Educational Robotics Applications as Tools to Support the Social Interactions and Integration of Refugee Children in the Community of Schools of Primary Education

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Abstract: The paper presents an attempt made to use the Arduino platform and the Scratch for Arduino (S4A) environment for the implementation of an educational project for 6th grade primary school students in a classroom attended by refugee, immigrants, and indigenous students. The aim was to investigate the opportunity to use educational robotics as tools to support the social interactions and social inclusion of refugee children in the classroom community. The research was a case study implemented in a primary school in rural Greece. Students had to work in groups to design, build, and program a construction that simulates an 'Escape Room'. Students of each group solving a riddle of the other groups must discover a code to unlock the door of the 'Escape Room', based on a series of six worksheets of increasing difficulty to create their final construction. The research tools were a diagnostic questionnaire, an evaluation questionnaire, specially designed worksheets, an observation sheet for participatory observation, and sociometric test tools. Based on the findings it could be supported that educational robotics are able to support social interactions of refugee children to a certain extent. The intervention supported social interactions and collaboration among students but without solving the problem of difficulties in the social integration of refugee students in the classroom community. Verbally all students stated that they had not any problem cooperating with refugee students, but this was not strongly reflected in practice. Greek students interacted strongly with immigrant students and refugee students seemed to prefer interacting with immigrant students too.

Keywords: Educational robotics, sociometry, sociogram, refugee students, social integration

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Introduction

The integration of refugees is one of the priorities of the European social inclusion process and their protection has been prioritized in EU policy, with the necessary funding (Kiss, Primecz, & Toarniczky, 2020). Social integration, together with economic empowerment and identity integration, are three main dimensions of refugee integration. Social integration is a dynamic and structured process in which all members participate to achieve and maintain peaceful social relations. Social inclusion focuses on the need to provide a safe, stable, and just society by improving living conditions and enhancing cooperation and cohesion. In recent years in Greece, the systematic increase of refugees and migrant students has resulted in a change of the cultural environment in the primary education sector, which in turn has affected the teaching methods in an attempt to better approach the new situation (Zaragas, Mantzioukas, Stergiou, Nikolaou, 2022). International literature highlights that educational robotics activities could effectively promote the social integration of refugee children in the school environment (Jung, & Won, 2018).

The present study describes an attempt to investigate the opportunity to use educational robotics activities as tools to observe and support the social relationships/interactions and social inclusion of refugee children in the classroom community of primary education schools and discusses the findings.

Educational Robotics and Interculturality in Education

Intercultural education aims to change the school and society so that everyone has equal opportunities to express him/her-self freely, together with the support and cooperation of the state. For the management of the intercultural classroom, many models and approaches emerged in the 1960s. The main models of intercultural education are the assimilationist model, the integrationist model, the intercultural model, the anti-racist model and the multicultural model (Tsaliki, 2023).

Scientific literature highlights the role of Educational robotics applications in schools as effective tools to enhance social skills and support social interactions of students (Karatrantou & Panagiotakopoulos, 2011; Kalamatianou & Karatrandou, 2022). Educational robotics in classrooms has increased at different levels of schooling and supports the development of multiple skills (Lancheros-Cuesta, & Fabregat, 2022). Previous studies have shown that students acquire rich learning experiences with educational robotics activities with an experiential approach to learning, building their own structures and systems and programming them to perform desired behaviors, usually through structured guided exploration. Thus, educational robotics is highly conducive

to the development of interpersonal skills, such as interaction and cooperation with others.

Social robots are used more for interventions with children with disabilities or difficulties, as well as for the smooth social integration and inclusion of refugees. In particular, social robots are widely applied to teach basic social skills to children on the autism spectrum as they resemble humans but are less complex. Regarding the effectiveness of using social robots in teaching a foreign language, recent research suggests that it can lead to interesting results. Furthermore, some studies suggest that robot sociability increased learning by improving learning outcomes (Carolis, Cianciotta, Palestra, & Cervelione, 2019). The design and deployment of robotic systems that can model and recognize human behavior as well as adapt their behavior to the learner is a very critical issue, especially when dealing with students from different social and cultural realities (Agrusti, Gasparetti, Gena, Sansonetti, & Tkalcic, 2021). A good example is the creation of GeeBot that was motivated by the challenge of introducing and integrating refugees into host countries assisting them in cultural and linguistic needs (Simao, Avelino, Duarte, & Figueiredo, 2018).

Arduino, Scratch & Scratch for Arduino

The open-source Arduino electronics prototyping platform is based on flexible and easy-to-use hardware and software intended for anyone who has some programming experience, basic knowledge of electronics and is interested in creating interactive objects or environments. 'Scratch' is an educational programming environment aimed primarily at children aged eight to twelve (8 to 12), but it is attractive to students of all ages. 'Scratch for Arduino' (S4A) environment is a modification of the 'Scratch' programming environment (https://s4a.cat/). It provides the additional feature of simple programming of circuits and constructions built with the Arduino platform, providing the ability to create interactive objects or environments through the management of sensors and actuators.

The Aim of the Study and the Research Questions

The aim of the project was to investigate the opportunity to use educational robotics activities as tools to observe and support the social relationships/interactions and social inclusion of refugee children in the classroom community of primary education schools.

