Journal of Education and Learning (EduLearn)
Vol. 19, No. 1, February 2025, pp. 257~264
ISSN: 2089-9823 DOI: 10.11591/edulearn.v19i1.21364

The impact of Montessori method on early mathematical competence of young children

Athanasia Siaviki[1], Eleni Tympa[2], Vasiliki Karavida[1], Ioannis Fykaris[3]
[1]Department of Early Years Learning and Care, School of Social Sciences, University of Ioannina, Ioannina, Greece
[2]Department of Early Childhood Education and Care, School of Social Sciences, International Hellenic University, Thessaloniki, Greece
[3]Department of Philology, School of Philosophy, University of Ioannina, Ioannina, Greece

Article Info

Article history:

Received Oct 15, 2023
Revised Apr 10, 2024
Accepted May 18, 2024

Keywords:

Cognitive development
Early mathematical competence
COVID-19
Montessori
Teaching method

ABSTRACT

The Montessori method offers an alternative approach to public and independent schooling. In the Greek educational system, the Montessori method is mainly applied in preschool and primary educational contexts. The main research objective was to investigate the early mathematical competence of students aged 4-7 years old attending a Montessori preschool educational center with those of students aged 4-7 years old attending educational institutions where traditional teaching techniques and methods are being implemented at the Eastern Thessaloniki, Greece. The overall research sample was 142 students, 68 taught in the Montessori institution and 74 attending typical ones, as well as 119 parents of the children that were measured. A questionnaire was administered electronically to the parents who agreed to participate in the research, while the measurements of early mathematical competence were carried out via the Utrecht Early Mathematical Competence Scales. Overall findings showed that the scores of the students attending the Montessori educational institution were higher than those of the ones attending typical educational institutions, especially those of pre-kindergarten, kindergarten, and first-grade children.

Corresponding Author:

Athanasia Siaviki
Department of Early Years Learning and Care, School of Social Sciences, University of Ioannina
4th klm Ioannina-Athens National Highway PC 45500, Ioannina, Greece
Email: athsiaviki@gmail.com

1. INTRODUCTION

Undoubtedly, the spread of the COVID-19 outbreak and the policy of maintaining physical and social distance during the past 3 years has changed the pattern of life in all fields and has led to enormous socioeconomic challenges around the world [1], [2]. While the tremendous educational and pedagogical impact of the COVID-19 pandemic has been widely acknowledged in most educational systems, the proper cognitive and social development of children and students has been extremely disrupted in all levels of education. Preschools and kindergartens, schools, and universities have been closed both nationwide and on a local basis in more than 100 countries, affecting more than half of the world's student population [3].

Relevant results from studies conducted during these years indicate that overall cognitive scores and social skills in early childhood education and children under 3 years of age born since the beginning of the pandemic are significantly lower than over the past decade [2], [4]. Some of the negative results of the absence of real-life communication were: a decreased sense of awareness, inadequate communication and socialization skills, and lack of peer relationships. There has also been reported reduced development of problem-solving skills, ability to work in teams, and conflict-solving skills [5]. Additional predictions also include fewer literacy skills [6] including listening, speaking, reading, and writing as well as the process of

finding and analyzing information, especially for disadvantaged children who have unequal access to educational resources and stimuli [3]. Nevertheless, the implementation of learning techniques at home like reading daily to young children, storytelling, dictating, and having systematic interaction with the children are likely to result in the greatest maintenance of children's literacy skills and their socio-emotional connection with their parents [1], [6], [7].

In Greece, during the 2 main school years of the COVID-19 pandemic (2019-2020 and 2020-2021), specific restrictions on social interaction were implemented. The operation of educational settings, from early primary to higher education, was suspended for more than 6 months in total. During these months, synchronous and asynchronous distance learning was implemented through online platforms. In the current school year, all educational settings remain open with extremely specific and predefined health protocols.

The Montessori method is considered an alternative approach to modern educational practice. It is a concrete pedagogical method, well organized that allows individual choice and freedom [8]. It constitutes an effort to create the best possible learning conditions so as for the children to be able to develop their cognitive abilities from preschool age [8]–[10]. In this educational and pedagogical framework, each child is able to actively participate only in the activities he/she wants to engage in, at his/her own pace, within the predetermined learning environment. As a result, the learning environment of the classroom is based on well-structured activities, so that children have the possibility of free and autonomous choice concerning their involvement in them [11].

