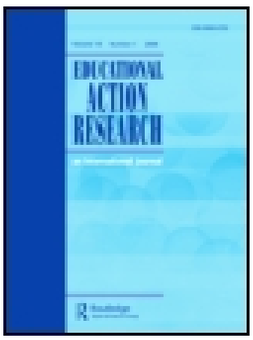

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The importance of classroom cooperative learning space as an immediate environment for educational success. An action research study in Greek Kindergartens

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ABSTRACT

Classroom space is a fundamental field of interaction in which all interchange and determination activities between the person and the social environment can be developed. The purpose of this study is to demonstrate the systemic relationship between places and groups. It specifically investigates how the pedagogical reorganization of classroom space during the application of cooperative structured mathematical activities can lead to educational success.

The method employed was action research. The research tools used were the sociogram, an observation guide and an archive, interviews, math tests and photos. The assessment of the programme was formative and final.

The basic conclusion was that both the places the children created and the group have a systemic function in the classroom's educational environment because their structure and function have common characteristics. This systemic function led the children in the research classrooms to 'educational success'; they all did better in mathematical activities and tests than the children in the control classes. They particularly improved their ability to ask questions, to problem solving, to compare and combine information and thoughts, and to generalize their ideas and the mathematical concepts.

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Classroom space; places; group; educational process; kindergarten

Introduction

Greek kindergartens constitute part of the Primary Education system and fall under the mandate of the Ministry of Education. They cater for children aged 4–6 years old, and in every class there is one kindergarten teacher for up to 22 pupils. The daily Early Childhood curriculum includes alteration between structured/guided activities and free play activities as well as two breaks. Guided activities are related to a specific cognitive area of the detailed curriculum (language, maths, music etc.), are always organised by the teacher, and take place in the 'group class area'. During free play activities, children play on their own or in small groups in the 'corners', without the teacher's participation.

The physical space of the kindergarten is organised into the 'group-class area', the 'tables area' and the 'corners'. The group-class area usually includes benches or

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couches for children in a rectangular arrangement and a chair for the teacher next to a low table. In this area, guided activities/lessons are organised by the teacher, mainly using a teacher-centred approach. Cooperative learning is seldom or never applied. The 'corners' include a variety of furniture, teaching material and decoration, all customised to their topic (e.g. shop, doll house, blocks, etc.), which usually remain the same throughout the school year. The specialization is so great that it allows space only for one potential function, that which is defined by its own characteristics. Thus, it acquires a monofunctional character.

The 'corners' are used only for the free play of a small group of children. The number of group members is pre-defined by the teacher; thus, children are not given the opportunity to organise playful activities with more children even though this would increase their interactions and social skills. No guided/structured activities take place in the 'corners' because they function in an inflexible way and do not allow for any intervention or rearrangement of the elements of their space such that larger groups, or even the whole class, could work together on the same activity.

This study investigates how the pedagogical reorganisation of classroom space during cooperative structured mathematical activities can lead to an improvement in the children's social and learning skills and to 'educational success'.[1] In order to achieve this, the 'corners' in the research classrooms were substituted with *activity areas*, which were more complex places as far as their organisation, function and equipment were concerned. They did not have a monofunctional character but could be used in active, flexible ways, by both teacher and pupils, for a variety of free and guided activities, thereby rejecting the conventional use of the 'corners'.

We chose cooperative learning because it has been widely endorsed as a highly effective method for the teaching of mathematics, especially in the development of numeracy in preschool children (listed on the UK's DfE website since 2009). Also, research has shown that the interactions that arise through the implementation of cooperative learning contribute to the cultivation of mathematical concepts (Slavin 2013a). Indeed, van Oers (2013) suggests that instead of focusing primarily on achieving the right solution, mathematics teaching should give priority to the cooperative dimension of mathematical activity. This would help children to communicate with each other in conditions associated with managing mathematical concepts such as numbers, quantities, and spatial concepts.

These factors led us to formulate the following research questions:

(1) Can the pedagogical reorganisation of space during mathematical guided activities in a cooperative kindergarten classroom help to improve children's social and educational skills and lead to 'educational success'?
(2) How does the creation of microenvironments and places by the children during cooperative/group working contribute to the formation of a systemic (holistic) approach to the learning process?

