How STE(A)M contexts may inspire social skills in early childhood educational settings

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ABSTRACT
The present study investigated how STE(A)M contexts may inspire social skills in early childhood educational settings. We conducted a collective case study design to provide an in-depth understanding of the development of preschoolers' social skills within STE(A)M contexts, based on ten past studies, considering each one as a case study. Results indicate that stability and improvement were the two types of the development of children's social skills, while deterioration has not been indicated. Improvement was the most viewed type and it have been either noticeable or significant. The study paves the way for a more intensive investigation of how STE(A)M education in early childhood contributes to the development of social skills and possibly to the intercultural awareness of preschool children.

KEYWORDS
Social skills, STE(A)M contexts, early childhood

RÉSUMÉ
L'étude présente a examiné comment les contextes STE(A)M peuvent inspirer les compétences sociales dans les environnements éducatifs de la petite enfance. Nous avons mené une étude de cas collective afin de fournir une compréhension approfondie du développement des compétences sociales des enfants d'âge préscolaire dans les contextes STE(A)M, en nous basant sur dix études antérieures, chacune étant considérée comme une étude de cas. Les résultats indiquent que la stabilité et l'amélioration étaient les deux types de développement des compétences sociales des enfants, tandis que la détérioration n'a pas été observée. L'amélioration était le type le plus fréquemment observé et a été soit notable, soit significative. L'étude ouvre la voie à une enquête plus approfondie sur la manière dont l'éducation STE(A)M en petite enfance contribue au développement des compétences sociales et, potentiellement, à la sensibilisation interculturelle des enfants d'âge préscolaire.

MOTS CLÉS
Compétences sociales, contextes STE(A)M, petite enfance

INTRODUCTION

The last few decades, as 21st century unfolds, education seems to stand at a crossroad. Globally progress has been made in education, but yet millions of children are held back from learning, because of exclusion, gender inequality, poverty and insecurities. UNESCO underlines the need

of a new vision for education, where "*schools and their surrounding education communities must be transformed to become more responsive to the needs of learners and to ensure that their rights are met*" (UNESCO, 2022, p. 1). As a result, an effort to secure equal opportunities and appropriate learning environments for students that are diverse in terms of gender, ethnicity, national origin, language, religion, disability, socioeconomic status, special needs and more is noticed across all levels of education worldwide (Ravanis, 2022).

UNICEF (2019) promotes the idea that education should provide tools for children to surpass situations and challenges they will face throughout their lives, based on the development of life skills. Those skills are very often included to the 21st century's skills. The Partnership for 21st Century Skills (2019), which constitutes a collaborative organization of governments and businesses that defined a framework for the development of skills and attitudes to succeed in the workplace and 21st century society, has listed three types of needed competencies: (a) learning skills (creativity and innovation, critical thinking, and problem-solving; communication and collaboration); (b) literacy skills (information literacy; media literacy; ICT literacy), and (c) life skills (flexibility and adaptability; initiative and self-direction; social and intercultural skills; productivity and accountability; leadership and responsibility (González-Pérez & Ramírez-Montoya, 2022).

Recently, ethical, technological, environmental, and social issues have been related to the approach of the Sciences in Early Childhood Education (Ravanis, 2022). Due to the current economic, scientific, and technological development, socio-scientific questions have been aroused that, in one hand are socially relevant and on the other hand concern real-world problems informed by science (Sadler et al., 2007). One possible way to deal with most of these issues seems to be the critical consideration of Science through developing a more multi-literate society. Science, Technology, Engineering, Arts and Mathematics, within the STE(A)M approach, create for students and provide to educators and researchers the lenses to view the future in a more scientifically literate, holistic and synthetic perspective (Hatisaru et al., 2019). STEAM brings together a multiplicity of social actions, pursuing intersecting discourses and potentially conflicting agendas (MacDonald & Wise, 2018).

SOCIALS SKILLS AND STE(A)M LEARNING ENVIROMENTS

UNESCO argues that we must support all children to gain foundational knowledge, skills, attitudes and behaviors by meeting them where they stand on their learning trajectory, and by helping them reach their full potential (UNESCO, 2022).

UNICEF defines life skills as a group of psychosocial competencies and interpersonal social skills that help people make decisions, solve problems, think critically and creatively, communicate effectively, build healthy relationships, empathize with others, and cope and manage their lives in a healthy and productive way (UNICEF, 2019).

