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Original Research

Encouraging young children's autonomy by supporting their fine motor skills development

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Abstract: A significant number of children in Greece, observed through their interaction with school materials, enter preschool with underdeveloped fine motor skills. Many children struggle, to varying degrees, with activities in the classroom, whether individually or in groups. As a result, children advance to primary school unprepared. In several European countries, preschool education includes object manipulation workshops that improve fine motor, cognitive and emotional skills. Based on these findings, a study was designed to assess the effectiveness of such workshops in Greek kindergartens. Preschool teachers in Iraklion, Crete, participated in a training program, in which they were instructed to create and implement object manipulation workshops in their classrooms. The workshops were designed to be playful while also fostering a variety of skills. To evaluate the outcomes of the study, teachers were given a questionnaire with open-ended questions. The content analysis of the responses revealed that, due to their engaging and playful nature, the workshops encouraged children's participation, enhanced their concentration and improved their fine motor skills. The children demonstrated a strong creative inclination, used the materials in innovative ways and even designed new workshops themselves.

Keywords: Fine motor skills, Autonomy, Preschool, Object manipulation

Introduction

Autonomy and fine motor development in preschool children

A child's development moves towards the achievement of autonomy. The transition from infancy to the relative independence of adulthood is a universal journey. Developmental psychologists have argued since the early 20th century that every child has natural or inherent tendencies that can lead them towards autonomy (Dewey, 1938; Erikson, 1963; Piaget, 1971; Nakamura & Rogers, 1969). Nevertheless, the key question remains: what conditions need to be identified and established to support rather than hinder this process? Developmental theories focus on how the child develops, learns and gradually becomes independent by using his/her body. More specifically, there is a direct connection between motor and cognitive development (Shi & Feng, 2022) during this process. Decades ago, Wallon (1942) stated that children develop through movement. According to the psychologist, development takes place from the concrete to the abstract, from action to representation. Piaget (1936) also suggested that physical action prepares logical processes, since logic is based on the coordination of movement before it is verbally

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formulated. The child discovering his/her environment with his/her body discovers himself. Additionally, Maria Montessori emphasized the importance of developing fine motor skills in young children as a crucial aspect of their education. She believed that developing fine motor skills through hands-on activities such as pouring, tying and cutting not only enhanced a child's physical abilities, but also had a direct impact on their cognitive and emotional development (Marshall, 2017).

Enhancing fine motor skills, cognitive development and autonomy

The development of motor skills is of paramount importance as it supports the needs and choices of children, as it contributes to their personal development, helps them to take more initiative and become highly autonomous (Grissmer et al., 2010). The development of motor skills, particularly fine motor skills, provides children with a sense of efficiency and autonomy, while inefficient motor skills may be the source of problems of a socio-emotional nature and marginalization, such as low self-esteem, lack of self-confidence and experiencing feelings of failure, incompetence and inferiority (McClelland & Cameron, 2019; Zaragas, Kampitsis, & Yiagazoglou, 2010). In addition, eye-hand coordination is associated with improved learning-related behaviors as well as better self-regulation skills (Purtaş & Duman, 2017).

More recent studies have argued that motor and mental functions develop in parallel and, while subsequently differentiated, they are subject to mutual interactions (Kim et al., 2018). In fact, there is a clear connection between the areas of the brain responsible for motor skills and those responsible for cognitive skills, whose development occurs simultaneously and is particularly rapid in the first years of a child's life (Leisman et al., 2016). Functions such as concentration and fine manipulation processing of a material play a significant role in the development of cognitive processes as well as fine skills (Dellatolas et al., 2003).

It has been established that the development of fine skills positively affects the cognitive development of children (Escolano-Pérez et al., 2020). More specifically, fine motor skills involve the action of small muscle groups, such as the use of the hands, and are divided into two categories:

1. Visual-motor coordination, which concerns the reception of visual-spatial information from the environment, such as the dexterity, speed and accuracy of finger movements. These skills include tracing, tapping keys, imitating hand movements, playing with building materials, stringing beads, playing with pegs, moving coins from one place to another or dropping them into a slot.
2. Fine motor integration, which involves organizing small muscle movements with the hand and fingers by processing visual stimuli. This means that visual information from the environment is processed and integrated with subtle movements. Such skills include writing and copying shapes, letters and symbols.

Establishing a link between fine motor skills and autonomy in preschool children may help with the design and implementation of effective teaching in Greek kindergartens by improving specific motor skills that are most relevant for children's future academic success.

