education sciences

MDPI

Article

Attitudes towards the Use of Educational Robotics: Exploring Pre-Service and In-Service Early Childhood Teacher Profiles

Stamatios Papadakis [1,*], Julie Vaiopoulou [2], Eirini Sifaki [3], Dimitrios Stamovlasis [4] and Michail Kalogiannakis [1]

[1] Department of Preschool Education, Faculty of Education, University of Crete, 74100 Crete, Greece; mkalogian@uoc.gr
[2] Department of Education, University of Nicosia, 2417 Nicosia, Cyprus; vaiopoulou.cp@unic.ac.cy
[3] Department of Cultural Organisations Management, Hellenic Open University, 26222 Patras, Greece; sifaki.eirini@ac.eap.gr
[4] Department of Philosophy and Education, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece; stadi@auth.gr
* Correspondence: stpapadakis@uoc.gr

Abstract: The introduction of STEM education, and specifically the implementation of educational robotics (ER), has drawn researchers' attention and has shown that teachers play a crucial role in leading this innovation. The present study concerns in-service and pre-service early childhood teachers, focusing on their perceptions and attitudes about ER use in daily teaching practice. The data were collected via a questionnaire (N = 201) and explored using latent class analysis, which detected distinct clusters/profiles of participants based on their pattern of responses. Two clusters were identified: Cluster1 was relatively homogeneous, including those who share a positive attitude towards ER, while Cluster2 was heterogeneous, comprising participants with inconsistent responses and expressing negative and skeptical thinking. The cluster memberships were associated with external covariates, such as age, years of teaching experience, and variables measuring their technological competencies. The results showed that teaching experience and age were negatively associated with cluster1-membership, while educational robotics knowledge was positively associated. The findings are interpretable, and the implications for education are discussed considering the current literature.

Keywords: educational robotics; STEM; in-service teacher profiles; pre-service teacher profiles

Citation: Papadakis, S.; Vaiopoulou, J.; Sifaki, E.; Stamovlasis, D.; Kalogiannakis, M. Attitudes towards the Use of Educational Robotics: Exploring Pre-Service and In-Service Early Childhood Teacher Profiles. *Educ. Sci.* **2021**, *11*, 204. https://doi.org/10.3390/educsci11050204

Academic Editor: James Albright

Received: 1 April 2021
Accepted: 22 April 2021
Published: 27 April 2021

1. Introduction

During the last decades, the interest in acquiring skills demanded by twenty-first-century society has risen significantly. Supporters of this idea argue for systematic educational reform that encompasses technology with creative thinking and problem-solving in early childhood education settings (throughout this study, the term "early childhood" is used for the period from birth to age eight) to prepare students as future citizens in a society fundamentally based on technology [1–4]. Teaching science, technology, engineering, and mathematics (STEM) to students at an early age is one of the most prevalent ways to achieve this goal and, at the same time, to increase children's self-concept and interest in the field and provide information about relative career options. Children are born with an innate desire to tinker and a natural curiosity; the preschool classroom environment is particularly rich in opportunities to do this by engaging actively in STEM activities [5,6]. Thus, incorporating more technology-based educational tools in early childhood education curriculums might yield the most significant benefits possible by helping children develop skills they will need in the future [7,8].

Educational robotics (ER), as a part of STEM education, incorporates a broad range of general knowledge and permits any specific discipline to be translated into a more comprehensive educational context. ER has attracted policymakers and researchers worldwide, especially as a helpful medium for cultivating students' cognitive, emotional, and social skills, from preschool to university and in general and special education contexts [9,10].

Nowadays, there are numerous educational tools available for preschool-age children to engage them in STEM activities, such as visual block-based environments (e.g., ScratchJr), online environments (e.g., Code.org), robotic devices (e.g., Bee-bot), and unplugged activities [11,12].