Social skills are defined as a set of learned behaviors that individuals employ in the interpersonal situations, they face in order to gain or maintain a strengthened relationship with their environment (Kelly, 2002, as cited in Asensio-Ramon, 2022). Social skills are also considered as learned behaviors based on social rules that allow the development of the children in an individual or intrapersonal context, expressing their feelings, attitudes, desires, opinions or rights in line with the situation (Caballo, 2005, as cited in Asensio-Ramon, 2022) and enable them to interact appropriately with others in society (Takahashi et al., 2015). Furthermore, social skills are defined as a component of social competence and a general measure of the quality of social behavior (Pečjak et al., 2009), that enable human beings to develop social relationships in various life stages, enable social adaptation, create and maintain existing social

relationships, and have long- and short-term effects over an individual's life (Maleki et al., 2019).

The foundations of learning are highly built in the early years of life, before a child ever crosses the threshold of a primary school. Early childhood is the natural starting point for introducing STEM cognitive fields to children and engages them in related learning activities (National Science Foundation, 2022; OECD, 2016). Children internalize and elaborate their personal experiences of the world, by interacting with the environment around them (Christidou, 2015). Preschool and early-primary age is the significant period for children to discover the world, described by intense desire and spontaneous interest in acquiring knowledge (Helm & Katz, 2016). Early years education, as the first organized educational setting, is the learning environment where children's prior knowledge, experienced mental representations, perceptions, initial alternative ideas and interpretations can be expanded modified, evolved and transformed in the direction of scientifically accepted ideas (Christidou, 2015; Kalogiannakis, 2018). Preschool age is also a crucial period for the development of social skills among children, during which they internalize gender norms, stereotypes and identities (UNESCO, 2019). Early childhood systems are increasingly expected to prepare young children not only for basic education, but for new attitudes that promote understanding, pluralism, respect for diversity, friendly relations and solidarity among each other, groups and all nations (Magos, 2022).

The interdisciplinary nature of the world we live and work, demands a broadening of STEM education and research (Hoachlander, 2014/2015). The integration of science, technology, engineering, arts and mathematics contextualize teaching in real-world issues, and could make the disciplinary practices more relevant to students and teachers (Takeuchi et al., 2020). Integrated STE(A)M education promotes teaching all disciplines as one unit, as a coherent entity like it exists in real life (Breiner et al., 2012). STE(A)M education is perceived not as a curriculum of individual disciplines, but more as a way of organizing teaching by weaving the disciplines together, in a common goal, as a single idea, in ways that teach them as a unit, as a coherent entity (Breiner et al., 2012) that attract and help students acquire 21st century skills (Morrison et al., 2009). The ideas of multidisciplinary problem solving, teamwork and collaboration, connecting learning to personal experience, multiple embodiments, and representational fluency provide the theoretical foundations for effective STEM learning environments (Glancy & Moore, 2013).

STE(A)M education, if approached correctly, can provide opportunities for teachers to engage children in activities that leverage their interests, experiences and prior knowledge (Campbell et al., 2018). At the same time such experiences enhance children's appreciation of science and its value in everyday life (Fleer et al., 2006). In effective STE(A)M learning environments students can relate to and engage with problems and make sense of them based on their own experiences (Tsoukala, 2021). They are active, collaborate to complete learning activities, take ownership of their learning, and apply their knowledge and skills to real problems (Glancy & Moore, 2013).

But in which way and how STE(A)M contexts and learning environments may inspire social skills in early childhood educational settings? That was a question not answered in literature. Therefore, it was our main research question and the motive to conduct the research presented in this paper. In particular, we investigated social skills that allow the development of the children in an individual or intrapersonal context, by a positive sense of self, autonomy and interdependence, the cultivation of emotional awareness that employs perception and expression of emotions, the development of empathy, self-regulation of emotions and behavior. Also, skills that enable children to develop social interpersonal relationships, like interaction, effective communication (verbal and non-verbal), respect, cooperation, problem-solving and active citizenship were examined.

METHODOLOGY

The present study investigated how STE(A)M contexts may inspired social skills in early childhood educational settings. According to Creswell (2016) and Yin (2003), case studies explore a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) or phenomena over time through detailed, in-depth data collection involving multiple sources of information. In a collective case study, we use information from different studies to formulate the case for a new study, while the use of past studies allows additional information (Stake, 2000). We conducted a collective case study design to provide an in-depth understanding of the development of preschoolers social skills within STE(A)M contexts, based on ten (10) past studies, considering each one as a case study.

The past studies were implemented by the author and other qualified experts in collaborative ERASMUS+ and eTwinning projects and also academic research concerning environmental and scientific issues (Tsoukala, 2014, 2019, 2021; Tsoukala & Christidou, 2016, 2018; Tsoukala & Ioannidou, 2020, 2021; Tsoukala & Halkiadaki, 2015; Tsoukala & Stylianidou, 2018; Zacharia et al., 2020).