Theoretical framework

The pedagogical dimension of space

School architecture is not the assembling of spaces; it involves a philosophy, a way of thinking about education, learning, relationships, the role of action and the construction of knowledge (Miller 2019). Research in Human Sciences has shown that space is a fundamental interaction field where significant exchange activities and interdefinitions are developed between individuals and the social environment. The relationship with the material space is an essential element in communication procedures (Weinstein and David 2012).

The interactive process between space, subject and the social environment has been proven to be pedagogically important, since the information provided by space stimulates learning and its configuration frames and supports both structured and spontaneous communication and cooperation activities (Dudek 2005; Germanos 2001; Williams and Brown 2012). The physical learning environment can shape relationships and create the conditions for physical and mental wellbeing that are conducive to learning (Miller 2019).

Moreover, children's learning develops when they come into contact with the stimuli offered in their immediate environment; indeed, it may even shape their skills and personality by suggesting methods and techniques to engage with it (Malinin and Parnell 2012). Corsaro (2009) notes that children make persistent efforts to gain control of their lives and to share that control with others. For these reasons, space might be an integral part of the educational process, functioning as a *material educational field* (Germanos 2001; Vayer, Duval, and Roncin 1991). Furthermore, Dudek (2005) argues that while space itself may not cause or prevent learning, all physical parameters of classrooms are a significant part of the educational process.

Reggio Emilia educators have long recognized the importance of the design and use of the physical environment to promote learning, and they acknowledge the complex set of relationships that exists between the environment, the student and the teacher. That is why they regard the space as the 'third teacher' in the classroom (Rinaldi 2006).

The classroom as a system

The issue we address in this research focuses on the 'systemic approach to change', which aims to study a system in order to change it. Instead of using pre-structured models for the analysis of the system (as happens in the case of the 'systemic analysis' approach), it attempts to identify a specific configuration of the system components which will make change possible (Weick 2009; Yatchinovsky 2012). Its main goal is the study of the complexity that characterizes the relationships and interactions between the system components, through which the processes for improvement can be identified (Perrenoud 2004).

In this context, the educational environment in general, and the classroom in particular, might be considered as a system which affects the mechanism by which we acquire new knowledge and ways of thinking. A system of human activity, which has a dynamic character and constantly changes because of the interactions that occur both inside and outside its environment. These changes may concern the components of the system, their

interrelationships, as well as the relationships with the environment and the purpose of the system (Dunn and Scileppi et al. 2007; Montandon 2002).

The structures of the 'classroom' system

The components of the 'classroom' system could be classified into two basic structures, the material and the social (Vayer, Duval, and Roncin 1991).

The material structure includes the *general configuration of the space and the objects in it*, including the furniture, equipment and materials of the classroom. As far as kindergartens are concerned, the material structure should offer numerous and intense stimuli to activate the child and give it the opportunity to acquire knowledge and skills. However, if the space lacks stimuli while simultaneously setting limits on the child's activity and restricting its interactions, then it cannot contribute to learning and development.

The material structure of the kindergarten aims to provide an enriched and interactive learning environment with the following characteristics, that can be classified at four levels:

- the wealth of the stimuli for learning;
- the organization of diverse/different spaces, having the scope to support particular aspects of the learning and development process;
- the creation of a 'familiar/home atmosphere';
- the creation of micro-environments and places for both the individual and the group. This is necessary because it facilitates alteration between cooperative and individual forms of work and is connected with the creation of personal space by the child, which is of great importance for its self-image, self-esteem and socialization.

The social structure, in the systemic approach, is defined as an organized subset of relations linking the basic components of a social system (Smith 2010). Regarding the school classroom, the social structure contains all the non-material factors, the creation of which is independent of space and derives from both the social/educational environment and the subject (Vayer, Duval, and Roncin 1991). These factors do not act alone but are combined through interactive relationships which form the psychological-social environment of the classroom.