The relationship between fine skill development and academic achievement

A study (Escolano-Pérez et al., 2020) in kindergartens in Spain has shown that there is a direct correlation between the development of fine skills and the child's later academic success. Spanish kindergarten children who took part in the study participated in fine-skill development activities and their academic performance were assessed one year later when the children were in the first quarter of first grade. Activities included controlling objects with hands, coordinating finger movements, working with fingertips, tying, copying shapes, letters, words and numbers. The tests have manifested that the role of fine motor skills in the kindergarten curriculum can enhance students' later academic performance.

Selected, play-based fine motor activities should be part of the preschool curriculum routine. Specifically, guided play in which an adult chooses or organizes a context for learning with clear goals, whereas children direct the play (Weisberg & Zosh, 2018). Another study (Saraiva et al., 2019) conducted in Portuguese kindergartens clearly reinforced the hypothesis that fine motor skills are a developing skill at preschool age that depends on the opportunities provided by the school and family environment to practice them. This research also states that fine motor competence is linked to children's adaptation and integration into the school environment as well as to their socialization during the transition from kindergarten to primary school. In conclusion, the research findings suggest that fine motor skills are a strong predictor of school readiness as well as a predictor of later academic achievement, particularly in reading, writing and mathematics.

In kindergartens in Germany, studies demonstrated the relationship between fine motor skills and early reading and writing skills of preschool children (Suggate et al., 2018). In particular, the development of fine skills facilitates the development of writing-motor skills, which in turn are linked to reading. In addition, fine skills facilitate reading through writing (Molfese et al., 2011). Writing skills are writing-motor skills combined with knowledge of letters and words, which then lead to the ability to produce and recognize letters and words (Sang-Min, 2018). Children who have developed fine skills are more likely to be able to hold and handle a pencil correctly and further develop their motor skills, which in turn facilitates the development of writing and reading. Consequently, they are more likely to

progress further in their development and acquire writing and early reading skills (Suggate et al., 2023).

In the preschool and primary school years, developed fine skills facilitate children's participation in the learning process (Glenberg & Gallese, 2012). Fine motor manipulation activities such as symbol tracing, stringing beads, playing with pegs, building with construction materials, tapping on keys with fingertips, drawing frames and solving mazes, etc. promote cognitive skills such as reasoning and thinking, information processing speed and concentration. This correlation exists because both (fine motor skills and reasoning ability) use neural circuits that determine their development (Martzog et al., 2019).

The above studies illustrate the correlation between fine manipulation of objects, cognitive development and self-regulation and autonomy in preschool children (Chandler et al., 2022. Suggate et al., 2018. Suggate et al., 2023). Therefore, it is significant for preschool teachers to promote fine object manipulation activities to develop the autonomy of their students, which has many positive effects (increasing children's motivation and self-confidence, developing a sense of responsibility and academic success), (Mazgaltzis, 2019. Sporidou, 2023).

Object manipulation workshops

As part of the daily planning of routines (date, weather, news of the day), free play, organized activities and projects, fine motor workshops take place in kindergartens in many European countries, such as France (Ministère de J.E.N.R., 2015). We will take fine-motor workshops from French kindergartens as an example, as we have studied and observed them during previous research (Athanasopoulou, 2011). In France, such workshops are called workshops of autonomous manipulation of objects or autonomy ateliers. In these workshops, students learn to autonomously handle materials that are constantly renewed as children evolve and become more autonomous themselves by playing with them. The ultimate goal of such workshops is the development of autonomy through fine skills, visual-motor coordination and self-concentration (Cazenave, 2018).

The workshops of autonomous manipulation of objects are mainly inspired by Montessori pedagogy. The teacher reinforces the child's innate need to learn by using sensory material with a variable degree of development and the possibility of self-correction by the child him/herself so that he/she learns to function on his/her own (Laloux, 2014). The child is encouraged to work alone and/or in pairs on the material, which always has a specific learning goal that can be evaluated and that has been suggested to each child to help him/her with a skill that needs to be developed. Using everyday objects (such as keys, containers, beads, straws, spoons, rubber bands, lids, tongs, syringes, sponges, pegs, chopsticks and more), the child gradually develops the skills that enable him/her to handle his/her body, hands and fingers, and to use the material autonomously. The more the child develops, the more complex the activities and goals become.

