclusive Education for MD students using a 7-point Likert scale.

The questionnaire adhered to ethical provisions and specifications, including a section detailing the study’s scope, aims, and objectives. Participants were required to sign a consent declaration to participate in the research. The questionnaire was initially piloted with participants selected through convenience sampling. Following this pilot phase, adjustments were made, resulting in the final version of the questionnaire. This version was then distributed in an electronic form to primary school teachers through dissemination actions of the Erasmus+ project SpicE<sup>1</sup> organized by the Greek project partners. The sampling technique selected was snowball sampling, as teachers were informed through such actions about the survey and were asked to distribute it to other colleagues.

Data analysis was performed using SPSS for Windows (ed. 22). The Likert-type questions were analyzed using mean (M) and standard deviation (SD), whereas percentages and frequencies were used for nominal variables. We evaluated the internal consistency of the items within each category by calculating Cronbach’s Alpha. The Cronbach’s Alpha values ranged from  $\alpha = 0.735$  to 0.905, indicating good internal consistency and reliability.

## 4 Results

### 4.1 Profile of Participants

The sample of this study consisted of 68 primary teachers, with 59 (86.8%) women and 9 (13.2%) men. Our sample has slight differences from the statistical distribution of Greek primary teachers, found in 2021 by Eurostat (74% female and 26% male teachers)<sup>2</sup>. Many teachers who participated in the survey were between 31-40 years old (30.9%), followed by those aged 41-50 (27.9%), 51-60 (23.5%), and 20-30 (17.6%). Regarding educational qualifications, the majority of the participants (51.5%, n=35) held a Master’s degree, while 41.2% (n=28) had a Bachelor’s degree, and 7.4% (n=5) held a PhD. In terms of teaching experience in general education, 29.4% (n=20) of participants had 1-10 years of experience, followed by those with 11-20 years (25%, n=17), 21-30 years (25%, n=17), no experience (14.6%, n=10), more than 31 years (4.4%, n=3), and less than 1 year (1.5%, n=1). Regarding experience in special education/ educational inclusion of students with disabilities, the majority (54.4%, n=37) had no teaching experience. Other participants had 1-10 years (39.8%, n=27), 11-20 years (3%, n=2), and less than 1 year (3%, n=2) of experience in that context. Furthermore, 92.6% (n=63) of the teachers did not hold any degree in STEAM Education, with only 7.4% (n=5) indicating that they did. Similarly, in Special/Educational Inclusion

of MD students, 60.3% (n=41) did not hold any degree in the subject, whereas 39.7% (n=27) reported having such qualifications.

### 4.2 Inclusive STEAM Education Initiatives in Greece

The results of the second part of the questionnaire, namely “STEAM/ Inclusive Education Initiatives in Greek primary schools,” revealed a limited adoption of the STEAM approach in Greek primary schools. Most of the sample (91.2%, n=62) was not aware of the implementation of STEAM Educational programs in either their country or their school. Nevertheless, among the teachers who were aware of the implementation of STEAM programs in schools (8.8%, n=6), half (n=3) were satisfied with the results of such interventions. Finally, concerning promoting and supporting STEAM and Educational Inclusion of MD students by local authorities through professional development programs/ activities, 66.2% (n=45) of teachers and 51.5% (n=35) answered negatively, accordingly. Moreover, most teachers had not ever participated in STEAM (83.8%, n=57) or Inclusive Education (86.8%, n=59) training programs/ activities for MD students as trainees and trainers, accordingly, organized by a central educational authority or local agents.

### 4.3 Teachers’ Knowledge and Intentions

Concerning the third part of the questionnaire, namely “Knowledge and Intentions”, the items included assessments of current knowledge of STEAM Education, personal interest in learning to implement STEAM Education programs, current knowledge of Inclusive Education for MD students, personal interest in learning to implement Inclusive Education for MD students, and personal interest in using STEAM activities for the inclusion of MD students (Figure 1).