Montessori programs are being implemented globally with extremely positive results for all members of the educational community. Relevant international research demonstrates that the cognitive and socio-emotional abilities of children from 3-6 years old attending traditional educational frameworks were poorer than those of the ones attending Montessori educational programs [12]–[14]. More specifically, preschoolers from Montessori programs have a higher phonological performance, tend to make fewer errors, concentrate more easily, have better social understanding, and mastery orientation, enjoy scholastic tasks more, and develop more psychomotor and mathematical skills [11], [14]–[19]. Furthermore, in Montessori educational programs, children are capable of deciding and choosing freely, resulting in gradually enhancing their self-esteem, self-awareness, and social skills as well as the pedagogical relationship between teachers and students [13], [20].

The term "early math" includes basic mathematical notions such as counting, quantity, shapes, spatial relations, measurements, and patterns. Because of children's natural curiosity, the understanding of these concepts is accomplished via their interaction with their surrounding environment [7]. Montessori believed that children first perceive value from the length of an object rather than the number of objects [17].

According to relevant research, children who attended Montessori educational programs, have higher academic performance, acquire critical approaches, and problem-solving skills, and can adapt much more easily to classroom conditions [11]. In addition, they succeed in more tasks and possess part-whole skills [21]. In the same context, relevant differences in the mathematical performances are also presented in the research results of Mallett and Schroeder [22] and Courtier *et al.* [8].

The Montessori method is considered an innovative teaching method in many countries around the world, including Greece. In particular, in the Greek educational framework, the Montessori method is mainly applied in preschool and primary educational contexts. Despite the fact that the method has been applied more systematically in Greek educational institutions in recent years than in the past, there isn't enough research conducted regarding the effectiveness of this method in our country especially regarding children's mathematical competence. In a recent study, parents whose children attend Montessori schools and teaching programs argued that their children are more confident, especially in the field of mathematics, and they also have the ability to assist their elder siblings [23].

In this context, we will present the results of relevant research regarding the impact of the Montessori method on the early mathematical competence of children 4-7 years old. The research was conducted during the years of the COVID-19 pandemic crisis in Greece. During those years, specific health protocols were implemented in all institutions, including schools.

2. METHOD

The main objective of the cross-sectional study design adopted was to investigate the early mathematical competence of students aged 4-7 years old attending a Montessori preschool educational center with those of students aged 4-7 years old attending educational institutions where traditional teaching techniques and methods are being implemented in North Greece. Furthermore, a correlation between the parent's socioeconomic status and their children's mathematical competence was assessed. While previous studies have explored the impact of the Montessori method on children's cognitive development worldwide, in Greece relevant studies have been quite limited, especially since the COVID-19 pandemic.

The study group consisted of children studying in the private Montessori setting, while the control group consisted of children from nearby typical educational settings. All children lived in the same area and came from 4 levels of education (early years setting, pre-kindergarten, kindergarten, and first grade). Measurements began with those who were the first to give the consent forms.

Cross-sectional studies are observational studies that analyze data from a population at a single point in time [24]. Cross-sectional research design does not provide findings from which certain causal inferences or causal relationships can be drawn, but exploratory mapping of the relationships between variables and the possibility of making correlations. The amount and quality of data were enhanced by the evaluation of multiple mathematical areas that determine children's performance in early mathematical competence [25], while different analytic methods were implemented.

Unlike other types of observational studies, cross-sectional studies do not follow individuals over time [24], [25]. They are usually inexpensive and easy to conduct [25]. In the current cross-sectional study, all participants live in the same geographical district of Eastern Thessaloniki, and data were collected at a single point in time for each age group.

Children's early mathematical performance was also correlated with parents' socioeconomic profile, regarding their studies and professions. All measurements were conducted during the school year 2021-2022 while the COVID-19 pandemic was still active. The following parts describe the sample as well as the methods and techniques used to collect and analyze the data.