As preschoolers are already familiar with digital devices before entering preschool, educators can easily take advantage of the latest technology [1,13], based on children's prior experiences, logical arguments, or other empirical evidence, to engage them in creative STEM activities and physical play with educational robotics kits. These offer the playful and enjoyable experience of constructing robots with or without software applications using motors, sensors, and various everyday materials [6]. These activities can also promote computational thinking (CT) skills, because they usually require kids to explore algorithms, modularity, sequences, loops, and variables [14].

A strong relationship exists between early childhood educators' attitudes towards technology and their actions in their respective educational settings [15,16]. Education practitioners' self-efficacy beliefs and knowledge, combined with uncertainty or fear regarding educational technology, can significantly impact their confidence in creating digital education experiences focusing on STEM and CT [6]. In this sense, any new medium can be successfully implemented and sustained provided that teachers are ready to introduce technology specifically in a student-centered learning fashion; that is, teachers need to (a) be aware of innovative technologies that are emerging; (b) accept innovative technology that offers valuable benefits; (c) feel confident that technologies can be used safely and securely; (d) have high confidence in their ability to use the technology properly [17]. On the other hand, robotics can help teachers expand their interest in STEM concepts and make CT and STEM activities more appealing for educators and students. Teachers' earlier experiences in robotics education can help them to reconsider their instructional designs and integrate interactive teaching approaches, such as student-centered teaching [18], which, when built within a student-centered environment, helps students to understand and appraise a technology's potential [19,20].

This study is focused on pre-service and in-service teacher perceptions regarding the factors that inhibit them from effectively incorporating ER in their daily teaching practice.

2. Benefits of STEM Education and Educational Robotics Activities

The rise of digital technologies brings new opportunities, demands, and challenges for students and teachers in the 21st century [21]. Today's preschoolers are tomorrow's inventors, decision makers, and problem solvers. Therefore, in recent years, concepts such as STEM, robotics, CT, and coding have been promoted by educational institutions and other organizations as skills that are as significantly and equally important for all 21st century students as numeracy and literacy [22,23].

Early childhood is a crucial period for children's development, and it is expected that a set of essential skills is acquired to minimize difficulties in later student or adult life [8]. STEM education can contribute significantly to the overall development of young kids. Introducing STEM activities early on has been found to predict later reading achievement, promote a positive attitude towards the respective field of study, and reduce gender-based stereotypes about traditional roles that hinder girls' participation in STEM, leading to expanded future career options [24–26]. Students of all educational levels, social classes, and genders may benefit by learning the scientific methodology of posing questions and observing to understand the world. Indeed, as children learn about science, they show greater academic interest in engineering and relative disciplines; by abandoning misconceptions that only talented individuals can follow a career in these fields, students gain higher self-confidence and, later in their life, may pursue such provisional choices [9,25,27,28].

Although there are various technological tools used in the classroom for the teaching and learning procedures, research has shown that ER contributes more to a student's emotional and intellectual engagement than other commonly used educational tools, such as interactive smartboards, due to the physical embodiment of the robotic kits and the possibility of promoting students' communication skills. In preschool classrooms, the educational goal is not to introduce coding literacy in separate subject classes but rather to teach students how to use digital technologies as tools to produce well-educated people [29]. More specifically, the aim is to ensure a broader focus so that students use the digital technologies and the CT and coding activities as learning opportunities for cognitive growth, creative problem solving, and entrepreneurship [30]. During ER activities, the students need to cooperate with their teammates in everyday tasks, working with everyday hands-on materials such as sensors, batteries, detectors, and lights to complete the activities assigned to them by their teachers [19,31].

In the present study, the term educational robotics (ER) defines a broad area of knowledge-based approaches requiring students to engage in activities using simple and standard electronic components. Furthermore, ER utilizes students' reasoning skills to program a robot or design and create its part(s) and program it; these approaches have been found to increase interest and motivation for acquiring new skills and school knowledge [31,32]. ER systems intended for use by young children (such as the new generation of Bee-Bot, provide an age-appropriate introduction to robotics by combining movements, light, sound effects, and wireless control via tablets such that it is both attractive to and educational for children [10].