Frequent changes in the classroom are one of its key features; small or large changes are constantly required in order to ensure a balance in its operating conditions. The organization of a social structure within the classroom creates the conditions for strengthening (or weakening) its psychological climate of the classroom and helping the children acquire experience of educational success. The implementation of cooperative learning, along with increased interactions, cultivation of social skills and self-assessment by children, is a determining factor in the creation of a social structure that enhances the psychological climate of the classroom and contributes to children's active learning.

The relationship between the two structures is based on a permanent process that develops a dynamic between them and continuously supports the material structure in order to accommodate changes in the social structure and to interact with them (Germanos 2006).

The characteristics of group function

'A group is an entirety/gathering of people who meet for a period of time and develop a consistent standard of relationships that allows them to discover and utilize any potential and existing energy sources that are available both collectively and individually' (Douglas 1997, 53). Being in a group, pupils coordinate their ideas and actions, share materials, and try to achieve a common goal by maximizing both their individual learning and that of their peers (Johnson and Johnson 1999, 2009; Slavin 2013). According to Bikos (2004, 77) 'each group, formal or informal, is a formation that has shown development, due to its *dynamic*, i.e. the dynamic fit of the values, attitudes and aspirations of the people who constitute it'.

In addition, the group may function as a system too. 'A group is considered to be a system, when the elements composing it, i.e. people relating to each other, interact and are interdependent in such a way as to form a separate unit, a self-contained unit' (Douglas 1997, 115). A change in any one part of the system causes changes in the other parts too.

The group in a cooperative classroom has a democratic, cooperative structure since it gives equal opportunities for communication to all members. Each group member takes a different social role in every activity, an element that contributes to the completion of the common task and provides for the members' equal participation (Kagan 1994). Cooperation is based on the existence of positive interdependence, promotive interaction, and the use of social skills (Johnson, Johnson, and Holubek 2008). In this case, the children feel that there is an atmosphere of acceptance in the group, that their views are taken into account, and thus the communication with their peers is characterized by symmetry and equality. 'The cooperative classroom is better aligned with the student's needs, since it supports that learning occurs through action and interaction' (Kagan 1994, 7.1).

In a kindergarten class, the introduction and training of children in order to work in groups is an ongoing process that takes place throughout the year and may extend to the full daily programme of the kindergarten. This is done by the teacher both directly, through the systematic and organized education of the children towards the necessary skills and attitudes, and, indirectly, by taking advantage of opportunities that arise in the classroom every day. This involves both guided (teacher structured) and spontaneous activities and organizing the programme and the space so that emphasis is given to communication and cooperative practices (Kutnick and Manson 1998).

We see, then, that the group contributes to the upgrading of educational practice, since it introduces forms of '*overall educational interaction*' to the social structure of the classroom, which forms are based on the relationship 'person-group-environment'. In this way, '*educational flexibility*' is generated, by which the educational process operates more flexibly and patterns of work and communication are created and adapted to both the age characteristics of children and the material environment of the classroom (Germanos 2006).

The space and the group

The space and the group are two concepts that complement each other and are in a constant interdependence. Between these two concepts there are active subjects

(the children and the teacher in our case), which operate in a cooperative environment by implementing space practices in two directions. On the one hand, by using space as is 'indicated' by its configuration and, on the other hand, by intervening in it.

Space, then, is the material context, within which group work evolves. Children's group work is not possible if the classroom's space remains unchanged, since, according to the systemic approach, any intervention should be made simultaneously with changes in all parts of the system in order for it to be effective. The adaption of new practices requires some reorganization of space, be it small or large. On the other hand, as effective as the organization of space might be in a classroom, it is not possible for one single configuration to meet the needs of all the activities that are to be carried out, nor can all the children's and teachers' wishes function within that classroom (Johnson and Johnson 1999). For this to be accomplished, space has to offer variable types of usage according to the subjects who use it.

The interactions of children which arise during cooperative learning often lead to a reorganization of space, which they adapt to their interests and to the demands of the current activity. Equally, space and its organization continually provides opportunities for new interactions among the members of classroom groups. So, teachers and children may intervene and actively contribute to the shaping of the educational life of the classroom, to the extent that the position and the qualifications of each one allows for it, a feature that is particularly important in systemic models (Staarman, Krol, and Van der Meijden 2005).