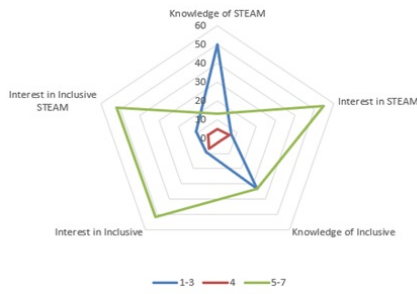
For the item “Knowledge of STEAM,” most respondents (50) indicated low knowledge, with 5 neutral and 13 indicating high knowledge. In contrast, for “Interest in STEAM,” most respondents (55) showed high interest in learning to implement STEAM Education, with 6 neutral and 7 indicating low interest. Regarding “Knowledge of Inclusive Education for MD students,” responses varied. Responses were split evenly between low (33) and high (33) knowledge, with 2 neutral. For “Interest in Inclusive Education for MD students,” most respondents (52) indicated high interest in learning to implement Inclusive Education for MD students, with 7 neutral and 9 indicating low interest. Similarly, “Interest in Using STEAM for Inclusion of MD students” showed a strong inclination, where most respondents (52) showed high interest in using STEAM activities for inclusion of MD students, with 5 neutral and 11 indicating low interest.

### 4.4 Teachers’ Attitudes

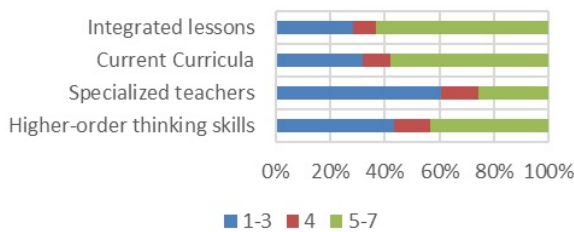
In Figure 2 the results of the questions are provided, which are associated with teachers’ attitudes toward STEAM Education, from the fourth part of the questionnaire, “Attitudes”. Participating teachers seemed to possess positive attitudes toward STEAM Education, as many respondents (38) agreed that integrated STEAM lessons are more beneficial, 5 were neutral, and 17 disagreed (M=5.15, SD=1.589). In addition, they did not seem to agree that only specialized teaching staff in STEAM is responsible for its implementation,

<sup>1</sup><https://spiceacademy.eu/>

<sup>2</sup>[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Primary\\_education\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Primary_education_statistics)



**Figure 1: Teachers’ knowledge about STEAM and Inclusive Education and intentions for training about STEAM, Inclusive and Inclusive STEAM Education approach**

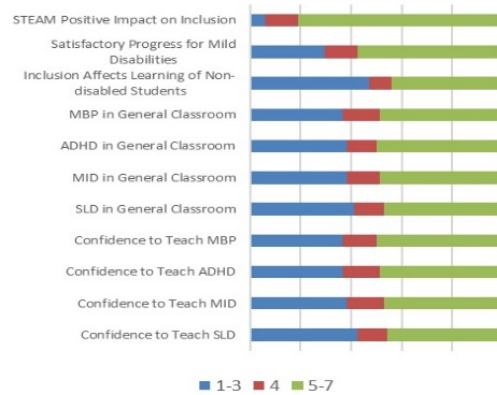


**Figure 2: Teachers’ answers to questions referring to their attitudes towards the STEAM Education approach**

as the majority of respondents (35) disagreed that only specialized teachers should implement STEAM Education, 8 were neutral, and 15 agreed ( $M=2.57$ ,  $SD=1.586$ ). Regarding the item that students should possess high order thinking skills to understand STEAM fields, responses were almost evenly split between disagreement and agreement, with 26 respondents each in these groups and 8 in the neutral category ( $M=2.84$ ,  $SD=1.512$ ). Moreover, they seemed to have moderate to positive agreement that the current educational curricula can properly support the implementation of STEAM Education in primary settings ( $M=4.59$ ,  $SD=1.557$ ), while most respondents (29) agreed that current curricula could support STEAM Education with modifications (see Figure 2).

Figure 3 presents the frequency distribution of scores (in the same three group scores) for the items related to teachers’ confidence in teaching students with different MD types and their perceptions of challenges and supports in inclusive education.