TABLE 1

Titles and types of the educational settings (CSs)

Case Study	Educational setting	Type	STEAM Disciplines*	Social Skills
CS1	Educational robotics - The Bee game in a playground	Academic research	S-T-E-A-M	Positive sense of self, Perception and expression of emotions, Interaction, Effective communication, Cooperation
CS2	The internal structure of the human body	Academic research	S-T-E-A	Autonomy and interdependence, Self-regulation, Interaction, Effective communication, Cooperation,
CS3	The life cycle of a butterfly	Academic research	S-T-E-A	Autonomy and interdependence, Self-regulation, Interaction , Effective communication, Cooperation,
CS4	Familiarizing preschoolers with Nature of Science through Plant Growth	ERASMUS+ project	S-T	Positive sense of self , Effective communication, Cooperation, Problem-solving
CS5	Dinosaurs	Academic research	S-T-E	Autonomy and interdependence, Effective communication, Cooperation
CS6	Lake Ecosystem	eTwinning project	S-T-A-M	Autonomy and interdependence, Interaction, Effective communication, Respect, Cooperation, Problem-solving
CS7	Water pollution & shortage	eTwinning project	S-T-A-M	Autonomy and interdependence, Interaction, Effective communication, Respect, Cooperation, Problem-solving
CS8	STEMMission: BeeBot possible (year1)	eTwinning project	S-T-E-A-M	Autonomy and interdependence , Perception and expression of

				emotions, Empathy, Interaction, Effective communication, Respect, Cooperation, Problem-solving, Active citizenship
CS9	STEMMission: BeeBot possible (year2)	eTwinning project	S-T-E-A-M	Positive sense of self, Autonomy and interdependence, Perception and expression of emotions, Empathy, Interaction, Effective communication, Respect, Cooperation, Problem-solving, Active citizenship
CS10	eTreeHuggers project	eTwinning project	S-T-E-A-M	Positive sense of self, Autonomy and interdependence, Perception and expression of emotions, Empathy, Interaction, Effective communication, Respect, , Cooperation, Problem-solving, Active citizenship
			* *S= Science, T=Technology, E= Engineering, A= Arts, M= Mathematics*	

Our Case Studies (CSs), within the ten (10) educational settings, as presented in Table 1, were: (1) CS1: Educational robotics - The Bee game in a playground, (2) CS2: The internal structure of the human body, (3) CS3: The life cycle of a butterfly, (4) CS4: Familiarizing preschoolers with Nature of Science through Plant Growth, (5) CS5: Dinosaurs, (6) CS6: Lake Ecosystem, (7) CS7: Water pollution & shortage, (8) CS8: STEMMission: BeeBot possible (year1,) (9) CS9: STEMMission: BeeBot possible (year2), (10) CS10: eTreeHuggers project. Case studies were implemented in an urban region in Greece within ten (10) years period, in early childhood classrooms (public kindergarten schools).

Additionally, the CSs combined in the present collective study were analyzed in the view of the STEAM disciplines each one contained. During the time that the CSs were implemented, their main teaching method was not STEAM approach and the researcher was not familiar with the theoretical STEAM interdisciplinary dimension. Nevertheless, STE(A)M disciplines were combined at a basic level. In particular, one (1) CS integrates two STEAM disciplines, one (1) CS three disciplines, in four (4) CSs four disciplines were combined, and also four (4) CSs managed to combine the integrated type of STEAM approach, as shown in Table 1.

Social skills encompassed a wide range of behaviors, such as positive sense of self, autonomy and interdependence, emotional awareness that employ perception, expression and self-regulation of emotions, and empathy. Skills concerning social interpersonal relationships, like interaction, effective communication (verbal and non-verbal), respect, cooperation, problem-solving and active citizenship were also investigated. All of them were under our lenses during each CS, but in Table 1 are indicated the most significant in every CS.

As shown in Table 2, a total amount of 233 students participated throughout the ten educational settings and CSs. The participants had some specific characteristics. Students in all CSs were boys and girls, 3 to 5 years old. Children with learning difficulties participated in 7 from the 10 CSs (0.7). During the half of the educational settings (5 to 10 CSs) students from

different areas, regions, cities, and countries were involved. Students' population was multicultural in all CSs, with the meaning of cultural diversity as it is defined by Magos (2022). An additional and very crucial point is that children with a migrant background took part in half of the CSs (as in 5 of the 10 educational settings = 0.5).