Giving children the opportunity, either individually or in groups, regardless of their age or ability, to explore places, to think and express opinions about the function of those places, and also to reorganize them, provides an inexhaustible opportunity for the development of creativity, critical thinking, recognition of relationships and reporting of unusual questions (Ward-Thompson, Aspinall, and Montarzino 2008). Consequently the class reflects the uniqueness of the children who use it and live in it. Indeed, Loris Malaguzzi refers to space as an aquarium that mirrors the ideas and values of the people who live in it (Miller 2019).

The organization of space in Greek kindergarten classrooms rarely provides children with the opportunity to use space as their own attractive springboard to acquire information, knowledge, skills and behaviours, to use it as a *material educational field*. Therefore, in order to develop various forms of behaviour, the reorganization of space is necessary to allow for multiple uses according to the needs of the children and teachers who experience it. Moreover, these multiple capabilities of usage contribute to the development of different types of communication and work in the classroom and, thus, to the development of alternative forms of educational practices (Dudek 2005).

The availability of space to be adapted to different requirements of usage gives a degree of flexibility to the material structure of the classroom; this allows it to undergo internal changes in order to follow developments in the social structure (i.e. all non-material factors, the creation of which is independent of space and which results from both the subject and the social environment).

Creating microenvironments and places

The social space has material and symbolic power, is constantly changing over time, and enables the children to move into different positions (Nordtømme 2012). When educational practices restrict the use of space, then the educational process works dimensionally and its development is not favoured. If, however, there is freedom in a child's practices in space, then the child is able to create microenvironments and places which are adapted to its needs and wishes, as well as to the requirements of the activity. Children love to create their own worlds in any environment they can manipulate or modify (Strong-Wilson and Ellis 2007). During this process, space is converted into a place where practices and behaviours with a high degree of interaction appear and individual and group activities are developed.

Place is the basic unit area of social life and is characterized by its complex nature. It includes fixed and flexible characteristics in its organization, which connect space elements, particularly its layout and equipment, (material structure) with elements of human behaviour and culture (social structure)(Lévy and Lussault 2003). Place is a source of meaning, belonging and identity, largely because of these relationships (Strong-Wilson and Ellis 2007). Within a kindergarten, it is a material environment bearing the child's stamp, it is highly charged symbolically, and functions both as a child's means of accessing the material and social characteristics of the surroundings and as a means of learning, leading to the acquisition of knowledge. The characteristics of place give space a new form and a new identity, adapted to the child's experiences, and create a familiar and safe environment, elements which enable the child to identify with it (Cresswell 2013; Hague and Jenkins 2005).

In a cooperative kindergarten classroom, groups have the opportunity to create the microenvironment and the place they want in all guided (teacher-structured) activities. These possibilities for intervention significantly affect the developmental process of children and signify their activity (Strong-Wilson and Ellis 2007). The planned creation of places by the teacher and/or the freedom of children to spontaneously create microenvironments and places in the classroom might therefore be used to counter stereotypes and mono-dimensional classroom space, thus promoting the creation of a positive psychological climate in the classroom due to more extensive interaction (Germanos 2015).

While children create places within the educational process, they highlight elements of their personality, character and their emotional world. This data is particularly important for the teacher as it both provides information about each child's potential and helps them understand the environment from the perspective of the child (Clark 2010). This in turn enables them to carry out educational programmes that are perfectly adapted to children's interests.

Materials and methods

The organization of an action research

We have chosen 'action research in education' because we wanted to engage with the agents of the educational environment so as to gain cooperative features that would lead to the reformation of the material and social structure of the classroom. In

addition, action research gives researchers the opportunity to make revisions during the programme if difficulties appear. It also offers the possibility to study the situation in the classroom (original framework) in a holistic way, where all factors are dealt with as a set of relations with each other which constantly interact (McNiff and Whitehead 2009).

The research was conducted in four kindergartens in Thessaloniki and lasted for six months. We had two research and two control classrooms. The sample was 66 children, (4–6 years old).