The research questions under investigation were:

- To what extent could educational robotics activities support and enhance the *social integration* of refugee children in the primary school classroom community?
- To what extent could educational robotics activities support and enhance the *cooperation* of refugee children with their peers in the community of the primary school classroom?
- To what extent could the *Arduino platform and S4A* be used as *effective tools* to support and enhance social relationships/interactions and social integration of refugee children in the primary school classroom community?

Method

The research was a case study and for the needs of the sociometric part of the research, sociometry based on the indicative method without hierarchical ranking was used. Using the non-hierarchical ranking, elements from different methods of data collection can be combined (e.g., from students' form/questionnaire, researcher's observation, and discussion with teachers), thereby ensuring the validity and reliability of the research (Bukowski, Hoza, & Boivin, 1994, Keliouri, 2019).

Students of the 6th grade of a primary school in rural Greece attended by refugee, immigrant, and Greek students participated. All the educational activities during the intervention were in accordance with the Greek Primary Education curriculum. Students had to work in groups and collaborate to design, build, and program a construction that simulates an '*Escape Room'*. The students of each group solving a riddle of the other groups must discover a code to unlock the door of the 'Escape Room' and escape before it is locked again. The project was implemented by the students based on a series of six worksheets of increasing difficulty to create their final project (the Escape Room).

The Arduino platform and S4A coding environment were used to design and implement activities and applications that combine concepts from Physics, Mathematics and Computer Science to solve the problem. Students were required to work harmoniously and interact to solve the problem in a working group, appreciating and accepting knowledge and skills of each group member regardless of their country of origin.

Research Tools

The research tools to support the case study and the sociometry approach based on the indicative method without hierarchical ranking were:

A. *Interview* with the classroom teacher
B. *Diagnostic questionnaire* before the intervention
C. *Evaluation questionnaire* after the intervention
D. Worksheets to support students' work
E. *Observation sheet* for participatory observation
F. *Sociometric test* tools (Sociometry table and Sociogram) before and after the intervention

Interview with the Classroom Teacher

The teacher answered questions and offer information about the age, the country of origin, the time living in Greece, the student performance, the social behavior during the lesson, the social behavior during breaks, friendships and general behavior of each foreign student in the classroom.

Diagnostic Questionnaire before the Intervention

The purpose of the questionnaire was to diagnose the previous knowledge and experiences of the students with the tools they would use during the project to better design the educational activities. The diagnostic questionnaire consists of six (6) questions of general content, that include: *the gender of the students, their age, how they would characterize their knowledge in the use of Computers, whether they have attended Educational Robotics courses before and in what framework, whether they have attend Programming courses, if they know what Arduino is, if they know what Scratch is, and if they know what Scratch for Arduino is.*

Evaluation Questionnaire after the Intervention

The purpose of the questionnaire was collecting students' evaluation for the activities during the project, the Arduino and Scratch for Arduino tools, as well as the cooperation and acceptance of the members of their group and their class. The evaluation questionnaire consists of ten (10) questions, that include: *the gender and age of the students, what they liked most about the activities with Arduino and Scratch for Arduino, what they liked least about the activities with these tools, what was difficult for them during the activities, from which lessons they needed knowledge to implement the activities, what new they learnt, if they found the activities easy, if they faced difficulties in cooperation and communication with their team, if they cooperated with all team members and if they would like to change team to work with other students.*

Worksheets to support Students' Work

Five (5) worksheets were used by the students during the activity, which were based on the learning content of the 5th-6th grade level curriculum of Primary school.

Observation Sheet for Participatory Observation

During the participatory observation, the researchers followed the *discussions*, the *activities* and the *reactions* of the students of the refugee children and immigrant students and recorded their observations answering six (6) questions. The observation sheet was based on the observation sheet developed and used in the research of Vezyrtzis (2017). Based on this sheet, it was recorded individually for each student: *if he/she was always in the demarcated area of his/her group, if he/she simply remained in the group during the activities without participating in them, if he/she worked alone so that there was no good cooperation and communication in the group, if he/she was marginalized by members of his/her group, if he/she experienced discrimination due to his/her different origin, how he/she interacted and cooperated in his/her group.* Additionally, comments/observations were recorded, based on the observer's personal notes that include *activity flow* (*date, time duration, analysis*), *thoughts*, *feelings*, *impressions*, *behaviors*, *overview of the class* before, during and after the intervention.

Sociometric Test Tools (Sociometry Table and Sociogram) before and after the Intervention

The sociometric test is a questionnaire that investigates whether a person (a child/student in this case) is *tolerated*, *popular* or *isolated* in a group or community according his/her preferences to work with others in the framework of an activity or project. The results of the sociometric test are recorded in a *Sociometry table*, which is represented by the *Sociogram*. The sociogram is a graphic representation of the Sociometry table, giving the necessary information for all the relationships of the group in a complete and comprehensible way. All the students in the classroom answered a questionnaire of positive and negative preferences of their classmates in order to cooperate in a group during the project. They answered it before and after the intervention. The questionnaire of positive and negative preferences was based on the questionnaire that is internationally used in research with such purposes (Bukowski, Hoza, & Boivin, (1994).

Reliability and Validity

All the research tools were checked for validity and reliability as required by the rules of educational research (Panagiotakopoulos & Sarris, 2016). The questions in the Diagnostic Questionnaire and the Evaluation Questionnaire as well as the Worksheets were designed by the researchers, reviewed by two experts in the field (one expert in ICT in education and one experienced Primary Education teacher) in terms of their suitability for the age level of the students, the validity and completeness of the questions on the subject under consideration Some comments by the experts regarding the wording of the questions and statements and appropriate corrections were made. The Observation sheet and the questionnaire of positive and negative preferences are valid and reliable tools use in research in Greek language.