TABLE 2

Specific features of the CSs

Case Study	Educational setting	Students' population	Gender Differe-nces	Age Differe-nces	Students with Learning Difficu-lties	Area Differe-nces	Cultural Differe-nces	Students with migrant background
CS1	Educational robotics - The Bee game in a playground	8	Y	Y	N	N	Y	N
CS2	The internal structure of the human body	24	Y	Y	N	N	Y	N
CS3	The life cycle of a butterfly	24	Y	Y	N	N	Y	N
CS4	Familiarizing preschoolers with Nature of Science through Plant Growth	15	Y	Y	Y 3	N	Y	N
CS5	Dinosaurs	68	Y	Y	Y 6	N	Y	N
CS6	Lake Ecosystem	35	Y	Y	Y 5	Y	Y	Y
CS7	Water pollution & shortage	35	Y	Y	Y 5	Y	Y	Y
CS8	STEMMission: BeeBot possible (year1)	22	Y	Y	Y 3	Y	Y	Y
CS9	STEMMission: BeeBot possible (year2)	23	Y	Y	Y 2	Y	Y	Y
CS10	eTreeHuggers project	38	Y	Y	Y 2	Y	Y	Y
Y= Yes N=No								

The analysis adopted a basic thematic analysis approach, identifying, organizing, and understanding patterns and categories within the data (Braun & Clarke, 2012).

RESULTS

The Development of students' social skills was categorized in three types: a) Deterioration, when no development is indicated, b) Stability, when social skills are developed steadily, c) Improvement, when social skills are developed evolutionary.

In Table 3 are mentioned results regarding the Development of students' social skills in each CS. Three (3) types of Development are identified Deterioration, Stability and Improvement. Stability is noticed in CS1: Educational robotics - The Bee game in a playground, in CS4: Familiarizing preschoolers with Nature of Science through Plant Growth, and also in CS5: Dinosaurs. Improvement is noticed in CS2: The internal structure of the human body, in CS3: The life cycle of a butterfly, in CS6: Lake Ecosystem and CS7: Water pollution & shortage, in CS8: STEMMission: BeeBot possible (year1) and CS9: STEMMission: BeeBot possible (year2), and also in CS10: eTreeHuggers project.

TABLE 3

Categorization on the development of children's social skills

Case Study	Educational setting	Development of social skills		
		Deterioration	Stability	Improvement
CS1	Educational robotics - The Bee game in a playground	N	Y	N
CS2	The internal structure of the human body	N	N	Y
CS3	The life cycle of a butterfly	N	N	Y
CS4	Familiarizing preschoolers with Nature of Science through Plant Growth	N	Y	N
CS5	Dinosaurs	N	Y	N
CS6	Lake Ecosystem	N	N	Y
CS7	Water pollution & shortage	N	N	Y
CS8	STEMMission: BeeBot possible (year1)	N	N	Y
CS9	STEMMission: BeeBot possible (year2)	N	N	Y
CS10	eTreeHuggers project	N	N	Y
N=No, Y=Yes				

Figure 1, depicts the categorization of students' social skills development with the total number of CSs that appear in each type. Deterioration is not observed in any CS, however, in three (3) CSs Stability type and in seven (7) CSs Improvement type, are noticed in the development of students' social skills.

FIGURE 1

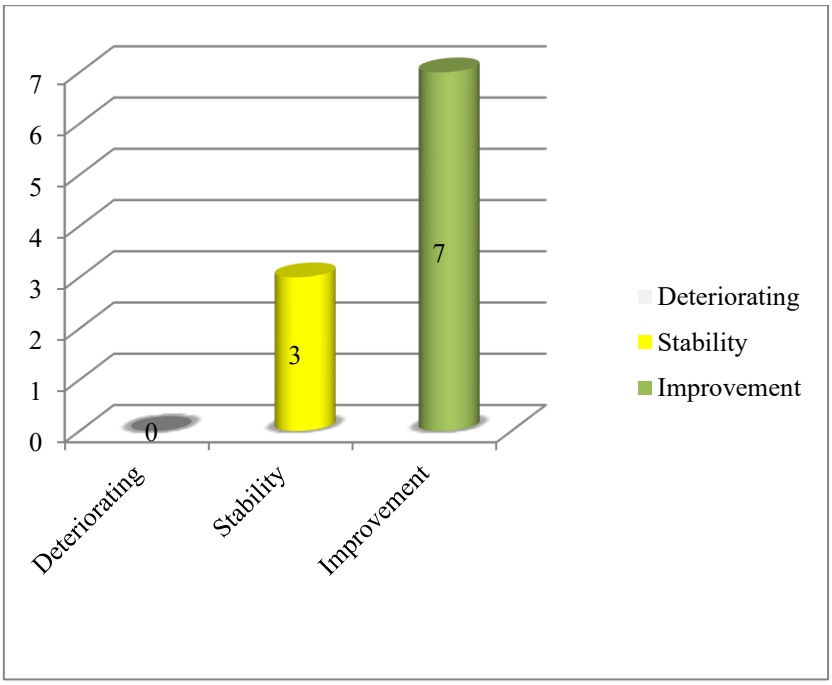

Diagram presenting the categorization of students' social skills development

The development of social skills in each CS is presented in Table 4, despite the variations in certain characteristics of the population involved in the CSs of this study. The disciplines (Dscs) which are promoted in every CS are also mentioned.