For teachers’ confidence, responses showed a balanced distribution regarding teaching students with Specific Learning Disabilities, with 29 respondents indicating low confidence, 8 neutral, and 31 high confidence ( $M=4.07$ ,  $SD=1.808$ ). Similarly, for teaching students with Mild Intellectual Disabilities, there were 26 respondents with low confidence, 10 neutral, and 32 with high confidence ( $M=4.22$ ,  $SD=1.796$ ). Self-confidence in teaching students with ADHD was also balanced, with 25 respondents indicating low confidence, 10 neutral, and 33 high confidence ( $M=4.30$ ,  $SD=1.816$ ). Responses were somewhat evenly split for teaching students with Mild Behavior Problems, with 25 indicating low confidence, 9 neutral, and 34 high confidence ( $M=4.32$ ,  $SD=1.822$ ).



**Figure 3: Teachers’ answers to questions referring to their attitudes towards the Inclusive STEAM Education approach and their attitudes and self-efficacy towards the Inclusive Education approach**

Regarding the appropriateness of instructing MD students, regarding students with Specific Learning Disabilities, 28 respondents disagreed with the statement, 8 were neutral, and 32 agreed ( $M=4.12$ ,  $SD=1.873$ ). For students with Mild Intellectual Disabilities, 26 disagreed, 9 were neutral, and 33 agreed ( $M=4.24$ ,  $SD=1.815$ ). For students with ADHD, 26 disagreed, 8 were neutral, and 34 agreed ( $M=4.21$ ,  $SD=1.856$ ). For students with Mild Behavior Problems, 25 disagreed, 10 were neutral, and 33 agreed ( $M=4.25$ ,  $SD=1.828$ ). Most agreed that MD students can make satisfactory progress in general classrooms if appropriately taught, with 39 agreeing, 9 neutral, and 20 disagreeing ( $M=4.85$ ,  $SD=1.761$ ). Moreover, most teachers ( $n=32$ ) disagreed that implementing inclusionary programs for MD students has a negative impact on the learning progress of students without disabilities, with 6 providing a neutral answer and 30 agreeing with the statement ( $M=3.18$ ,  $SD=1.912$ ).

Finally, teachers appeared to have positive attitudes towards Inclusive STEAM Education, derived from their positive answers about its benefits for MD students. Most respondents (58) indicated agreement or high agreement that STEAM education positively impacts the educational inclusion of MD students. A smaller number of respondents (10) were neutral on this statement, and a minority (2) indicated disagreement or low agreement. This distribution suggests a strong overall belief in the positive impact of STEAM education on inclusion, as reflected in the high mean score ( $M=5.92$ ,  $SD=1.240$ ).

#### 4.5 Teachers’ challenges and needs

Significant results concerning teachers’ challenges were also found in the fifth part of the questionnaire. Figure 4 presents the results of questions referring to the factors that teachers perceive as challenges and can provoke the proper implementation of the STEAM Education approach in Greek primary settings.

The responses indicated varied perceptions regarding the lack of sufficient educational resources for implementing STEAM education programs. Specifically, 19 respondents indicated low agreement, 10 were neutral, and 39 showed high agreement, with a mean



Figure 4: Teachers' challenges in STEAM Education approach

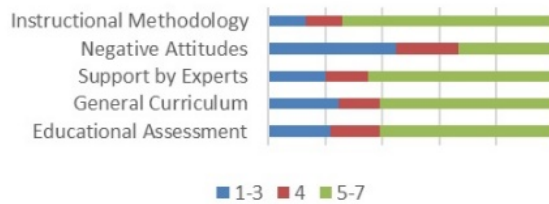


Figure 5: Teachers' challenges in Inclusive Education

score of 4.84 (SD=1.771). There was a strong belief that appropriate training could compensate for other insufficiencies affecting the implementation of STEAM education. Most respondents (45) agreed with this statement, while 10 were neutral, and 13 indicated low agreement, resulting in a mean score of 5.18 (SD=1.580). Responses regarding the feasibility of implementing STEAM education due to increased teacher workloads were mixed. Twenty-four respondents indicated low agreement, 8 were neutral, and 36 showed high agreement, with a mean score of 4.38 (SD=2.027).