The Procedure

The educational activity in the classroom had a duration of twelve (12) didactic hours in total implemented during 4 sessions:

Session 1: During two (2) hours, the students completed the diagnostic questionnaire and the questionnaire of positive and negative preferences. After that, students started working in groups of four (4) to be familiarized with Arduino platform and Scratch for Arduino based on the 1st and 2nd worksheet.

Session 2: Students work based on the 3rd worksheet for one (1) hour to put a motor in their circuits and program it to operate.

Session 3: During two (2) hours students working based on the 4th and 5th worksheet had to create a program for the operation of their escape room, compose a riddle to be solved by the other groups and discover the code to unlock the door of the Room. The winning group was the one who solved the most riddles.

Session 4: During the last hour, students completed the evaluation questionnaire and the questionnaire of positive and negative preferences.

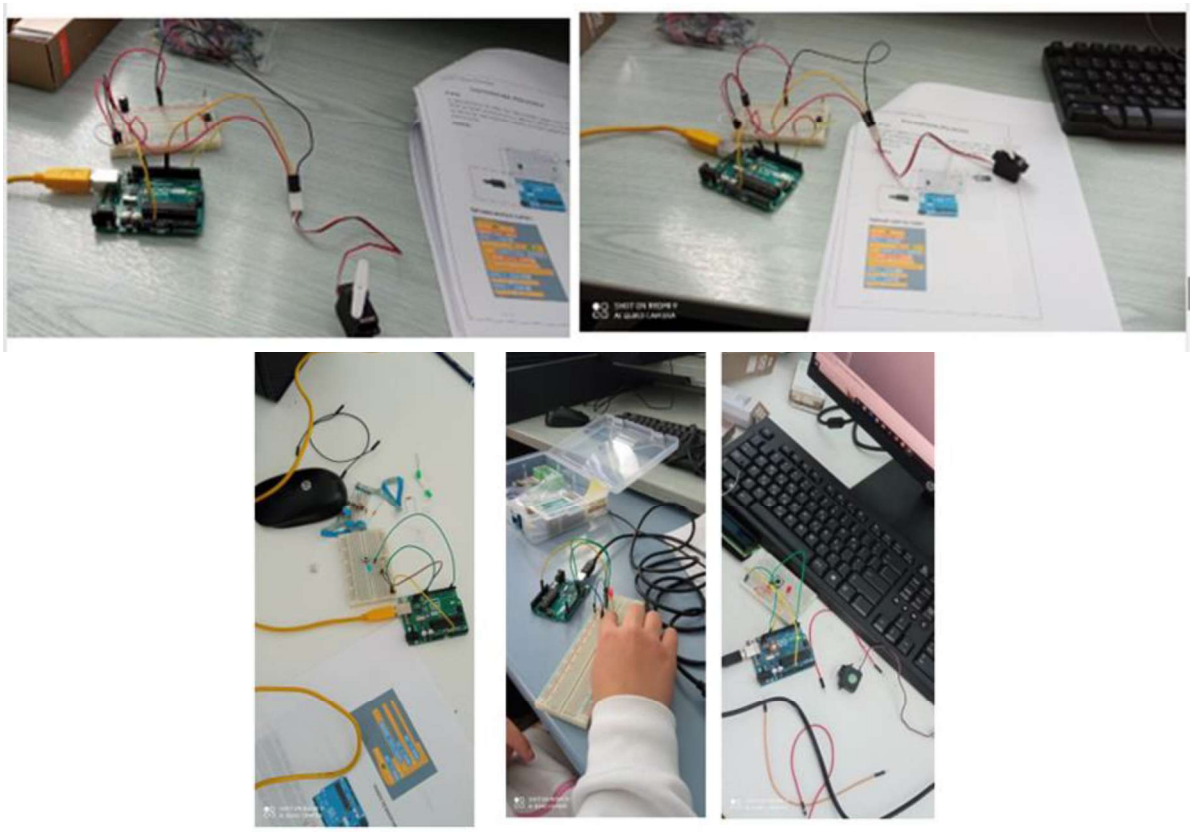

Figure 1. Students are working based on the worksheets.

Students Participants

The participating students were twenty (20) students attended the 6th grade class at the Primary School of Lechena town in western Greece. Two (2) refugee students (2 boys) and five (5) students (one girl and four boys) coming from immigrant families attended the class. It was considered important to discuss all seven (7) cases since all seven students have an impact on the social environment of the classroom. In Table 1 characteristics of the participating refugee and immigrant students are described shortly. This data derived from the interview with the classroom teacher before the start of the intervention.

Table 1. Characteristics of the seven (7) foreign students in the classroom

	Name Initial	Student's description
Refugee children	F.	F. is a 13-year-old boy; he comes from Syria; he is isolated; he lives in a refugee camp and is socializing with other children from the camp *(some of which have dropped out of school);* he is very nervous; he does not cooperate with other students in the class but prefers to work alone.