Limitations of the study

We chose the area of mathematics because at the Greek kindergarten, teachers usually use only teacher-centred methods during this lesson; they don't use group working no do they use the classroom space with flexibility. We had the limitation of choosing just one cognitive area because the researchers had permission to stay at the kindergartens only for specific hours and we couldn't disturb the whole kindergarten curriculum. We weren't able to extend the research into the next year because only the children aged 4–5 remained at the kindergarten while the 6 year olds went on to different elementary schools.

The characteristics of space and of the mathematical activities

The first step in the pedagogical reorganization of classroom space is the abolition of standardization and the monofunctional character of the classroom. Our reorganization of space aimed at developing cooperative activities and relationships and enriching the learning stimuli. For that reason, in all the research classrooms, we created two qualities of space: the 'group-class area' and the 'activity areas', the latter replacing the 'corners'. All the areas could be used flexibly according to the children's desires and the aims and needs of the activities. For example, in the activity 'castle treasure', where the groups had to add all the traces in order to get into the castle, the children created a 'castle' in the classroom, a new element that prompted them into action and cooperation.

Instead of creating just one specific mathematical area, we created rich contexts, with a variety of mathematical materials that allowed children to find their own 'affordances' through their interactions with the objects and with the other pupils. In every mathematical activity there was 'the material table', and a member of each group, the 'material supplier', had to pick up all the suitable and necessary materials for the group's particular activity. Then each group could create the place that wanted, due to their own desires or those of the activities. During this phase, the teachers and the researchers were listening closely to the children's conversations because children often find uses for objects and spaces that adults do not anticipate.

Before the beginning of the programme, we organised a series of cooperative games because they are necessary for team-building and the cultivation of the children's social competence. The activities carried out during the programme involved the cognitive unit of mathematics, mainly addition and subtraction from 1–10. They had a playful form, were experiential, tangible and representational, and the degree of difficulty was adapted to

the characteristics of the child of preschool age and their level of cognitive development. In addition, they all had a scenario attached in order to prompt children's interest and participation and also because research has indicated that stories of children's literature, semantic activities, schematic representations and training are useful in Mathematics (Sarama and Clements 2009).

All the activities included cooperative methods, which described the structure that cooperative activities would have and the type of work they would include (a combination of individual-cooperative work, inter-group work and work between groups etc.) (Johnson and Johnson 1999). They also included cooperative techniques/structures, which referred to four sectors (Kagan 1994):

- the organization of class building and the organization of teambuilding,
- information sharing, both among group members and between groups,
- thinking and communication skills, and
- skilfulness and mastery, which refer to the skill of managing various issues arising within the group, during group work.

These guidelines would help to create a relationship between the child and the space, which would focus on both the child and the knowledge offered.

We completed twenty activities in each of the classrooms. All of them were organized cooperatively and included pupils working in small and large groups (whole class groups). All the activities included three phases:

(a) work in the whole class group, where the teacher had to explain the content and the aims of the activity, the roles of each group member, and the cooperative rules
(b) work in small groups, where the children could choose any area they wanted and reorganize that space to create their own new places
(c) work in the whole class group: presentations and evaluations. The groups were presenting their group work either in the group-class area or in the new places they had created. This phase also included children's self-evaluation.

We applied a combination of the conceptual and the structural approaches of cooperative learning. This combination operated as a reinforcement for the effective application of cooperative learning and promoted both the social and cooperative skills and the pupils' performance (Stevens and Slavin 1995). We used formal cooperative learning, so the groups remained the same during the research programme. The groups were heterogeneous because, with such groups, the quality of the pupils' work can be improved through the expression of a variety of opinions, and everybody can benefit from the application of cooperative learning (Sharan 2010).

Research tools

The research tools used were the sociogram, an observation guide and an observation file, interviews with the children and kindergarten teachers, maths tests and regular photo shoots. We used triangulation for more reliable results.

More specifically, the sociogram was used before the beginning of the research programme so that the children's opinions on the formulation of the heterogeneous groups could also be taken into consideration.

The observation guide: was filled in by the observer during each cooperative maths activity, and emphasis was given to the way space was used by the children and on their work in groups (three times per week).

The observation file: was filled in by the observer and the kindergarten teacher-researcher, based on the data collected from the observation guides and the photos, after the completion of all weekly activities (once per week)

Interviews with the children: took place once before the beginning of the intervention and once at the end, so that there could be a comparison of the children's opinions.