The mere incorporation of ER in a classroom setting is not the primary goal. The focus should move towards its use as a tool, supporting engaging hands-on activities for kids in developmentally suitable student-centered learning scenarios [31,33]. The proper use of ER can help students learn and implement scientific methodology and acquire a set of 21st century fundamental skills, such as logical thinking, critical thinking, computational thinking, problem solving, collaboration, programming, and coding skills, leading to meaningful technological literacy and improved achievement in math and science [5,14,19,34–36].

3. Teachers' Attitudes towards Educational Robotics

Inside the preschool class setting, teachers are the key persons for creating an interactive learning environment to integrate ER STEM educational activities. To achieve this goal, the educator needs to provide the necessary resources and support to boost student engagement and maximize their potential through various projects inside an open and non-judgmental atmosphere; this results in a collaborative classroom environment that fosters creativity and knowledge creation. This role can be rather challenging because it requires a significant shift from the traditional teacher-centered instruction, where the educator functions as an "authority" transmitting knowledge, to a student-centered approach, where the education practitioner acts as a facilitator and enabler of students learning and social interaction [8,37]. In professional learning, it is essential to set up conditions responsive to how teachers learn and elaborate on their own experiences.

Given the crucial role of teachers, the importance of their beliefs and attitudes to the everyday use of ER in STEM teaching practice has been investigated by numerous scholars. Previous studies have shown that, even though educators are keen on ER [34] and appreciate its apparent added value, they tend to have a negative opinion towards using robots in schools. They are unwilling to use robots in diverse learning settings, and these attitudes are independent of age or gender [38]. The percentage of in-service teachers who have strong opinions against incorporating new forms of technology in the preschool classroom has been reported to be up to 25%, raising significant worries about how they would introduce ER to young children if it became necessary [16,39].

The above results can be interpreted by considering certain systemic obstacles that hinder a teacher from integrating educational technology into the classroom. These barriers are so substantial that, even though teachers appear to be enthusiastic about and capable of supporting ER and STEM activities, they lead to a "STEM-phobic" educational system [1,40].

Due to the lack of knowledge, resources, and official assistance, many teachers feel uncertainty, anxiety, or even fear regarding digital media use in daily teaching practice [6,41]. Indeed, educators face various difficulties in their efforts to include ER in their daily teaching practice, which results in the weak presence of ER in the classroom. Kenny [42,43] reports on the effectiveness of a professional partnership approach to preparing pre-service primary teachers to teach science. Teachers outside of technology-oriented fields rarely receive proper training. This may cause misconceptions about the utility, ease of use, and applicability of robotics models and a perceived lack of ability to organize these types of activities, especially when gender stereotypes regarding STEM concepts are apparent. These barriers, combined with a lack of knowledge about ER benefits in the educational context, underfunding, the relatively high cost of ER systems, and the lack of specific institutional injunctions, lead to limited learning materials in the classroom and a reduction of the time available in a classroom setting to engage in robotics activities, both actively and mindfully [8,10,34,40,44]. The lack of self-confidence in teaching with ER, especially if the education practitioner has low general digital teaching self-efficacy, leads to avoidance of technology usage in the classroom [33]; further prevention of technology use leads to lower self-confidence, which leads to lesser use, and so on, affecting one another in a circular causal way.

Creating new meaningful professional development programs in STEM is the best way to break this circle of reciprocal causality. Research has found that, after participating in training programs targeting ER, teachers acquired knowledge in a short period, and quite quickly they were able to recognize the educational value of ER. These interventions resulted in positive attitudes, as the participants felt better qualified and more self-confident; they showed greater interest in implementing ER in their classroom settings as well as a strong intrinsic motivation to be further trained in ER [6,10,37]. As a result, training leads to increased self-efficacy for in-service and pre-service teachers and a higher possibility of adopting technology into their daily teaching and learning practices [33,45]. Research has also shown that educators are admittedly aware of their weaknesses, and the majority of them declare that professional training in new educational technology is necessary [46].