Noticeable Improvement (NI) characterizes the improvement that is easy to see or perceive and works at a basic level. On the other hand, Significant Improvement (SI) is mentioned when it is important, substantial or meaningful and functions in an upper level.

In CS1, where disciplines of Science, Technology, Engineering, Arts and Maths were approached, Stability (S) in the social skills of students is noticed despite age, gender and culture differences among children. In CS2 and CS3, where Science, Technology, Engineering and Arts are involved, Noticeable Improvement (NI) is observed, despite age, gender and culture differences among the young students. In CS4 and CS5, where Science, Technology and Engineering have been approached, Stability (S) is mentioned, despite learning difficulties of some students and also age, gender and culture differences. In CS6 and CS7, with Science, Technology, Arts and Maths disciplines, Noticeable Improvement (NI) in social skills is spotted, despite age, gender and culture differences and also learning difficulties of some students, but there is Significant Improvement (SI) despite area differences and the migrant background of some young students. In CS8 and CS9, which have all five STEAM disciplines, Noticeable Improvement (NI) is observed, despite age, gender, and culture differences, also despite some children's migrant background. Concerning area differences in CS8 there is Noticeable Improvement (NI), but in CS9 there is Significant Improvement (SI) for the same characteristic. There is noted Significant Improvement (SI) despite learning difficulties in both CS8 and CS9. Finally, in CS10 (all STEAM disciplines), Noticeable Improvement (NI) is observed despite age and gender differences and Significant Improvement (SI) despite all the others variations in the certain characteristics of the population involved in the CSs of this study.

TABLE 4

Types of the development of social skills, per CS, characteristics & disciplines

Development of social skills											
Case Study (CS)		**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**CS7**	**CS8**	**CS9**	**CS10**
Disciplines (Dscs)		S-T-E-A-M	S-T-E-A	S-T-E-A	S-T	S-T-E	S-T-A-M	S-T-A-M	S-T-E-A-M	S-T-E-A-M	S-T-E-A-M
Certain characteristics of the population involved in the CSs	**Age Differences**	S	NI	NI	S	S	NI	NI	NI	NI	NI
	Gender Differences	S	NI	NI	S	S	NI	NI	NI	NI	NI
	Learning Difficulties	-	-	-	S	S	NI	NI	SI	SI	SI
	Area Differences	-	-	-	-	-	SI	SI	NI	SI	SI
	Culture Differences	S	NI	NI	S	S	NI	NI	NI	NI	SI
	Migrant background	-	-	-	-	-	SI	SI	NI	NI	SI
	- = no existence *S= Stability* *NI= Noticeable Improvement* *SI= Significant Improvement*										

In Table 5, the Development of children's social skills regarding Stability and Improvement is mentioned throughout the 10 CSs. Stability (S) is shown in 3 CSs despite age and gender differences, in 2 CSs despite learning difficulties and in 3 CSs despite culture differences. Improvement on the Development of children's sis shown in 7 CSs despite age differences, gender differences and culture differences. In half of the total quantity of CSs (5/10) Improvement is shown despite learning difficulties, area differences and also despite the migrant background of some students.

More specifically, Noticeable Improvement (NI) appears in 7 CSs, despite age and gender differences, in 2 CSs despite learning difficulties and just in 1 CS despite area differences. Moreover, Noticeable Improvement appears in 6 CSs despite culture differences and in 2 CSs despite the migrant background of some students. On the other hand, Significant Improvement (SI) comes into sight in 3 CSs despite learning difficulties, in 4CSs despite area differences, in 1 CS despite culture differences and in 3 CSs despite the migrant background of some students.

TABLE 5

Development of children's social skills regarding to stability and improvement

			Stability on the Development of Social Skills		**Improvement on the Development of Social Skills**			
					Noticeable Improvement		**Significant Improvement**	
		Total quantity of CSs with Development (100%)	Quantity of CSs	Quantity in percentage %	Quantity of CSs	Quantity in percentage %	Quantity of CSs	Quantity in percentage %
Certain characteristics of the population involved in the 10 CSs	Age Differences	10	3	30%	7	70%	0	0
	Gender Differences	10	3	30%	7	70%	0	0
	Learning Difficulties	7	2	28.55%	2	28.55%	3	42.9%
	Area Differences	5	0	0	1	20%	4	80%
	Culture Differences	10	3	30%	6	60%	1	10%
	Migrant background of on amount of students	5	0	0	2	40%	3	60%

The development of children's social skills regarding Stability, Noticeable and Significant Improvement despite certain characteristics of the population involved in the CSs of this study in percentage, is showed in Figure 2.