Interviews with the kindergarten teachers: took place at the end of the intervention so that the teachers' opinions regarding the pedagogical reorganisation of space, in combination with the children's work in groups in maths activities, could be analyzed.

Maths test: pre- and post-maths test in order to compare the children's knowledge

Photo shoots: during every guided mathematical activity

For the analysis of the research data, a semantic analysis method was followed (Muchielli 1994) which was developed in three stages:

- *thematic content analysis* (identifies conceptual modules/themes that make up the content and organizes them into categories)
- *opinion analysis* (refers to judgements expressed by the subject and the orientation – positive, negative, or neutral characterising his/her speech)
- *frequency analysis* (refers to the comparison of frequencies which characterize the appearance of speech data).

The classification system with the reference items followed the rules of:

- objectivity
- completeness (all reference items should be placed in some of the thematic categories that were selected) and
- mutual exclusion (the inclusion of a reference unit in a thematic category excluding it from being subject to another)

The evaluation was formative and final (Johnson and Johnson 1999). We also included the children's self-evaluations in all the mathematical activities as it is very effective in the development of their learning and progress (Mergendoller et al. 2006). The children had to explain their intervention in the space, aspects of their group work and cooperation, and the solution and result of the mathematics.

Research findings

The research findings obtained after the data analysis showed important developments in forms of work and in communication procedures. They also confirmed the two research questions, showing great connections between them in that they upgraded the

classroom's educational environment in a holistic way and led the children to achieve educational success.

Through the pedagogical use of space and the implementation of cooperative maths activities in the classroom, the organization of space was not standardized and did not have the features of traditional, 'teacher-centred' operation. Group work caused reorganizations in space and flexibility in the operation and use of space supported and strengthened work in groups (Germanos 2006). The group members created their own places according to their desires and the needs of cooperative activities, an element which gave them great pleasure and facilitated their participation in mathematical activities. Both children and teachers were active in using the new classroom spaces (group-class area and activity areas) and materials in the alternative ways offered by the programme we had created. In each of the areas various cooperative activities were applied, using different methods and techniques and with different educational material. So activities were not of a stereotypical form and offered variable possibilities for educational interaction.

Children and teachers also had the opportunity to move freely throughout the classroom space and to use furniture and educational material in various ways and with semantic changes. This liberated each child's relationship with the space without creating obstacles to the smooth operation of the classroom because it developed within a context of self-regulation of behaviour by the children themselves; this simultaneously strengthened the positive psychological climate of the classroom.

Under these circumstances children started to develop social and learning abilities and new forms of communication and interaction. This helped them to discuss their opinions and hear the opinions of other group members, take part in mathematical activities without hesitation (because they knew that their group would help them if there was any problem) and try to find the solutions to the mathematical problems, using different educational material and different learning strategies. The most competent children started to help the weaker ones and encourage them in order for the group work to be completed.

The cooperative way the mathematical activities in the programme were organized, and the variety of educational material and features they included, gave high self-action potential to children, leading them to the culture of mathematical concepts not through some standard procedure, but rather through their own critical thinking and action. These included control procedures on the part of children in order to recognize their own mistakes, training games, verbal formulations and semiotic activity, data that significantly enhanced metacognition. This data was also verified by the observation guides and the final maths test in which the children in the research classes performed better in all exercises than the children in the control classes. They could write the numbers from 0–10 and also the equations more easily, they found it easier to do mental arithmetic (addition and subtraction) and they started to use strategies and mathematical material in order to solve exercises whenever they didn't know the right answer.

These activities also helped the children develop a positive interdependence among themselves and enjoy their 'face-to-face' communication and cooperation. This helped them realise their mistakes in a positive way and facilitated the resolution of disputes among them. By using appropriate questions, they created an environment of dialogue and encouraged discussions. During the phase of work presentation, the children

communicated by systematically cultivating self-assessment, not just of each individual member separately but of the entire team as well. In this phase they also discussed their difficulties or conflicts, explained their mathematical actions, and expressed their feelings.