Figure 5 presents the frequency distribution of scores (from 1 to 7) for items related to the challenges faced by primary education teachers, including insufficient knowledge of educational assessment, high demands of the general curriculum, insufficient support by special education experts, negative attitudes of students without disabilities towards inclusion, and insufficient knowledge on instructional methodology for MD students.

Responses indicate varying levels of perceived insufficiency in knowledge of educational assessment (Figure 6). Expressly, 14 respondents indicated low agreement, 15 were neutral, and 40 showed high agreement, with a mean score of 4.99 (SD=1.754). Responses about the high demands of the general curriculum were mixed. There were 18 respondents with low agreement, 16 were neutral, and 35 indicated high agreement, resulting in a mean score of 4.59 (SD=1.846). Many respondents agreed that there is insufficient support from special education experts. Specifically, 20 respondents indicated low agreement, 16 were neutral, and 33 showed high agreement, with a mean score of 4.67 (SD=1.865). Respondents generally disagreed that students without disabilities hold negative attitudes towards inclusion, with 18 indicating low agreement, 19 neutral, and 32 agreeing, resulting in a mean score of 4.23 (SD=1.763). The responses indicated significant concerns about insufficient knowledge of instructional methodology, with 9 respondents indicating low agreement, 9 neutral, and 51 showing high agreement, with a mean score of 5.18 (SD=1.635).

Finally, regarding their training needs identified in the last part of the questionnaire, teachers seemed to have great needs in almost all the parameters. Figure 6 presents the distribution of teachers' answers concerning their training needs in the Inclusive STEAM Education approach for MD students. Incorporating STEAM in daily practice is the most critical need, with 64 responses in the '5-7' range, a mean (M) of 6.28, and a standard deviation (SD) of 1.08. Adapting the curriculum for MD students' needs also has strong support, with 64 responses in the '5-7' range, a mean of 6.12, and a standard deviation of 1.15, highlighting the necessity of modifying the curriculum to cater to the needs of all students. Practical solutions for inclusion are highly important, with 62 responses in the '5-7' range, a mean of 6.24, and a standard deviation of 1.24, indicating consistent acknowledgement of their significance for inclusive education.

Including MD students in general classroom activities has strong support, with 63 responses in the '5-7' range, a mean of 6.07, and a standard deviation of 1.19. Instructional methodology for MD students is also highly needed, with 61 responses in the '5-7' range, a mean of 6.07, and a standard deviation of 1.25. Integrating multiple learning goals is crucial, with 60 responses in the '5-7' range, a mean of 5.84, and a standard deviation of 1.28, highlighting the importance of interdisciplinary learning objectives.

Organizing STEAM lessons is essential, with 60 responses in the '5-7' range, a mean of 5.94, and a standard deviation of 1.23. This indicates a high need for effective planning of integrated STEAM lessons. Procedures for school progress show a balanced distribution, with 57 responses in the '5-7' range, a mean of 5.63, and a standard deviation of 1.41, indicating a recognized need for effective procedures to monitor and ascertain student progress. Educational assessment for MD students is considered important, with 58 responses in the '5-7' range, a mean of 5.68, and a standard deviation of 1.35, reflecting the necessity of appropriate assessment methods.

Instructional methodology in STEAM shows most responses (56) within the '5-7' range, with a mean of 5.75 and a standard deviation of 1.27, indicating consistent recognition of the need for effective STEAM instructional strategies. Finally, the theoretical background in STEAM shows 46 in the '5-7' range, a mean of 5.31, and a higher standard deviation of 1.59, suggesting varied opinions on its necessity. Overall, these results highlight the need for teachers to effectively implement inclusive STEAM education for MD students effectively, emphasizing integrating STEAM into daily practice and adapting curricula for inclusivity.