2.1. Sample

The research sample consists of 142 children, 68 taught in the Montessori institution (study group) and 74 attending typical ones (control group). It also consists of 119 parents, 55 from private educational settings (Montessori and first grade) and 64 from public ones. More specifically, 47.9% of the children's sample was female (N=68) and 52.1% male (N=74). Moreover, 89.9% (N=107) of the parents were female, and 10.1% (N=12) of them male.

2.2. Measures and instruments

The Utrecht early mathematical competence scales standardized in the Greek language by Barbas *et al.* [26] assessed the early mathematical competence of children aged 4-7.05 in the eight areas: i) comparison, ii) classification, iii) correspondence, iv) seriation, v) use of number words, vi) structured counting, vii) resultative counting, and viii) general understanding of number words. Based on the number of correct answers in each area and the age of the participant, he/she is then classified into one of five levels of mathematical competence (A: good to very good, B: quite good to good, C: average to quite good, D: weak to average, and E: very weak to weak). At the same time, in each age group, a questionnaire was administered to the parents electronically. The questionnaire contained items regarding the demographic characteristics of the parents, their studies, and professions in order to form the factor socioeconomic status (SES) and the type of educational setting their children are attending (Montessori, typical, private, and public) [27], [28].

2.3. Procedure

The assessment of early mathematical competence of children aged 4-7 years old, both studying in the Montessori educational setting and the typical ones, was conducted with the Utrecht early mathematical competence scales, standardized in the Greek language by Barbas *et al.* [26]. First-grade students were measured before all the others during the first school term in order to assess their performance at the beginning of the school year. Measurements continued during the second term with the children in kindergarten, then at third term with those in pre-kindergarten, and during June with the youngest ones aged 4. The demographic characteristics questionnaire designed by the researcher was distributed to the participating parents through the class teachers online. The questionnaire was pilot-tested to ensure that parents understand all questions and there are no ambiguous words.

2.4. Ethics

The study got approval from the ethics research committee from the University of Ioannina. Following this, parental consent was sought and the researcher assessed only the children whose parents agreed. It goes without saying that although children are young and unable to sign an informed consent, their assent was sought and only if they wished to do so they participated.

2.5. Data analysis

The current analysis was quantitative. Data was analyzed using SPSS. All data was collected and analyzed gradually during the school year 2021-2022 based on the ages of the students from the oldest to the youngest. Descriptive (frequencies) and t-tests, correlations, and regression analysis were performed.

3. RESULTS AND DISCUSSION

Regarding their ages, Table 1 indicates that the youngest participants at age 4 were 38 (f=26.8%), those at the pre-kindergarten 43 (f=30.3%), at kindergarten 36 (f=25.4%) and first grade 25 (f=17.6%). All 142 children were categorized into 5 levels of early mathematical competence, as described in Table 1. From the whole sample, 78.8% (112) of the participants have achieved a quite good to very good level of early mathematical competence, 14.8% (21) a weak to quite good level, and 6.3% (9) a very weak to weak level.

Table 1. Level of early mathematical competence

Valid	Frequency	Valid Percent
A: Good to Very Good	79	55.6
B: Quite Good to Good	33	23.2
C: Average to Quite Good	13	9.2
D: Weak to Average	8	5.6
E: Very Weak to Weak	9	6.3
Total	142	100.0

More specifically, children attending the private Montessori educational setting (study group) were categorized into levels A, B, and C as seen in Table 2. Most of them, 86.8% (59) were at level A (good to very good), 10.3% (7) at level B (quite good to good), and only 2.9 % (2) at level C (average to quite good). On the other hand, only 27% (20) of the children attending private and public typical educational settings (control group) have been categorized in level A, 35.1% (26) in level B, 14.9% (11) in level C, 10.8% in level D (weak to average) and 12.2% (9) in level E (very weak to weak) as described in Table 3.