	Name Initial	Student's description
	Mo.	Mo. is an 11-year-old boy; he comes from Syria; he lives in a refugee camp; he has been at this school only for a month; he is quite sociable and open to meeting new people; he is very attentive and actively participates in school activities with his classmates.
Immigrant children	E.	E. is a 13-year-old girl; her parents are Romanian, but she was born in Greece; she is a student of average performance; she reads and writes with difficulty; she has two very good friends (a Roma student and an Albanian student).
	P.	P. is a 11-year-old; he was born in Greece, but his parents are Albanian; he and his parents do not speak Greek, *so he faces acceptance issues at school by classmates;* although he has no friends, he plays with everyone in gym, and during breaks he tries to be with other students.
	D.	D. is a 11-year-old boy; his family comes from Albania; he is fully integrated and a very social child.
	A.	A. is a 11-year-old boy; his family comes from Romania; he faces various problems of integration at school, as he does not actively participate and there is no communication with his classmates; as he says: *he has a hero mother who keeps him going on and progressing.*
	Μα.	Ma. is a 11-year-old boy; his family comes from Romania; he is mild mannered, silent in the classroom; he enjoys excellent cooperation and communication with his classmates.

Results and Discussion

The results of the study are presented below as they derived from the analysis of the data collected by the research tools, and they combined with each other in order for the research questions to be answered.

Diagnostic Questionnaire

According to students' answers to the questions of the questionnaire before the start of the intervention, five (5) students were able to use computer applications very well, thirteen (13) students moderately and two (2) students not very well. Ten (10) students were aware of educational robotics and had been involved in such activity in the past but the other ten (10) students were not. All the students had experience in coding (lessons at school), eighteen (18) of them had experience in Scratch but none of them had experience in Arduino and Scratch for Arduino.

Sociometry Table before the Intervention

The sociometry tables offer information for the sociometric status of each student in the study. According to the research of Coie, Dodge and Coppotelli (1982) five categories of sociometric status are defined:

- The popular student garnered the most preferences and no or few rejections.
- The average student usually gets preferences but few rejections.
- The controversial student gets a lot of likes but also rejections.
- The neglected student usually has few or no preferences and rejections.
- The rejected student usually attracts rejections.

Figure 2 presents the sociometric status of each student before the intervention:

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	STUDENTS' CLASSIFICATION
A1		-	-	-		-				-	-	-	-	-				+			REJECTED
A2			+	+	+											-		+		+	POPULAR
A3		+		+		-												+			AVERAGE
A4		+	+		+	-					+				-	+	-	+	+		POPULAR
A5															-		-	+			CONTROVERSIAL
A6							+	+	+		+					+	+	+		+	POPULAR
A7						+		+	-						+			+			CONTROVERSIAL
A8	+		-			+	+				+					-		+		+	POPULAR
A9	-						-								+		+	+	+	-	CONTROVERSIAL
A10	-			-					-			+	+	+				+			CONTROVERSIAL
A11		+	+			+	+	+								+	-	+			POPULAR
A12	-				-					+			+	+				+		-	CONTROVERSIAL
A13				+	+				+	+		+		+				+	+		POPULAR
A14				-						+		+	+					+			AVERAGE
A15			-				-		-									+	-		REJECTED
A16	+							-		-	-	-	-	-				+	-		REJECTED
A17		-			-			-							-			+			REJECTED
A18		-						-							-						REJECTED
A19									+							+	+	+		-	AVERAGE
A20	+				-		-									-		+			CONTROVERSIAL

Figure 2. The Sociometry Table for the students before the intervention

Refugee students: F. (A1) was *rejected*, as he was chosen negatively by eight (8) native students and positively by one (1) refugee student. A18 (Mo.) was *rejected*, since he was chosen negatively by three (3) students, and no one selected him positively.

Immigrant students: A. (A6) was *popular,* as he was chosen positively by eight (8) students (native and foreign) while no one chose him negatively. P. (A7) was *controversial*, as he was chosen positively by four (4) students (native and foreign), while only one (1) native chose negatively. D. (A16) was *rejected*, as he was chosen positively by two (2) refugee students, while negatively by seven (7) natives. E. (A17) was *rejected*, as she was selected negatively by four (4) native students and positively by one refugee student. Ma. (A20) was

controversial, as he was chosen positively by two (2) refugee students, while negatively by one (1) native and two (2) foreign students.

Sociogram before the Intervention

Figure 3 presents graphically the sociometric status of each student before the intervention:

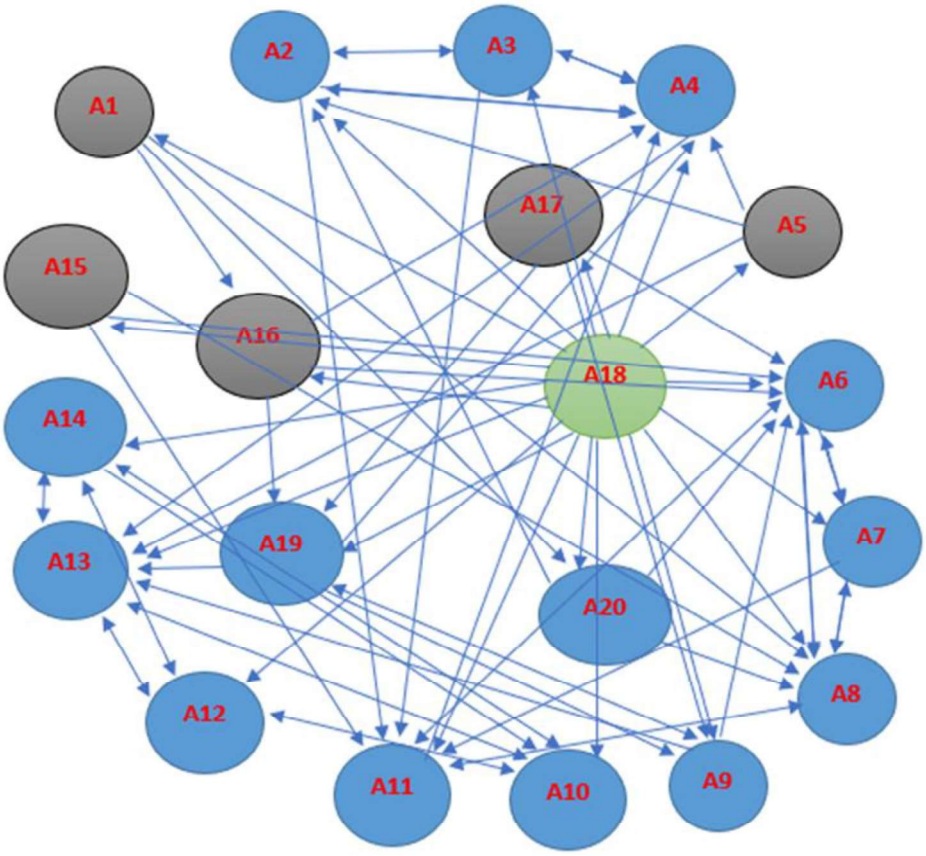

Figure 3. Sociogram before the intervention

The preferences of the students are also observed in the sociogram, according to which Mo. (A18), who is in green, *has positively chose all the other students*, but he was not chosen positively by anyone. Also F. (A1), D. (A16) and E. (A17) in gray were selected positively only by A18. The other immigrant students were chosen by their classmates.

Analysing the Worksheets

While students were working with the worksheets, emphasis by the researchers was placed on how the group members worked together rather than on the knowledge content of the students' answers/notes on the

worksheets. It is worth noting that all groups of students worked on the worksheets, focused on *what* they had to construct and sometimes *without reading the instructions* on the worksheets. Students were interested in the practical outcome of the activities, and they followed the sequence of sub-activities on the worksheets. The two refugee students worked thoroughly with the worksheets and participated in all phases of the construction and project implementation; despite difficulties they faced while working together with the other students. Figure 4 shows students working based on the worksheets as well as the cards with the riddles and one of the circuits students had to create.

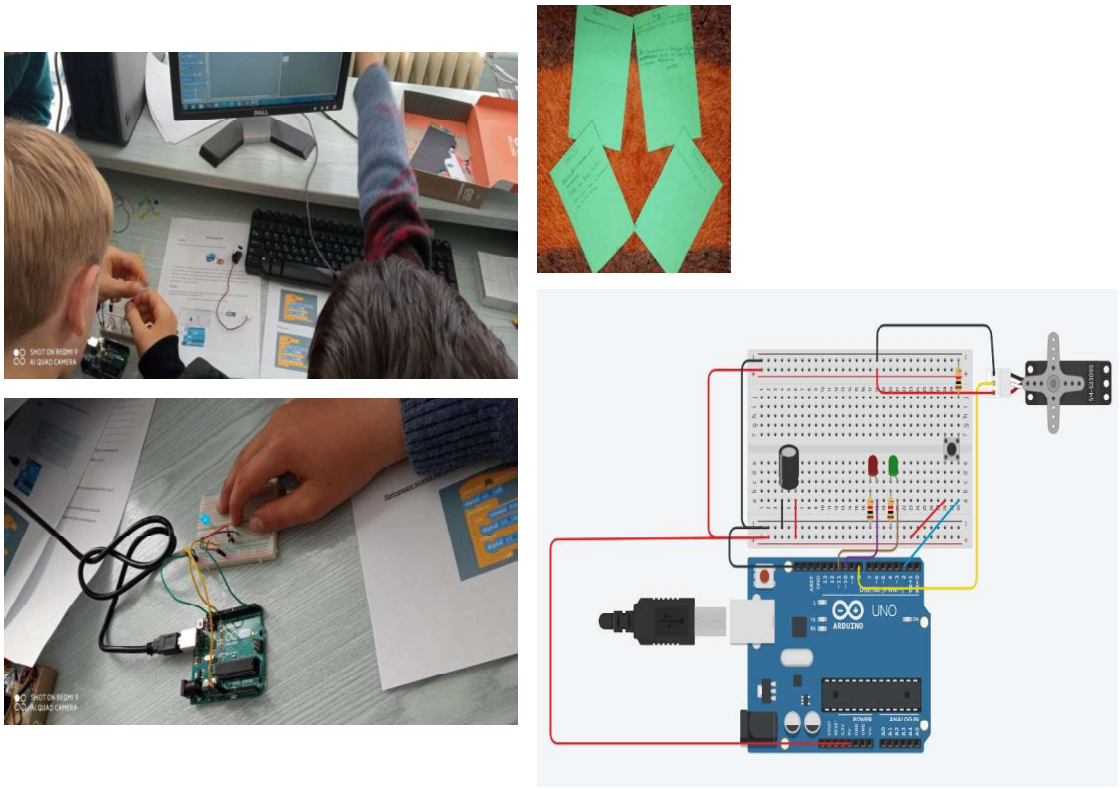

Figure 4. Snapshots of children's work

During the intervention, collaborative activities were highlighted, particularly during the construction phase of the project. Verbally all students, during their work on the project, stated that they had not any problem cooperating with refugee students, but this was not strongly reflected in practice, although improved social interactions between foreign and Greek students were observed by the researchers.