## 5 Discussion and conclusion

This study aims to explore preliminary insights into the potential adoption of the Inclusive STEAM approach by Greek primary school teachers while also examining the factors that may hinder or facilitate its successful implementation in the future. To this end, we examined Greek primary teachers' attitudes, knowledge, challenges, and needs concerning the potential combination of Inclusive and STEAM Education, treating these two approaches separately, as teachers are more familiar with them. After gaining initial insights by examining the components of Inclusive STEAM Education, we proceeded to investigate Greek primary teachers'

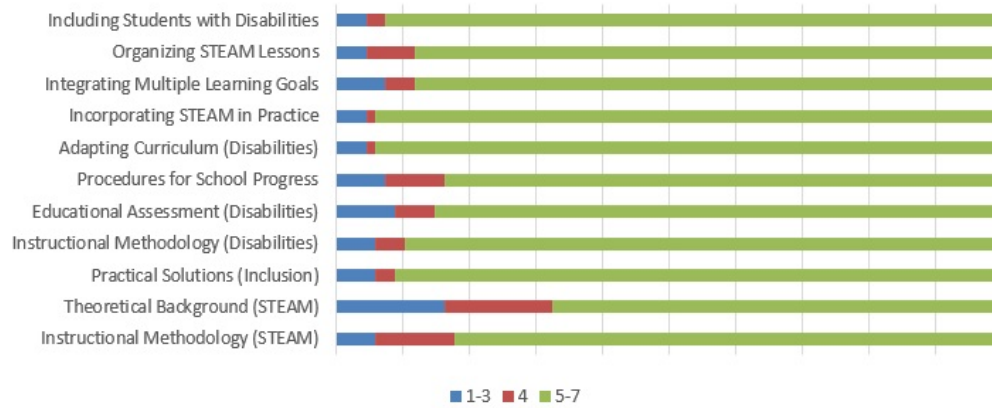


Figure 6: Teachers’ training needs in the Inclusive STEAM approach

attitudes towards this approach to better support them. We also explored their specific training needs in Inclusive STEAM Education.

Greek primary teachers presented a lack of knowledge about the STEAM Education approach, a finding that is also supported by one Greek postgraduate study [31]. This finding is understandable given that most participants reported a lack of training in STEAM education. Furthermore, the teachers in our study presented equally distributed responses concerning their knowledge of Inclusive Education, between “low” (n=33) and “high” (n=33) knowledge, with two neutral responses provided, as well. This finding is also explainable as almost half of the participants did not possess any teaching experience in Special/ Inclusive Education fields. It is also understandable, given that most participants presented a lack of training in supporting MD students in Special/ Inclusive Education initiatives. However, as teachers’ lack of knowledge can be a parameter that can hinder Inclusion [41], we have to investigate in a future study, whether it has the potential to hinder Inclusive STEAM Education as well. Moreover, the sufficiency of currently offered undergraduate and specialization study course [47] should also be questioned in a future study regarding whether they equip teachers with the necessary knowledge in Inclusive and STEAM initiatives. Nevertheless, the positive stance of teachers towards participating in training on STEAM, Inclusive and Inclusive STEAM approaches could stand as a positive indicator for designing and implementing future professional development programs in all fields.

The participating teachers presented positive attitudes towards STEAM Education, a fact that was supported by the literature found [34, 35]. A possible explanation of this finding is that teachers recognize the benefits of STEAM Educational approach, despite their limited knowledge and lack of training in it. Moreover, regarding the Educational Inclusion of MD students, participating teachers demonstrated positive attitudes toward Inclusion, a fact supported by previous studies [38–40]. Nevertheless, the diversity of results that was revealed in this question indicates that we should investigate this parameter in more depth and with a greater sample in a future study. In addition, more specialized investigation should be conducted into whether teachers are willing to implement inclusive education for MD students. In fact, one study [47] revealed

that teachers were positive towards inclusion in case other more specialized professionals implemented it. As the teachers’ attitudes in implementing STEAM Education have not yet been examined, an investigation should also be made in this direction.

Moreover, the results of this study showed that the adoption of STEAM practices is in an early phase in Greek primary schools. This finding justifies the limited number of studies in this field during the literature review [33–35].