Table 2. Level of early mathematical competence (study group)

Valid	Frequency	Valid Percent
A: Good to Very Good	59	86.8
B: Quite Good to Good	7	10.3
C: Average to Quite Good	2	2.9
Total	68	100.0

Table 3. Level of early mathematical competence (control group)

Valid	Frequency	Valid Percent
A: Good to Very Good	20	27.0
B: Quite Good to Good	26	35.1
C: Average to Quite Good	11	14.9
D: Weak to Average	8	10.8
E: Very Weak to Weak	9	12.2
Total	74	100.0

Table 4 presents the results of an independent samples t-test analysis, using the level of early mathematical competence as the test variable and the study group and the control group as grouping variables. The results showed statistically significant differences in the level of early mathematical competence between the study group and the control group (t=-7.681, p<.05). More specifically, the study group achieved higher mathematical performance at the mathematical tasks.

Table 4. Independent samples t-test between study group, control group, and level of early mathematical competence

Level of Early Mathematical Competence	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference
Equal Variances Assumed	-7.681	140	.000	-1.29769	.16894
Equal Variances Not Assumed	-7.947	90.446	.000	-1.29769	.16330

Tables 5-7 show the differences through an independent samples t-test analysis at the level of early mathematical competence between the study and the control group for the children in the same age group. More specifically, Tables 5-7 show a statistically significant difference in the level of early mathematical competence between the study and the control group for the children at pre-kindergarten (t=-7.744, p<.05), at kindergarten (t=-3.729, p<.05) and at first grade (t=-4.984, p<.05) respectively.

Table 5. Independent samples t-test between study group, control group, and level of early mathematical competence for pre-kindergarten children

Level of Early Mathematical Competence	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal Variances Assumed	-7.744	41	.000	-2.47174	.31920
Equal Variances Not Assumed	-8.288	23.268	.000	-2.47174	.29823

Table 6. Independent samples t-test between study group, control group, and level of early mathematical competence for kindergarten children

Level of Early Mathematical Competence	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal Variances Assumed	-3.729	34	.001	-1.00000	.26813
Equal Variances Not Assumed	-3.729	17.000	.002	-1.00000	.26813

Table 7. Independent samples t-test between study group, control group, and level of early mathematical competence for first-grade children

Level of Early Mathematical Competence	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal Variances Assumed	-4.984	23	.000	-.92308	.18521
Equal Variances Not Assumed	-5.196	12.000	.000	-.92308	.17765

Table 8 presents a correlation analysis conducted among the variables of early mathematical competence, profession of the mother, profession of the father, educational level/studies, and SES. The analysis didn't approve any statistically significant relation between the level of early mathematical competence of the participants and the SES of their parents, which could be attributed to the fact that all participants live in the same municipality of Eastern Thessaloniki.

Table 8. Correlation between the variables: early mathematical competence, the profession of the mother, the profession of the father, educational level/studies, and SES

Grouping Variables		Level of Early Mathematical Competence	Profession of The Mother	Profession of The Father	Educational Level/Studies	SES
Level of Early Mathematical Competence	Pearson Correlation	1	-.088	-.050	-.119	-.156
	Sig. (2-Tailed)		.377	.592	.198	.116
	N	142	103	117	119	102
	Sig. (2-Tailed)	.000	.767	.390	.540	.313
	N	142	103	117	119	102
Profession of The Mother	Pearson Correlation	-.088	1	.380**	.459**	.810**
	Sig. (2-Tailed)	.377		.000	.000	.000
	N	103	103	102	103	102
Profession of The Father	Pearson Correlation	-.050	.380**	1	.359**	.717**
	Sig. (2-Tailed)	.592	.000		.000	.000
	N	117	102	117	117	102
Educational Level/Studies	Pearson Correlation	-.119	.459**	.359**	1	.769**
	Sig. (2-Tailed)	.198	.000	.000		.000
	N	119	103	117	119	102
SES	Pearson Correlation	-.156	.810**	.717**	.769**	1
	Sig. (2-Tailed)	.116	.000	.000	.000	
	N	102	102	102	102	102

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Finally, a regression analysis was run (Table 9), using the level of early mathematical competence as the dependent variable and sex, SES, and type of group (study/control) as independent variables. Holding all the relevant independent variables constant the model shows that the type of group has a statistically significant effect (b=1.608, p<.05). On the contrary, the variables Sex and SES do not have a statistically significant effect on the level of early mathematical competence of the children for the whole sample.