FIGURE 1

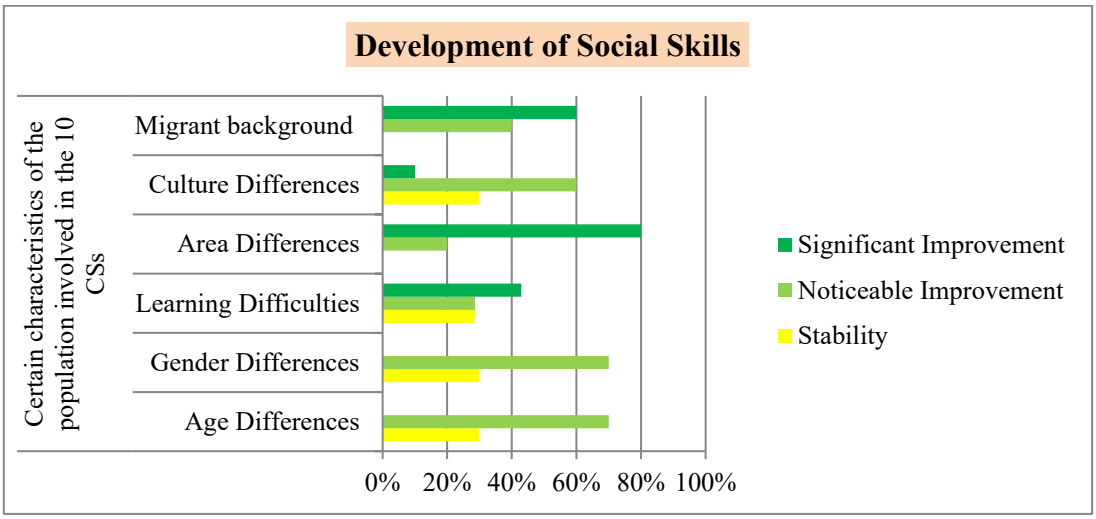

Diagram depicting the Development of children's Social Skills regarding Stability, Noticeable and Significant Improvement

In Table 6, the types of the Development of children's Social Skills and each quantity are mentioned for every CS of this study. More precisely, in CS1 Stability (S) type exists in 3 out of 3 certain characteristics of the population and additionally in CS4 and CS5 in 4 out of 4 characteristics. On the other hand, the type of Noticeable Improvement (NI) is showed in CS2 and CS3 where there is a 3 to 3 analogy despite certain characteristics. In CS6, CS7, CS8, CS9 and CS10 the type of Significant Improvement (SI) is revealed except the type of Noticeable Improvement (NI). In CS8 there is Noticeable Improvement (NI) in 5 out of the 6 characteristics and Significant Improvement (SI) in 1 characteristic. In CS6, CS7 and in CS9, there is Noticeable Improvement (NI) in 4 out of the 6 characteristics, and Significant Improvement (SI) to the other 2 characteristics. On the contrary, in CS10, Noticeable Improvement (NI) in 2 out of 6 characteristics and Significant Improvement (SI) to the other 4 characteristics are noticed.

TABLE 6

Quantity of the types of the Development of children's Social Skills

Case Study (CS)	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10
Development of Social Skills	3/3 S	3/3 NI	3/3 NI	4/4 S	4/4 S	4/6 NI	4/6 NI	5/6 NI	4/6 NI	2/6 NI
						2/6 SI	2/6 SI	1/6 SI	2/6 SI	4/6 SI
						S= Stability *NI= Noticeable Improvement* *SI= Significant Improvement*				

Table 7 shows the types and quantities of the Development of Social Skills regarding the number of Disciplines (Dscs) at the CSs. Regarding the CSs with 2 or 3 Disciplines 4/4 Stability is noticed, but when 4 or 5 Disciplines are used Noticeable Improvement (NI) and Significant Improvement (SI) in more complicated relations are revealed.