By combining the results of Greek primary teachers’ attitudes towards STEAM and Inclusive Education for MD students, it could be hypothesized that teachers would have positive attitudes towards Inclusive STEAM Education for MD students. Our study’s results supported this hypothesis. In fact, it was revealed that participating teachers tended to present positive attitudes towards Inclusive STEAM Education for MD students. This positive attitude was, also, supported by a previous Greek post-graduate study on teachers [31]. Despite teachers’ positive attitudes towards Inclusive STEAM Education, the parameters that can hinder its adoption were investigated. For that investigation, we explored teachers’ challenges and needs on Inclusive STEAM Education components which are those of STEAM and Inclusive Education.

Concerning teachers’ challenges in STEAM Education, teachers seemed to face, as a challenge, a lack of educational resources, which was also stated in the literature [33, 34]. Another teachers’ challenge is the increased workload, which can be linked with the parameter of time, found in a study [33]. In addition, concerning Inclusive Education, the challenges that the participating teachers are facing are their lack of knowledge of MD students’ instructional methodology and insufficient support from special education experts. The first finding was supported by the literature [39, 40, 42, 43]. In contrast, the second can be associated with the need for teachers to collaborate with other educators, special education staff, and experts, as shown in previous studies [38, 41, 46, 48]. In addition, teachers seemed to perceive their insufficient knowledge in educational assessment as challenges, a finding that was supported by the literature [23]. Moreover, the teachers’ challenge associated with the demanding curriculum can be linked with the time parameter found in the literature [41, 43, 46, 48].

The teachers' challenge associated with the demanding curriculum, if combined with the teachers' challenge of workload and resources in STEAM, can indicate the need for educational reform concerning the existing curricula of Greek primary schools to support, to a greater degree, the proper adoption and implementation of Inclusive STEAM Education. In addition, the challenges in Inclusive education fields (instructional methodology, assessment) reported by teachers, if combined with the insufficient support they feel they receive from experts, could increase their feeling of insufficiency in coping with MD students educationally. This hypothesis should be further examined in the aspects of validity in a future study. Moreover, as teachers' lack of knowledge in STEAM and Inclusive education initiatives was also revealed as a challenge in the current section, this could indicate teachers' need for further professional development in those areas, which should be addressed.

To address this need, our study revealed knowledge regarding the specific training needs of Greek primary teachers in the Inclusive STEAM approach. More specifically, teachers indicated a need for professional development activities that provide practical ideas for incorporating STEAM education into their daily practice. They also reported a need for practical solutions to support MD students' educational inclusion, and training on curriculum adaptation to meet their specific needs. Furthermore, teachers expressed the need for training in instructional methodologies tailored to MD students, the organization of integrated STEAM lessons, and the integration of multiple learning goals from different content areas. They also required guidance on instructional methodologies specific to each of the STEAM fields, educational assessment for MD students, and procedures to ascertain the progress of all students. Additionally, there was a need for a deeper understanding of the theoretical background of STEAM Education. These findings, reveal a lot about existing teacher initial and in-service training, as they could stand as initial insights about the parameters that should be incorporated in them.

The findings highlight a clear need for initial or in-service professional development programs incorporating practical ideas and solutions for teachers, which could be used in their daily practice, especially for students with mild disabilities (MD). Additionally, those programs should provide practical strategies for including MD students in STEAM activities and integrate solutions for all the stages of the educational process (from educational design through implementation and assessment) in parallel. Those programs could also benefit from incorporating STEAM Education foundational knowledge so teachers could better conceptualize the approach.

As with all studies, this work has its limitations. The primary limitation is the small sample size ( $n=68$ ). However, this study contributes to the Body of Knowledge on Inclusive STEAM Education in Greece by offering initial insights into the training needs of in-service primary teachers. Additionally, it sheds light on the current state of STEAM and Inclusive and Inclusive STEAM Education in Greek primary schools, examining educators' mindsets, knowledge, and needs. Its results aim to open the ground of discussion about the proper establishment and promotion of Inclusive STEAM education nationally and worldwide, putting educators' effective and efficient professional development in the foreground.

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