Table 9. Regression analysis with level of early mathematical competence as the dependent variable

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.058	.171		6.174	.000
Sex	.156	.200	.062	.780	.437
SES	.118	.110	.094	1.079	.283
Type of Group	1.608	.219	.639	7.334	.000

Analyzing the previously mentioned results, it can be stated that the majority of children attending the private Montessori educational setting were categorized in levels A (good to very good) and B (quite good to good). On the other hand, almost half of the children attending private and public typical educational settings have been categorized in levels A and B. In addition, a little less than 25% of the children from the control group were at levels D (weak to average) and E (very weak to weak) compared to none of those from the study group. Similar findings indicating that children taught with the Montessori method complete successfully more mathematical tasks and possess problem-solving skills are presented in other research [8], [21], [22], leading to the hypothesis that the Montessori teaching method leads to higher performance.

Moreover, an independent samples t-test analysis showed a statistically significant difference in the level of early mathematical competence for the children at the ages of pre-kindergarten, kindergarten, and first grade. These results indicate that all students at the ages of pre-kindergarten, kindergarten and first grade taught via the Montessori method had a higher level of early mathematical competence compared to those receiving typical education. Further regression analysis also proved that the type of group has a statistically significant effect on the level of early mathematical competence. Similar results appeared in relevant research [11], [14]–[17]. Furthermore, a correlation analysis didn't show a statistically significant relation between the level of early mathematical competence of the participants and the Socioeconomic status of their parents. This result could be possibly attributed to the fact that all participants live in the same municipality of Eastern Thessaloniki.

4. CONCLUSION

Overall findings showed that the scores of the children attending the Montessori setting were higher than those of the children attending typical educational settings while most of the children from the study group were at the highest-level A. In the present research, no statistically significant results were found regarding the level of early mathematical competence about gender and between the level of early mathematical competence and the variable SES level of the parents. This finding is probably related to the fact that the sample in this research came from families that resided in the same Municipality and had a similar socioeconomic profile.

One can argue that more research on the impact of the Montessori teaching method on the cognitive development of children from preschool education to the primary educational level is needed, especially in the Greek educational framework. As many pedagogical and teaching factors impact the academic performance of children, further research regarding the teaching techniques and materials, the teacher's proper training, the available resources, and the socio-economic context of upbringing is also of great importance. Furthermore, additional Montessori schools from other cities in Greece as well as children with diagnosed learning disabilities could also be included so that it would be possible to generalize the results. Finally, the present research could also be carried out within a different methodological framework and by conducting measurements at the beginning and the end of the school year.

REFERENCES

[1] A. Darmiyanti, O. Supriadi, and A. Nurlaeli, "The impact of the COVID-19 pandemic on language and social development for early childhood children age 4-6 years in Karawang district," *Indonesian Journal of Early Childhood Education Studies*, vol. 10, no. 1, pp. 27–32, 2021.

[2] Najamuddin, Sahrip, K. W. andri Siahaan, W. Yunita, and R. Ananda, "The impact of the dissemination of the COVID-19 epidemic on social development in early children," *International Journal of Elementary Education*, vol. 6, no. 2, pp. 232–238, 2022.

[3] N. Reuge, R. Jenkins, M. Brossard, B. Soobrayan, S. Mizunoya, J. Ackers, L. Jones, and W. G. Taulo, "Education response to COVID 19 pandemic, a special issue proposed by UNICEF: Editorial View", *International Journal of Educational Development*, vol. 87, 102485, 2021, doi: https://doi.org/10.1016/j.ijedudev.2021.102485.

[4] S. C. Deoni, J. Beauchemin, A. Volpe, V. Dâ Sa, and R. Consortium, "The COVID-19 pandemic and early child cognitive development: a comparison of development in children born during the pandemic and historical references," *medRxiv : the preprint server for health sciences*, 2021, doi: 10.1101/2021.08.10.21261846v2.

[5] M. A. Alsubaie, "Distance education and the social literacy of elementary school students during the COVID-19 pandemic," *Heliyon*, vol. 8, no. 7, p. e09811, Jul. 2022, doi: 10.1016/j.heliyon.2022.e09811.