The materials of the workshops are gradually presented to the children, and the difficulty degree of the activities increases according to the skills they have. At younger ages (3-4 years old), more emphasis is given on object handling activities related to daily life, such as self-care, buttoning and unbuttoning, washing hands, sweeping tables/floors, polishing, arranging objects, plant care and fluid transfusions. At an older age (5 years old), materials from more complex subjects are presented, such as buttons for mathematical sequences, geometry cards, letter recognition cards or graphs (Raab, 2015).

The teacher introduces a workshop that covers the needs of the group. He/She then moves on to a demonstration of the workshop, in which the instructions given to the students play an essential role (Raab, 2016). The instructions make it clear to the children what is expected of them. Thus, they acquire the correct vocabulary and understand the importance of the knowledge offered by each workshop. The evaluation of the newly acquired knowledge and skills can be explained verbally by the student. The assessment is conducted in a differentiated way depending on how each student wants to present his/her achievement (Ministère de JENR, 2015).

Based on the above, it would be interesting to investigate the adaptation and effectiveness of these workshops in the learning environments of Greek kindergartens, in which the learning corners almost always operate in a concrete, static and given manner. The learning areas in Greek kindergartens are far from being creative, deeply child-centered and supportive to the needs of preschool children.

Method

Purpose

The purpose of this study is to investigate whether object manipulation workshops in Greek kindergartens can be implemented after appropriate adaptations to specific conditions (space, resources, school climate, curriculum, culture of teachers and learners).

Research questions

a) Are the object manipulation workshops effective in developing fine motor skills of preschool children?
b) Are the object manipulation workshops effective for children's emotional regulation (concentration, demonstration of perseverance, effectiveness and effort) while they are participating?
c) Are the object manipulation workshops effective in developing children's autonomy and sense of responsibility?
d) Do the children who participated in the object manipulation workshops show any improvement in

other skills (sounds, letter recognition, vocabulary, logical and mathematical thinking, problem solving, etc.) in addition to fine motor skills?

Sample

The sample consisted of 52 full-time and substitute teachers working in the public (38 preschool teachers) and private sectors (9 preschool teachers) in Greek kindergartens as well as in special education kindergartens (5 preschool teachers). All teachers participating in the research worked in kindergartens in Crete, Greece, which were located in urban (28 preschool teachers) and rural areas (24 teachers). The age of the teachers ranged from 28 to 58 years old. All fifty-two participating teachers held a bachelor's degree in education and 12 of them had master's degrees in ppsychology, special education and language arts. Sampling was taken by means of convenience, i.e., teachers participating in the workshops were those who indicated their willingness to complete an online form.

Procedure

The training program for the teachers lasted two years from 2019 to 2021 (including a period in 2022) and consisted of two major training cycles. The training cycle meetings took place either face-to-face or online, as part of the training conducted during the pandemic. Each cycle of training included two phases. In the first phase, teachers were introduced to modern educational techniques for creating a learning environment characterized by a targeted organization of pedagogical material, focusing on the development and reinforcement of basic life skills such as autonomy, respect, acceptance, cooperation, initiative and creativity. We presented and analyzed examples of workshops, the means, as well as methods and procedures that had to be adopted by teachers in order to create a pedagogical atmosphere in which children could act freely to follow their desires, inclinations and interests. At the same time, there was a discussion on the workshop material, which was organised based on the Montessori philosophy (cards, pictures, letters/words, tactile, symbolic and representational). In addition, the key pedagogical elements of the workshops were analysed regarding applying specific techniques such as modelling, thinking aloud, multi-sensory learning experience, exploratory and collaborative learning and more.

The second phase that followed focused on the demonstration of specific object manipulation workshops. We explained to the teachers involved in the project how the materials should be presented to the children (presentations, questions, instructions, demonstration of use, completion of the workshops, evaluation and reflection). Teachers were also encouraged to select the materials based on the needs and interests of their students. It was further explained that the purpose of the workshops was to help students develop their autonomy by enhancing their fine motor skills, motor-visual coordination and concentration, while the goal was to improve a range of skills related to the curriculum, such as language, ICT, science, social sciences, physical education and arts. Each teacher then selected an everyday material such as felt, buttons, files, straws, pipe cleaners, feathers, pegs, rubber bands, etc. and was asked to organise a workshop with these materials, thus enhancing children's fine motor skills. After organizing the workshop and receiving feedback from the project facilitators, the teachers introduced the workshops in their classrooms, followed by a collective reflection on the results of their work by the whole group of participating teachers.