TABLE 7

Types and quantities of the Development of Social Skills regarding the number of Disciplines (Dscs) at the CSs

How many Disciplines	How many CSs	Types & Quantity of the Development of Social Skills
2 Dscs	**1 CS**	4/4 S
3 Dscs	**1 CS**	4/4 S
4 Dscs	**4 CSs**	2* (3/3 NI) + 2 * (4/6 NI + 2/6 SI)
5 Dcs	**4 CSs**	3/3 S + 4/5 NI + 1/5 SI + 4/6 NI + 2/6 SI + 2/6 NI + 4/6 SI

Finally, in Table 8 are presented in vivo texts or text excerpts of the ten CSs of the current study, based on the sections of 'results' and/or 'discussion'. These texts highlighted the social

skills identified in every CS and the synergy developed between certain social skills and the STEAM learning environments.

TABLE 8

In vivo texts or text excerpts about the Improvement of social skills/CS.

CS1: "*During the implementation of the educational program, social skills and knowledge were developed steadily and in parallel in every step of the learning process. Children built and expanded social skills such as cooperation and mutual acceptance, as they collaborated effectively with each other in groups, in order to give appropriate instructions to Bee-Bot, to play the digital games correctly and to construct the playground toys on the floor mat. They also followed the rules of the playful framework and developed communication skills".*

CS2 & CS3: "*While engaging to the learning activities and the pedagogical material, which were based on theoretical approaches regarding the development of biological knowledge in preschool age and also on multi-sensory approach to knowledge, children were active in contexts with meaning and socio-emotional significance for themselves, acted in groups and developed skills of cooperation, argumentation, feelings of self-perception and acceptance. It is considered that the pedagogical climate and the teamwork that was developed, contributed to the understanding of the new knowledge, about the internal structure of the human body and also about life cycle of the butterfly".*

CS4: *"The combination of inquiry activities with various forms of educational material, both haptic and digital, seems to have motivated children to think critically and to act scientifically. Social skills were equally developing to children's conceptual understanding. Multimodal educational material (MmEM) led them to combine social skills with concepts' understanding and playing with scientific literacy. More research must be done for MmEM in multicultural learning environments".*

CS5: "*The concept of dinosaurs activated children, especially boys who created a new small group within the class group. The social relations between them became more cohesive and they showed respect for the opinion of any other child who had more knowledge about the topic. Girls created another group which functioned as responsible for the organization and management of the educational material. However, in the learning activities, children, regardless of their gender, participated with enthusiasm and willingness to investigate the topic as little scientists, to collaborate and to gain new knowledge for the whole team".*

CS6 & CS7*: "The development of cooperation between the schools-members of the eTwinning project, as well as between teachers and children, was evident throughout the project. Over 30 activities were implemented that required the contribution of all partners. Dynamic interaction between schools was observed, which was organized through video conferences, voting, textual, visual and audio compositions".*

"In CS6, where children investigated the lake ecosystem, they cooperated in inquiries about biotic and abiotic components, flora and fauna, birds, fish and plants living in a lake. Doing research for their own local lake enhanced their team spirit, motivated them to cooperate with each other for common products, regardless their gender, age or race. Through playing children developed a class ecosystem perspective".

"In CS7, where children had to deal with the pollution of lakes and the lack of water they investigated causes and results of the topics and joined together to make campaigns to inform parents about the wetlands. While planning their activities, children had to argue about and communicate their opinions and beliefs. They had to interact in verbal and nonverbal ways, with respect and facilitate their relationships".

CS8 & CS9: "*The networking of this eTwinning project, the constant communication and interaction between the partner schools, as well as the combination of robotics and other digital media with the construction of the model and playground toys with hands-on*

materials, had a positive impact on the better understanding of science concepts, the development of mathematical thinking skills, robot programming skills and cooperation skills. These specific STEM projects contributed to developing students' ability to understand the environment that exists in their city, to orient themselves, to identify problems, to think critically and act, in order to solve these problems. Their work motivated them to take on roles and get involved in planning actions to change their immediate experiential and local environment. The STEM approach and robotics were linked to sustainability, in the sense that they used it to approach issues that concern children in their daily lives and the improvement of the conditions of their City Park and life in their city more broadly, both as a natural and as a built environment. This specific field has also great research interest in the sense of investigating how STEM approach can be integrated into the daily educational process and curriculum, and how it can affect the cognitive development, the scientific literacy and the social identity of children".

CS10: "*During this innovative environmental eTwinning project, children collaborated in small groups and in the plenary of the class and developed cooperation and social interaction. Their active participation in group activities helped in their personal empowerment, self-regulation and the acquisition of social skills. In addition, children proceeded with actions that stimulated their environmental awareness, their voluntary contribution and activated them, leading them to the acquisition of active citizenship skills".*

CONCLUSIONS AND DISCUSSION

Our research question was to investigate in which way and how STE(A)M contexts and learning environments may inspire social skills in early childhood educational settings.