[6] X. Bao, H. Qu, Z. R, and T. Hogan, "Literacy loss in kindergarten children during COVID-19 school closures," *SocArXiv*, pp. 1–16, 2020, doi: 10.3390/ijerph17176371.

[7] B. Harris and D. Petersen, "Developing math skills in early childhood," *Mathematica Policy Research*, no. February, pp. 1–6, 2019.

[8] P. Courtier *et al.*, "Effects of Montessori education on the academic, cognitive, and social development of disadvantaged preschoolers: a randomized controlled study in the French public-school system," *Child Development*, vol. 92, no. 5, pp. 2069–2088, Sep. 2021, doi: 10.1111/cdev.13575.

[9] G. Kayılı, "The effect of Montessori method on cognitive tempo of kindergarten children," *Early Child Development and Care*, vol. 188, no. 3, pp. 327–335, Mar. 2018, doi: 10.1080/03004430.2016.1217849.

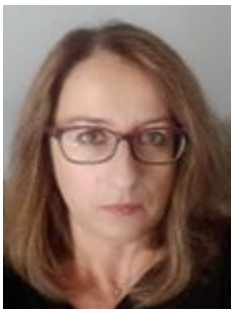
[10] W. Sumanasinghe and S. Sethunga, "Montessori against p21 early learning: a quantitative benchmarking analysis," *International*

Journal of Management and Human Science, pp. 30–46, 2021.
[11] A. Siaviki, E. Tympa, V. Kravida, I. Fykaris, and D. Grmmatikou, "The functionality of the Montessori method: preschool and primary Greek school teacher's attitudes," *Article in International Journal of Humanities and Social Science*, vol. 11, no. 6, pp. 115–125, 2021.
[12] S. Denervaud, J. Knebel, M. H. Immordino-Yang, and P. Hagmann, "Effects of traditional versus Montessori schooling on 4- to 15-year old children's performance monitoring," *Mind, Brain, and Education*, vol. 14, no. 2, pp. 167–175, May 2020, doi: 10.1111/mbe.12233.
[13] E. Gentaz and S. Richard, "The behavioral effects of Montessori pedagogy on children's psychological development and school learning," *Children*, vol. 9, no. 2, p. 133, Jan. 2022, doi: 10.3390/children9020133.
[14] A. Demangeon, S. Claudel-Valentin, A. Aubry, and Y. Tazouti, "A meta-analysis of the effects of Montessori education on five fields of development and learning in preschool and school-age children," *Contemporary Educational Psychology*, vol. 73, p. 102182, Apr. 2023, doi: 10.1016/j.cedpsych.2023.102182.
[15] J. J. Randolph *et al.*, "Montessori education's impact on academic and nonacademic outcomes: a systematic review," *Campbell Systematic Reviews*, vol. 19, no. 3, Sep. 2023, doi: 10.1002/cl2.1330.
[16] J. Kvintova *et al.*, "Preschoolers' attitudes, school motivation, and executive functions in the context of various types of kindergarten," *Frontiers in Psychology*, vol. 13, Mar. 2022, doi: 10.3389/fpsyg.2022.823980.
[17] T. F. Nisa, F. L. T. Ariyanto, and A. H. Asyhar, "Montessori learning: understanding the concept of early childhood mathematics," *Journal of Physics: Conference Series*, vol. 1211, p. 012094, Apr. 2019, doi: 10.1088/1742-6596/1211/1/012094.
[18] V. Chytrý, J. Medová, J. Říčan, and J. Škoda, "Relation between pupils' mathematical self-efficacy and mathematical problem solving in the context of the teachers' preferred pedagogies," *Sustainability*, vol. 12, no. 23, p. 10215, Dec. 2020, doi: 10.3390/su122310215.
[19] A. Basargekar and A. S. Lillard, "Math achievement outcomes associated with Montessori education," *Early Child Development and Care*, vol. 191, no. 7–8, pp. 1207–1218, Jul. 2021, doi: 10.1080/03004430.2020.1860955.
[20] B. Bavlı and H. U. Kocabaş, "The Montessori educational method: communication and collaboration of teachers with the child," *Participatory Educational Research*, vol. 9, no. 1, pp. 443–462, Jan. 2022, doi: 10.17275/per.22.24.9.1.
[21] S. Ongoren and D. O. Yazlik, "Investigation of mathematical concept skills of children trained with Montessori approach and moe pre-school education program," *European Journal of Educational Research*, vol. 8, no. 1, pp. 9–19, Jan. 2019, doi: 10.12973/eu-jer.8.1.9.
[22] J. D. Mallett and J. L. Schroeder, "Academic achievement outcomes: a comparison of Montessori and non-Montessori public elementary school students," *Journal of Elementary Education*, vol. 25, no. 1, pp. 39–53, 2015.
[23] E. Tympa, V. Karavida, A. Charissi, and A. Siaviki, "Parental views of the Montessori approach in a public Greek early years setting," *Education 3-13*, vol. 50, no. 2, pp. 281–287, Feb. 2022, doi: 10.1080/03004279.2020.1849344.
[24] X. Wang and Z. Cheng, "Cross-sectional studies: strengths, weaknesses, and recommendations," *Chest*, vol. 158, no. 1, pp. S65–S71, Jul. 2020, doi: 10.1016/j.chest.2020.03.012.
[25] T. Clark, L. Foster, A. Bryman, and L. Sloan, "Bryman's social research methods," *Oxford University Press*, vol. 6, p. 704, 2021.
[26] G. Barbas, F. Vermeoulen, G. Kioseoglou, and G. Menexes, Psychometric criterion of early mathematical competence of Utrecht (adaptation – standardization). In: The framework of the project EPEAEK "Psychometric – differential assessment of children and adolescents with learning difficulties.", Thessaloniki, 2008.
[27] G. Charitaki, A. Alevriadou, and S.-G. Soulis, "Early numeracy profiles in young children with intellectual disabilities: the role of cognitive functions," *Journal of Intellectual Disabilities*, vol. 28, no. 1, pp. 48–66, Mar. 2022, doi: 10.1177/17446295221117021.
[28] N. Tsigilis, K. Krousorati, A. Gregoriadis, and V. Grammatikopoulos, "Psychometric evaluation of the preschool early numeracy skills test–brief version within the item response theory framework," *Educational Measurement: Issues and Practice*, vol. 42, no. 2, pp. 32–41, Jun. 2023, doi: 10.1111/emip.12536.