Greek students cooperated and interacted quite strongly and positively with immigrant students or students with an immigrant background. The same was the case with refugee students who seemed to prefer interacting with immigrant students or students with an immigrant background. Figure 5 shows the 'Escape Room' construction and the final program for its operation.

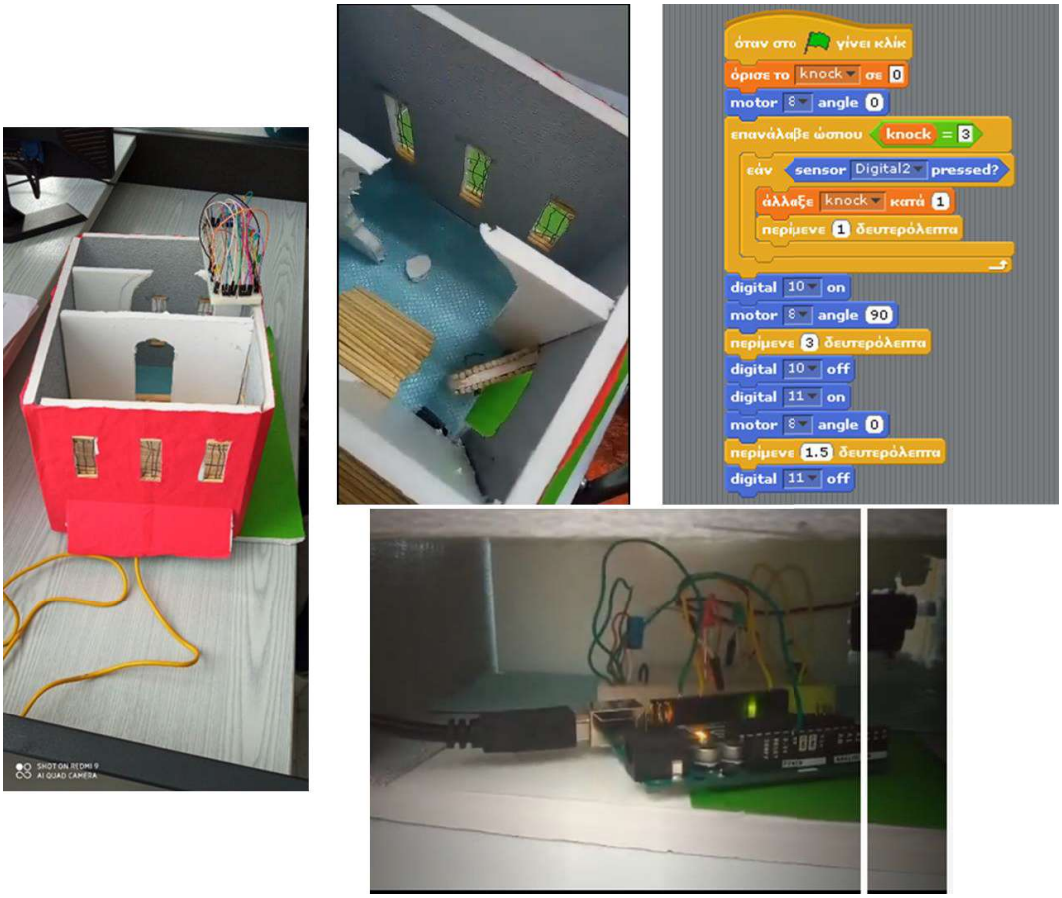

Figure 5. The 'Escape Room' construction and the program for its operation

Observation Sheets

Table 2 describes the findings derived analysis the data based on the Observation sheets for the seven (7) foreign students.

Table 2. Findings based on the Observation sheets for the seven (7) foreign students.

	Name Initial	Student's description
Refugee children	F.	F. at the beginning was not cooperating with his group members; he was just looking at them; the other members of the group ignored him; he wanted to work alone; he started working alone; was wearing a hood and looked sad. Before the end of the 1st day, a new group was formed with F, Ma and P (both foreigners) who were also ignored by their groups. The three of them worked together smoothly and had excellent communication during the intervention. On the 2nd day F entered the classroom smiling without the hood.

	Name Initial	Student's description
	Mo.	Mo. was in the demarcated area of the activity together with his group, he was not marginalized, nor was any kind of discrimination observed during the intervention. He cooperated and participated smoothly and actively showing special interest.
Immigrant children	E.	E, was in the demarcated area of the activity, together with her group. However, although she remained with the group during group activities, she did not participate actively. She was marginalized by her group. She probably experiences discrimination, and she has not been able to be integrated into the classroom due to many absences from lessons.
	P.	While P. was in the demarcated area of the activity with his group, he was marginalized and left the room crying. Then, he joined another group (with foreign students) and had better cooperation and communication. On the second day, he worked in his new group without any difficulty.
	D.	D. cooperated smoothly both days in his group. He was in the demarcated area of the activity with his group and remained there during it, actively participating, without being marginalized or discriminated against by his group.
	A.	A. faces various integration problems at school, as during the intervention he did not participate actively and there was no communication in the group.
	Mα.	Ma. was in the demarcated area of the activity with his group. He participated in it actively, without any communication problems. No marginalization or discrimination due to his different origin was observed. On the contrary, he had excellent cooperation and leadership in his group

Sociometry Table after the Intervention

Figure 6 describes the sociometric status of each student after the intervention. Based on this figure:

Refugee students: F. (A1) was again *rejected*, as he was chosen negatively by eight (8) native students and positively by one (1) refugee student. A18 (Mo.) was again *rejected*, since he was again chosen negatively by three (3) students, and no one selected him positively.