Research method

This study was conducted with a qualitative-descriptive, exploratory design employing the content analysis technique. The qualitative-descriptive approach was selected to obtain a thorough, objective, comprehensive and systematic description of the research subject. Therefore, the research utilized a qualitative-descriptive methodology (Miles et al., 2014).

Data collection process

A questionnaire with open-ended questions was used to evaluate the results of the workshops of participating teachers' classrooms in the preschool. The data analysis allowed us to explore the views of the teachers, focusing on their subjective perspective of how they experienced the process of introducing the workshops in their classrooms as well as the outcomes of those workshops on their students' fine motor skills and autonomy (Verma & Mallick, 2004). The questions in the questionnaire were based on specific topics related to the objectives and research questions of the study (Cohen, Manion, & Morison, 2008). The questionnaire was sent to the participants via email, as email is considered a natural, modern and relatively accurate form of communication (Milliner & Flowers, 2015). The analysis of the collected data allowed us to convert the verbal content of the responses into summarized findings, which were then interpreted in qualitative, descriptive terms.

Content dimensions of the research questionnaire

To ensure the validity and reliability of our research results, we strongly related the dimensions of the questionnaire to the research questions. More specifically, the research questions were formulated in an open-ended questionnaire format, adapting the dimensions for an effective application of the workshops in Greek preschool classrooms. These dimensions include:

(1) Content of the workshops. This dimension seeks information regarding the learning areas that the workshops fall into (language, mathematics, arts, sciences

etc.) and the content of the workshops (materials, tools, procedures). These workshops were designed/constructed by the teachers during the implementation of the program to support their children's interests and needs.

(2) **Influence of the workshops.** This theme encompasses questions about the impact of the workshops in enhancing preschool children's fine motor skills. These skills relate to the stability of children's hands in painting, writing, cutting and self-care.

(3) **Emotional regulation.** This dimension examines children's emotional regulation during engagement with the workshops, such as the degree and duration of children's concentration and children's demonstration of perseverance, effectiveness and effort, as well as children's willingness to interact and communicate with each other.

(4) **The development of children's autonomy.** This aspect examines children's ability to effectively complete each school activity, children's initiatives to engage in constructions that utilize different classroom materials, and children's autonomy in supporting their personal desires and needs.

(5) **Further improvement.** This dimension collects information about further beneficial effects of workshops on young children's improvement (knowledge, skills, attitudes) in various learning areas of the preschool curriculum (language, mathematics, science etc.).

(6) **Improvement of the workshops.** This last aspect explores the difficulties that preschool children encountered when engaging in workshops under teachers' proposals for improving the workshops at the level of instruction, extension and evaluation.

Results

The aim of this project was to explore the potential of object manipulation workshops in Greek preschool classrooms. Further objectives were to investigate the effectiveness of the workshops in enhancing the fine motor skills of preschool children, improving their emotional regulation, strengthening their autonomy and in improving skills related to their literacy.

The content analysis of the teachers participating in the research was divided into the following categories according to the teachers' opinions, the workshops helped children:

Strengthen their fine motor skills

Significant changes were observed in the children's self-care skills, such as using scissors and pencils. The progress of the children, especially those who had difficulties with even basic skills, was evident after three months of systematic application of the workshops. Amazingly, the teachers found that their students were able to cut out complex drawings with ease, as well as write and copy words in a straight line without using a guideline.

For example, a preschool teacher (T 2) stated:

"We saw children's differences in the handling of spoons and forks, pencils, the manipulation of brushes and scissors. The children stopped asking for help to unscrew and screw the lid of their water bottle or open and close their food bowl".

Enhance their concentration

The teachers explained that the children were more concentrated in the workshops, their engagement was of greater duration, and they were more interested than expected. This prompted the teachers to follow the same procedure in each organized class activity as in the workshops (presentation, explanation, repetition by the children, etc.). The fact that the children were aware of the objective of the activities made them participate more consciously and be more attentive. They showed greater concentration than in other classroom activities (lasting over 15 to 20 minutes for each workshop). And because the workshops were playful, the children were not discouraged and kept trying again and again until they achieved the desired outcome.

For example, another preschool teacher (T 17) stated:

"I noticed that children who were engaged in a workshop, were very focused on it. Even children who do not concentrate easily would sit and ask to "play" for a second time with some workshops that they liked a lot, such as the sand transport workshop. The children were engaged in this particular workshop for a long time (about two months) without getting bored with it.