The new ways in which the children and teachers communicated and their forms of work greatly affected the social environment of the classroom. The psychological environment improved greatly, conflicts were reduced and positive interactions increased. The aspects cultivated by the teachers, regarding the class group, were also used by the children during their work in small groups. Thus, *cooperation* and *interaction* were highlighted as the key elements of the educational process in the research classes.

These practices, which were influenced by their relationship with space, helped children in their learning process; through their participation in the group, they acquired greater potential in terms of self-motivation, freedom of movement and development of different forms of behaviour by incorporating the material space of the classroom into their activities (Gkloumpou 2014). In this educational environment, children created and recreated identity, skills, membership, interpersonal relationships, and knowledge. They transformed the kindergarten into a place of belonging and meaning making.

Conclusions and discussion

Based on all the data analyzed, we come to the conclusion that the microenvironments and places created by the children and teachers in the research classes during the pedagogical reorganisation of space, combined with the application of cooperative learning in mathematics, contributed greatly to the improvement of the social and learning skills of the children and lead them to 'educational success'. In using the term 'educational success' here, we also mean that the cooperative mathematical activities reinforced the children's competence in asking questions, in problem solving, in comparing and combining information and thoughts, and in generalizing their ideas and mathematical concepts. It also helped them assess their own efforts, their group work, and the results of their mathematical activities. Thus, their metacognitive ability was strengthened as well. These findings answer the first research question.

A second conclusion, which responds to the second research question, is that the space and the group, as factors of the educational process, can function effectively, because their *structure* and *function* have common features. We describe these features in detail below, in order to highlight this significant connection and systemic/holistic operation.

The first feature is that microenvironments and places of the classroom consist of individual spaces within its material environment, each one with different characteristics, which can be used for individual and cooperative activities and form a whole, an entity, a system that is interdependent. Meanwhile, the group is part of the social structure of the class which is also part of the microenvironment and the place. It also constitutes a unity by itself, a system which consists of individuals/members, each of whom has different characteristics and undertakes/assumes different roles in order to achieve specific goals and complete common projects.

The second feature refers to the fact that our research data indicates that the creation of microenvironments and places by the children and kindergarten teachers fights stereotypes and low complexity of space and helps create a positive psychological climate in the classroom. Similarly, group work removes the monofunctional way of working and communicating that prevails in traditional teacher-centred environments and instead reinforces children's interactions, thereby contributing to a positive climate in the classroom (Johnson and Johnson 1999).

The third characteristic is that each microenvironment and place, as any object or feature of space, works as much independently as in association with other material and non-material factors of its surroundings. Correspondingly, the group operates independently, but also in conjunction with other material (space, furniture, educational material) and non-material factors of its surroundings (peers, teacher).

The fourth characteristic is that microenvironments and places, on the one hand, and groups, on the other, are governed by specific rules and have particular social, psychological and pedagogical characteristics that are relevant to:

- the characteristics of the subjects which operate within this specific microenvironment and place and the specific group, and
- the requirements and characteristics or the type of activity that takes place within a specific microenvironment/place or a particular group.

The last feature is that microenvironments and places are more than just an assembly of individual areas. Similarly, the group is more than the number of its members (Johnson and Johnson 1999; Kagan 1994). It is a fundamental institution that is not static, but dynamic. It carries norms, values and rules that create feelings, cultivate behaviours, develop knowledge, and lead to learning (Konidari and Abernot 2008).

The systemic function of space and group at the kindergarten offered a broad framework of stimuli, by acting as a *material educational field*, which contributed to the children's learning process. Thus, an *interactive classroom* was created, where 'face-to-face' communication and cooperation and flexible use of all areas of activity, replaced the simple transmission of knowledge and the stereotyped use of space and instead led children to educational success.

We are continuing to apply this form of work, also in the cognitive area of language, at the kindergarten in order to collect and record more data about these issues. We think that it would be of great interest if similar programmes could be applied in more kindergartens in Greece and in most cognitive areas of the curriculum.

Note

1. This terms means a) improved performance for all the pupils, especially for the weaker ones; b) improved relationships among all pupils, and c) development of critical thinking as per Kagan (1994).

Disclosure statement

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