Immigrant students: A. (A6) was *average,* as he was chosen positively by five (5) students (native and foreign), while negatively only by one (1) refugee student. P. (A7) was *controversial*, as he was chosen positively by only one (1) native student, while negatively by three (3) native students. D. (A16) was again *rejected*, as he was chosen negatively by seven (7) native students, while positively by two (2) foreign students. E. (A17) was again *rejected*, as she was chosen negatively by three (3) native and foreign students, while no one chose her

positively. Ma. (A20) was *rejected*, as was received negatively by a native and a refugee student, while no one chose him positively.

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	STUDENTS' CLASSIFICATION
A1		-	-					-		-	-	-	-		-			+			REJECTED
A2			+	+		+	+	+								+					POPULAR
A3		+		+		-					+										AVERAGE
A4		+	+		+		+	+			+		+			-	-				POPULAR
A5							-										-				REJECTED
A6							+		+						+	+		-		+	AVERAGE
A7					-			-						-	+						CONTROVERSIAL
A8			-	-		-			-		+				-	-		+	-	+	CONTROVERSIAL
A9				-		+		-							-				+	-	CONTROVERSIAL
A10					-		-		-			+		+			+				AVERAGE
A11		+	+		+			+							+	-	-		+		AVERAGE
A12				-	-				+	+			+	+						-	CONTROVERSIAL
A13				+	+					+		+		+			+		+		POPULAR
A14										+		+	+				+				POPULAR
A15									-										-		REJECTED
A16						+		-		-	-	-	-	-				+	-		REJECTED
A17		-				-												-			REJECTED
A18		-								-	-	-	-	-							REJECTED
A19									+							+				-	CONTROVERSIAL
A20			-															-			REJECTED

Figure 6. The Sociometry Table for the students after the intervention

Sociogram after the intervention

Figure 7 presents graphically the sociometric status of each student after the intervention:

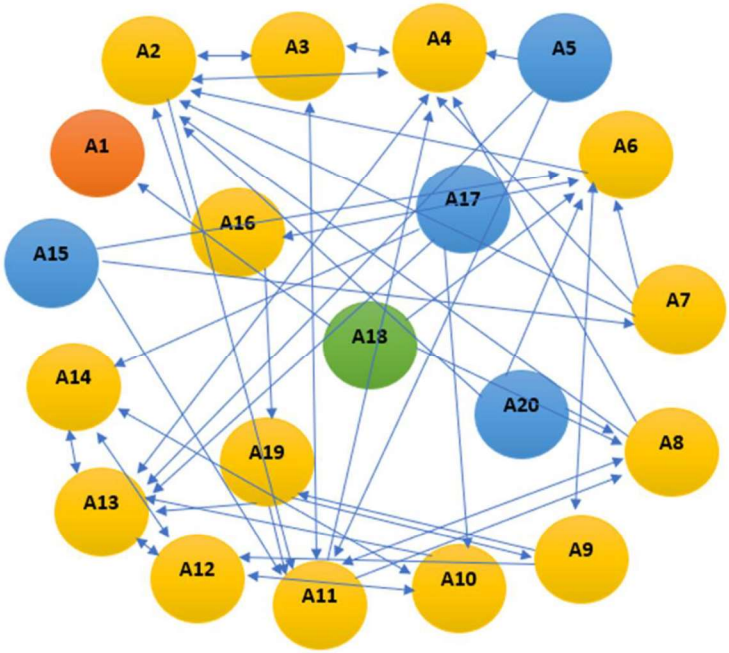

Figure 7. Sociogram after the intervention

According to Figure 7, F. (A1) is in red, because he did not complete anything in the positive and negative preferences questionnaire after the intervention. Also, E. (A17), Mo. (A18) and Ma. (A20) were not positively (Figure 7), by the same students as before the intervention. The other students chose classmates to work together and were also chosen. The classroom the sociometric status was changed after the intervention but no clear improvement in social interaction and relation were recorded.

Evaluation Questionnaire

Answering the questions of the evaluation questionnaire, students expressed their opinions for the activities they were involved in. All the students liked the activities and enjoyed themselves while they were working on the project. Twelve (12) of them found the activities easy but eight (8) students faced difficulties. Three (3) students faced difficulties in collaborating and communicating with others (one refugee students and two immigrants). Three (3) students faced difficulties in collaboration with the members of their working (one refugee students and two immigrants). Six (6) students should you wish to change working group while working group.

Sixteen students answered that they used knowledge concerning Coding, two (2) mentioned Mathematics and Physics and two more answered that knowledge concerning Coding, Mathematics and Physics in combination was needed. Ten (10) students stated that gained new knowledge on creating circuits and systems, six students (6) mentioned new knowledge in coding, but four (4) students talked about collaborating with friends. Eighteen (18) students liked most working on the construction and programming, but two (2) students enjoyed most working together with others. At the same time fifteen (15) students faced difficulties in coding. All students enjoyed discussions at the end of each session.