Many researchers are interested in observable teacher practices; several research projects have informed professional development materials used in schools and for courses. For example, Duran, Ballone-Duran, Haney, and Beltyukova [47] reported an inquiry-based teacher education project for early childhood education: Active Science Teaching Encourages Reform (ASTER). Zhang et al. [48] developed a Problem-Based Learning (PBL) collaborative action research model focusing on science talks in kindergarten classrooms. Building on the research of Zhang et al. [48], who investigated how to use science talks to promote student learning, in-service kindergarten teachers emphasized three areas through which modeling occurs: a collaborative learning community, the guidance of facilitators, and video analysis. Kenny [43] formed triadic partnerships, consisting of a final year pre-service primary teacher and an in-service colleague, to teach science in the colleague teacher's classroom with a teacher educator's support. This article documents that pedagogical knowledge is enhanced with sustained guided and mentored practice in teaching settings. In addition, the work of Goebel, Umoja, and DeHaan [49] serves as a confirmation of the emerging view that, next to field experiences, partnerships between members of the scientific and elementary school communities promote reform, as science partners bring explicit scientific knowledge, enthusiasm, and a sense of the importance of the subject. Schollaert [50] argues that constructivist approaches to teaching and learning dramatically alter how teachers install subject knowledge in their learners; however, their role is also to turn them into better learners and learners for life. Apart from subject experts, teachers also need to be experts in learning. They can only achieve the latter if they are expert learners themselves. Not only should they convey content knowledge and explain to their students how to learn, but they should also be able to demonstrate how learning works in rather generic terms. In other words, teachers should be role models concerning both subject-specific and pedagogical knowledge; likewise, they attempt to teach what they preach.

It seems that the value of ER has been established to a greater extent among pre-service early childhood teachers, with the majority of the reports suggesting STEM courses should be included in undergraduate education programs. Researchers believe that preschool children have an innate curiosity to engage with STEM concepts, and there are creative ways to teach children to read, write, and develop mathematics, coding, and programming skills [51–53]. Innovative approaches for practical undergraduate training should be applied to strengthen teachers' beliefs towards STEM and maximize their aspiration to incorporate STEM concepts and educational technologies into classrooms [5,28]. Given that ER activities encourage creativity and collaboration among classmates, students' long-term interest in STEM could be enhanced by focusing on pre-service teachers' knowledge and attitudes towards the implementation of ER activities in order to effectively prepare their teaching capabilities to function in a technology-enhanced learning environment [5,46].

4. Scope and Research Questions

The above literature review and the findings indicate that educational robotics' value has already been acknowledged among preschool educators. In addition, the willingness to foster such STEM education is not guaranteed, with a hesitance or resistance still existing towards ER. There has been considerable research conducted to understand this worldwide issue of renovating the educational process, and the scope of the present work contributes to this international endeavor. Pre-service and in-service early childhood teachers have shown similar comportments on ER, and the research interest is focused on this. It is crucial to understand the attitudes and reasoning that guide teachers' positions toward ER use. It seems that there is a transitional period of adoption, where positive acknowledgments coexist with counteracting negative attitudes that make teachers reluctant or negatively dispositioned toward the introduction of ER in early childhood education. Given the multiplicity of factors involved, it is appropriate to also consider methodological issues. The present research's novel contribution is also the implementation of a psychometric method, Latent Class Analysis (LCA), from which attitudinal profiles of the participants can be extracted. Thus, based on LCA, the following research questions are posited:

1. Can distinct clusters (profiles) be extracted based on participants' responses to the items capturing teachers' beliefs relevant to ER?
2. Do these clusters correspond to attitudinal profiles of teachers, which are interpretable within the theoretical framework fostered?
3. Are the ensuing latent profiles coherent or homogeneous in terms of responses? Or are the responses consistent across items?
4. Are the ensuing profiles associated with several individual differences, such as gender, age, knowledge of STEM and ER, degree, and other demographic variables?