Results indicated that in the ten CSs and through the STE(A)M contexts and educational settings that contributed to the present study, the development of early childhood students' social skills was significant.

Social skills that have been under our investigation allowed the development of the children in an individual or intrapersonal context, by a positive sense of self, autonomy and interdependence, the cultivation of emotional awareness that employs perception and expression of emotions, the development of empathy, self-regulation of emotions and behavior,. Also, skills that enabled children to develop social interpersonal relationships, like interaction, effective communication (verbal and non-verbal), respect, cooperation, problem-solving and active citizenship were examined.

Stability and Improvement were the two types of development, while Deterioration has not been indicated. Improvement was the most viewed type, and it has been either noticeable or significant. Stability was present in CS1 - Educational robotics. The Bee game in a playground, in CS4 - Familiarizing preschoolers with Nature of Science through Plant Growth and in CS5 – Dinosaurs, which integrated two, three and five STEAM disciplines. Stability in the development of social skills was present despite age, gender and culture differences and also in spite of learning difficulties among students. Improvement was present in CS2 - The internal structure of the human body, in CS3 - The life cycle of a butterfly, in CS6 - Lake Ecosystem, in CS7 - Water pollution & shortage, in CS8 - STEMMission: BeeBot possible (year1) and CS9 - STEMMission: BeeBot possible (year2) and also in CS10 - eTreeHuggers project. These educational settings integrated four of five STEAM disciplines. Improvement in the development of social skills was present despite all kinds of certain characteristics of the population involved in the CSs (meaning: age, gender, area and culture differences, learning difficulties or the migrant background of any amount of the students).

Both types of the development of social skills (Stability and Improvement – either noticeable or significant) took place in educational settings familiar to STEAM contexts (like: life cycles, internal structure of the human body, ecosystems and environmental issues) where STEAM disciplines were combined at least on a basic level.

Based on the above-mentioned and the reflective thinking we have conducted after the implementation in these educational settings, we concluded that perhaps it was STEAM contexts that inspired the development of students' social skills.

Due to the results, we argue that when educational settings include STEAM contexts which may refer to issues and everyday problems familiar to children, their social skills are developed through motivation and active participation. Social interaction, effective cooperation, communication, argumentation, acceptance of the others, empathy and self-respect seem to be improved despite all kinds of differences. Children (as shown in the ten CSs of this study) in STEAM contexts may facilitate their relationships and interact in verbal and non-verbal ways, with mutual respect. Team work was another aspect that is being enhanced in such contexts, which increased children's feeling of being part of a group, a team, a small community and motivate them to cooperate for common products, common action plans and interpersonal problem solving. Very important was that in STEAM contexts which concerned real world local environmental issues such as the school playground or their city park etc., the development of social skills might enhance action citizenship.

Besides that, when STEAM contexts were meaningful to children, they have been willing to make investigations as little scientists, and they could understand STEAM methodology efficiently and familiarize with Nature of Science with minor difficulties. Social skills, science thinking and scientific knowledge seemed to develop equally and in parallel throughout the STEAM contexts of this study, but more research in this issue should be done.

In summary, the present study examined case studies that concerned scientific (basically biological) and environmental issues that have recently appeared in the Sciences in Early Childhood Education (Ravanis, 2022). Some of them were socially relevant and concerned real-life problems, like the playgrounds in the cities parks (Sadler et al, 2007). The present study showed that the STE(A)M contexts made the disciplinary practices more relevant to students and the teachers (Takeuchi et al., 2020) and provided for all the lenses to view the issues in a more scientifically literate, holistic and synthetic perspective, as Hatisaru et al. (2019) argue. In the STEM learning environments examined, students could relate to and engage with problems and make sense of them based on their own experiences as shown in previous studies (Tsoukala, 2021). Furthermore, the development of the social skills mentioned in the present study confirmed that in early childhood settings where children internalize gender norms, stereotypes and identities (UNESCO, 2019), there can be established attitudes that promote understanding, pluralism, respect for diversity, friendly relations and solidarity among each other (Magos, 2022).

Undoubtedly, the inclusive perspective of the teacher/researcher, common to all CSs of this study, can be considered as a research limitation. Additionally, the learning strategies adopted and applied by the teacher/researcher had a significant role in the STEAM contexts, as in every learning context (Tsoukala, 2021). Play-based learning, child-centered pedagogical approach, also the utilization of multi-sensory and multimodal educational material that the teacher/researcher has chosen, may has affected the learning atmosphere, especially in these preschool educational settings.

The present study paves the way for a more intensive investigation of how STE(A)M education contributes to the development of social skills and possibly to the intercultural awareness of preschool children.

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