BIOGRAPHIES OF AUTHORS

Athanasia Siaviki is a primary school teacher at the Greek educational system in Athens, Greece, and has received a Ph.D. diploma from the Department of Early Years Learning and Care, School of Social Sciences at the University of Ioannina, Greece. Her research focus is on the fields of didactic methodology from early childhood to primary education, as well as on the assessment and organization of the learning process. She can be contacted at email: athsiaviki@gmail.com.

Eleni Tympa obtained a master's degree in mother and child health, at the University of London, UK in 1994, and a Ph.D. in risk factors for iron deficiency in childhood at the Harokopio University of Athens, Greece in 2004. She is an assistant professor at the Department of Early Childhood Education and Care, School of Social Sciences at the International Hellenic University, Greece. Her research focus is on the healthy lifestyle of preschool children, the role of storytelling in the healthy lifestyle, pretend play and art activities, and their contribution to the child's development. She can be contacted at email: eltympa@ecec.ihu.gr.



Vasiliki Karavida obtained a master's degree in special educational needs, at the University of Newcastle upon Tyne, UK in 2000, and a Ph.D. in childhood obesity at the University of Ioannina, Greece in 2016. She is an Associate Professor at the Department of Early Years Learning and Care, School of Social Sciences at the University of Ioannina, Greece. Her areas of research involve nutrition, healthy lifestyle, education, preschool learning environment, and all-round development in early childhood. She can be contacted at email: vkar@uoi.gr.

Ioannis Fykaris is an associate professor at the Department of Philology, School of Philosophy at the University of Ioannina, Greece. His areas of research involve didactic methodology, school books and analytical programs, teaching and educational innovations, and the role of the educator in the educational field. He can be contacted at email: ifykaris@uoi.gr.