Conclusion

The aim of the study was to investigate the role of educational robotics activities as tools to observe and support the social relationships/interactions and social inclusion of refugee children in the classroom community of primary education schools. Based on the combination of the findings derived from the data collected by the research tools it could be supported that:

Educational robotics activities seem to be able to support social interaction of refugee children in the classroom community of primary schools to a certain extent. The short duration intervention supported social interactions and collaboration among students but without solving the problem of difficulties in the social integration of these students in the classroom community. Although improved social interactions between foreign and Greek students were observed by the researchers and kept on the observation sheets, this social trend was not recorded strongly in the sociometric test tools.

During the intervention, collaborative activities were highlighted, particularly during the construction phase of

the project. Verbally all students stated that they had not any problem cooperating with refugee students, but this was not strongly reflected in practice. Greek students cooperated and interacted quite strongly and positively with immigrant students or students with an immigrant background. The same was the case with refugee students who seemed to prefer interacting with immigrant students or students with an immigrant background.

The Arduino platform and the Scratch for Arduino programming environment seem to be suitable tools to support such social interactions and relationships in the educational community. Important issues for student collaboration, interaction and social relationships emerged that can be the basis for future interventions to explore educational and social questions in our ever-evolving multicultural society.

The limited number of refugee and immigrant participating children in the study (due to the difficulty in finding a school with refugee pupils, as they easily drop out of school), as well as the short duration of the intervention, serve as limitations of the study, preventing the generalization of the findings and conclusions. However, the observations and results of the intervention indicate a positive result of the intervention to support the social relationships/interactions and social inclusion of refugee children in the classroom community of primary education schools. Longer-term interventions are required to contribute to the scientific discussion regarding the benefits of educational robotics activities for refugee and immigrant children in the classroom.

References

Agrusti, F., Gasparetti, F., Gena, C., Sansonetti, G., & Tkalcic, M. (2021). *Social and Cultural Integration with Personalized Interfaces (SOCIALIZE).* ACM ISBN 978-1-4503-8018-8/21/04. https://doi.org/10.1145/3397482.3450709

Bukowski, W., Hoza, B., & Boivin, M. (1994). Measuring Friendship Quality During Pre and Early Adolescence: The Development and Psychometric Properties of the Friendship Qualities Scale. *Journal of Social and Personal Relationships - J SOC PERSON RELAT,* 11, 471–484. DOI: 10.1177/0265407594113011

Carolis, B. C., Cianciotta, M., Palestra, G., & Cervelione, A. (2019). Social Robots supporting the Inclusion of Unaccompanied Migrant Children: Teaching the Meaning of Culture-Related Gestures, *Journal of e-Learning and Knowledge Society, v.15*, n.2, 43-57.

Coie, J., Dodge, K. & Coppotelli, H. (1982). Dimensions and types of social status: A cross-age perspective. *Developmental Phychology, Vol.18*(4), pp.557-570.

Jung, S. E., & Won, E. S. (2018). Systematic Review of Research Trends in Robotics Education for Young Children, 2018, 10, 905, doi:10.3390/su10040905.

Kalamatianou, M.E., Karatrandou, A. (2022). Utilization of educational robotics in the education of children on the autism spectrum. In C. Panagiotakopoulos, A. Karatrantou, S. Armakolas (eds). *Proceedings of the 7th Panhellenic Scientific Conference "Integration and Use of ICT in the Educational Process*", 16-18/9/2022. Patras: ΕΤΠΕ ISBN: 978-618-83186-7-0 [in Greek].

Karatrantou, A. & Panagiotakopoulos C. (2011). 'Educational robotics and teaching introductory programming within an interdisciplinary framework'. In A. Jimoyiannis (ed.), *Research on e-Learning and ICT in Education* (pp. 195-208). DOI 10.1007/978-1-4614-1083-6_15, Springer Science+Business Media, LLC 2011.

Kiss,J., Primecz, H., Toarniczky, A. (2022). Patterns of Inclusion: Social Enterprises Targeting Different Vulnerable Social Groups in Hungary. *Journal of Social Entrepreneurship, 13*(3), 408-430, DOI: 10.1080/19420676.2020.1806101

Lancheros-Cuesta, D., & Fabregat, R. (2022). Educational Robotics Intervention in the Motivation of Students. *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje, 17*(2), 131-139.

Panagiotakopoulos, C., & Sarris, M. (2015). *The preparation of a scientific paper using ICT: An integrated approach*. Athens: ΙΩΝ Publications [in Greek].

Simao, H., Avelino, J., Duarte, N., & Figueiredo, R. (2018). GeeBot: A Robotic Platform for Refugee Integration. *ACM* . ISBN 978-1-4503-5615-2/18/03. https://doi.org/10.1145/3173386.3177833

Tsaliki, E. (2023). Educational Models for Managing Diversity: What's Next? *IntechOpen.* doi: 10.5772/intechopen.110069

Zaragas, H., Mantzioukas, P., Stergiou, A., & Nikolaou, G. (2022). Researching the Behavior of Students Regarding the Multicultural Approach during of Physical Education Lesson in Greek Elementary School. *European Journal of Education and Pedagogy, 3*(6), 29-35.