Evolve their emotional development

The teachers stated that their students participated in the workshops with great interest, joy and curiosity. Even children who were normally indifferent to organised activities in the classroom were also observed to be engaged. They seemed very content to be involved in the workshops, both because familiar everyday objects were used in a different and entertaining way and, more importantly, because they were invited to suggest what the workshop should be called, how it could be extended, or what observations it should make. As a result, the children saw the workshops as 'theirs' rather than as something imposed. Furthermore, in the co-educational setting, teachers observed that those children with developmental disabilities, who usually did not participate in almost any activity, now engaged in some workshops with pleasure and cooperated with each other, following the steps of the process and each waiting for their turn. The teachers explained that it was a new feeling of success for those children as well as for them. Generally, after the first two months of the school year, the children stopped doing puzzles and blocks and sought out workshops to engage in creative activities. Consequently, the object manipulation workshops support preschool children's emotional

regulation while they were engaging in them.

For example, a preschool teacher (T 22) stated:

"The children participated in the workshops with great interest and curiosity even those who were indifferent to everything that was happening in the classroom. This year in our class, there were two children diagnosed with developmental disabilities, who hardly participated in any activity. However, they engaged in some workshops with great pleasure and collaborated with each other, following the steps of the process and waiting for their turn".

Succeed in other subjects of the curriculum

The teachers explained that the children also benefited from the workshops in other subjects of the curriculum. In particular, teachers stated that in mathematics, the children became familiar with measuring objects, quantities and shapes, comparing sizes, grouping and serialising objects and patterns. In terms of language, the workshops helped the children to improve their oral (vocabulary) and written expression (pencil grip and letter formation). The workshops also helped the children to experiment with different materials and situations and create their own "work of art" with greater skill and using new materials and techniques. The children seemed to progress gradually in every-day activities from the curriculum proposed by the teachers, as the daily practice was experiential and helped each child to learn in an enjoyable way.

For example, a preschool teacher (T 43) stated:

"The children gradually showed more interest in writing, and I noticed that some girls were selecting books from the library and copying words, others were constantly writing numbers and reading the number line both straight and reverse, and others were making hypotheses about the solubility of materials in a workshop that was recently proposed cooperatively by the classrooms' children and teachers".

Develop their autonomy

The teachers declared that the children seemed more confident during the workshops. They became self-sufficient in practical tasks such as buttoning their jackets, opening their snack bowls, cutting out complex designs with scissors, etc., which strengthened their sense of autonomy. They also took more initiative, completed the tasks of each workshop, evaluated their success, organised their time and the materials they worked with, proposed more workshops with different materials or different uses of materials in a workshop. After these workshops were introduced, the children often chose to construct using different materials during their free play.

For example, a preschool teacher (T 14) stated:

"The children took the initiative to use different pieces of cardboard, knitting wool, buttons, etc., and created their own original workshops. In addition, they learnt to be more organized, responsible, calm and focused on their activities".

Develop a sense of self-esteem when completing a workshop on their own

The teachers noticed that the children hardly needed any help to complete a workshop, but they always seemed to enjoy presenting the finished result to the teacher and their classmates. When younger children struggled with procedures that required more delicate manipulations, they asked the teacher for help, while older children sought help from their peers when involved with more challenging workshops. Presenting the finished result and discussing it with their classmates helped them establish a sense of achievement and recognize their own potential.

For example, a preschool teacher (T 33) stated:

"In the beginning, there were times when they would ask a classmate for clarification or help, but gradually they had less or no difficulty as they became more skilled and confident".

Find ways to improve workshops and learning

The instructions given by the teachers during the workshops were clear, step-by-step and also based on photographic material so that the children could easily focus on the goal. There were many ways in which each workshop could be extended regarding the purpose it served. The children could then evaluate their efforts and even make suggestions to develop or create a new workshop with the same materials or goals. The teachers explained that they could also evaluate each child individually and change a workshop according to the children's needs. The abilities and difficulties of each child were taken into consideration when introducing a new workshop.

For example, a preschool teacher (T 8) stated:

"The workshops were considerably organized. It might be easier for the children if the instructions were illustrated step by step or given with photos of how to implement them in each workshop".

Discussion

This study focused on the effectiveness of object manipulation workshops in the development of fine motor skills and autonomy in preschool classrooms in Greece (Sporidou, 2023). The workshops were proposed based on a particular concern in preschool education in Greece, which has to do with the difficulties that many children face in the classroom to work either individually or collaboratively, as well as to manage their emotions and accomplish everyday tasks (Mazgaltzis, 2019). Based on the difficulties faced daily by teachers of preschool children, a thorough study of contemporary theories on enhancing children's individual and social skills was conducted, focusing on their autonomy and the practices that can effectively support a range of related skills (motor, cognitive, emotional), (Sang-Min, 2018; Shi & Feng, 2022; Suggate et al., 2023). The

literature review revealed: a) the need to further strengthen the knowledge, attitudes and skills related to personal and social development of preschool and school-age children across Europe (Laloux, 2014), b) the need to strengthen fine motor skills as they are directly related to children's cognitive development (Dellatolas et al., 2003; Kim et al., 2018; Leisman et al., 2016).

After a thorough investigation to find activities that could enhance the autonomy and socialization of young children, our interest turned to specific workshops that operate mainly in France, which have achieved great results in increasing a range of skills related to cognitive, emotional and motor skills regarding the autonomy of preschool children. The analysis of teachers' responses, and the implementation of such workshops in several kindergartens in the region of Crete showed that:

a) The children's fine motor skills and self-regulation abilities were significantly improved (Chandler et al., 2022; Suggate et al., 2018). Therefore, the workshops positively affected the development of preschool children's fine motor skills.
b) The children's ability to concentrate was also improved. According to the teachers, the children seemed to be engaged in the activities for a long time and showed patience and perseverance until they had reached the desired outcome (McClelland & Cameron, 2019; Purtaş & Duman, 2017). Objects manipulation workshops helped the emotional regulation of children as they seemed calm and completed their work effectively (Grissmer et al., 2010; Laloux, 2014). In addition, they seemed to prefer the workshops more than other classroom activities, such as board games and building materials. Accordingly, the object manipulation workshops were effective in relation to children's emotional regulation.
c) At first, younger children seemed to have difficulties with very skilful movements, but with appropriate assistance (verbal, physical) they improved quickly. The older and more skilled children often suggested extending and modifying the existing workshops to make the learning process "their own business" (Hadji, 2012). The children were also involved in creating workshops, suggesting developments and extensions of the workshops with new materials and worksheets and presenting exhibits with new ideas (Cazenave, 2018; Raab, 2015). Consequently, the object manipulation workshops proved to be effective in developing the children's autonomy and sense of responsibility.
d) In addition, the children also improved other skills by using them systematically. Their verbal skills, written language and mathematical thinking improved, as did their ability to hypothesis and to rethink an original thought. They enjoyed experimenting with materials, discovering new ideas and were empowered by their desire to find solutions (Escolano-Pérez et al., 2020; Molfese et al., 2011; Saraiva et al., 2019). Thus, in addition to their fine motor skills, the children in the sample showed improvement in various skills from the preschool curriculum.

Conclusions

In general, object manipulation workshops have achieved great success in the daily program of preschool centers in Greece. They seem to enhance creativity and motivation in children and motivate both teachers and students to explore and learn. Moreover, they seem to strengthen the pedagogical relationship between those involved in the learning process, as the establishment of a new workshop requires a "good" understanding of the particular developmental needs of each child in the preschool classroom (Raab, 2016). Using workshops during the learning process also enhances the student-centered dimension of the educational process itself (Hadji, 2012; Vretudaki, 2022). In addition, the use of everyday, simple materials to design a workshop makes the whole process feasible, enjoyable and creative for every teacher.

Limitations

This study has a few limitations. The small and specialized sample from the Cretan region in Greece restricts the generalizability of the findings particularly concerning the subjectivity of the teachers' responses to the qualitative questionnaire. In addition, the sample was diverse in terms of urban and rural context and teaching experience, which prevents us from generalizing our interesting findings.

Authors' contribution

Hellen Vretudaki contributed to the conceptualization of the paper, project administration, original data preparation, writing, reviewing, editing, and creating literature about object manipulation workshops. Anna Athanasopoulou contributed to the original draft preparation and project administration.

Conflict of interest

The author does not have any potential conflict of interest that may influence the decision to publish this article.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Ethics statements

This study includes human participants, including vulnerable groups. Therefore, the authors guarantee that participation is both voluntary and anonymous and that strict measures have been taken to protect the confidentiality of respondents' data and personal information. Concerning data collection and research ethics, this study has received the approval of the Directorate of Primary and Secondary Education of the Religion of Crete. Greece.

Appendix

The appendix is avaible at https://file.luminescience.cn/RPPE-325%20appendix.pdf.

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