The above person-centered approach is an effective psychometric method when the latent variable in question is categorical [54–56]. The participant can be classified into distinct categories, bearing similar perceptions, attitudes, or mental structures. Thus, the choice of the measurement model is reasonable for this type of research, and theoretically meaningful findings are anticipated.

4.1. Research Design

The data were collected via a quantitative approach; the participants were asked to answer the survey instrument, which included closed-ended and open-ended questions, with the questions aiming to investigate their general views in ER use to gain insight into their profound perceptions.

4.2. Participants

In the present study, 201 preschool teachers participated. Ninety-nine (N = 99) were pre-service student teachers attending classes at the Department of Preschool Education at the University of Crete, Greece. This sample corresponded to 5% of the total population studying preschool education in Greece and included only senior pre-service students participating in practicum traineeship. The remaining part of the sample consisted of 102 in-service preschool teachers contacted during an educational technology seminar. All of them were women, with teaching experience ranging between 10 and 25 years in kindergarten; they answered the questionnaire before the session. They had not systematically received STEM training previously, and most of them were having their first experience with such professional development programs. Participants took part in the research of their own will, as it was emphasized that their involvement was optional, anonymous, and would not affect them in any way, and that they could quit at any given time.

4.3. Instrument

The questionnaire used in this study consisted of two parts. Part A included questions about demographics and participants' socio-professional background, training experience in educational robotics, and initial educational technology experiences. Part B comprised 15 questions that examined beliefs and perceptions about introducing educational robotics in the preschool classroom. A five-level ordinal rating scale, ranging from 1 "strongly disagree" to 5 "strongly agree" was used. The Cronbach's alpha coefficient of the internal reliability of the instrument was 0.89. The instrument was a simple, logically driven construction covering the present inquiry's needs and included items that provide empirical indexes that validly reflect what was meant to be measured: the teachers' perceptions under study. Furthermore, Latent class Analysis (LCA) was implemented. This is a person-centered approach different from the variable-centered approaches, i.e., factor models. The LCA's adequacy fitting secures the measurement model's validity to the empirical data [57].

4.4. Ethical Considerations

The study was approved by the University of Crete Ethics Committee and followed the university guidelines on ethical practice when researching adults. Anonymity and confidentiality, gaining consent and ongoing assent, and the right to withdraw were the ethical principles adhered to. Rigorous procedures were followed to ensure confidentiality, anonymity, and the voluntary nature of the study.

5. Data Analysis

In the data analysis, a person-centered approach was fostered, based on the hypothesis that individuals who share similar attitudes and beliefs concerning the issue under investigation could be classified into distinct groups. A Latent Class Analysis (LCA) was implemented to achieve this categorization. LCA is a psychometric method alternative to the variable–centered approaches (i.e., the factor model.); it is able to validly identify groups of participants who provide a similar response pattern [58]. LCA's difference from ordinary cluster analysis methods is that the classification is based on a set of conditional probabilities (CPs), which characterize any latent class (cluster). CP is the probability of observing a response pattern, given that the case belongs to a particular latent class. The latent class predictions are calculated via the Bayes's theorem and the posterior probability of belonging to a latent class c given a manifested pattern of responses y, P($X = c/Y = y$):

$$p_{(X=c/Y=y)} = \frac{p_{(Y=y/X=c)} \times p_{(X=c)}}{p_{(Y=y)}} \tag{1}$$

where $P(X = c)$ is the probability of belonging to class c and $P(Y = y/X = c)$ is the conditional probability of having response pattern y, given that X belongs to specific class c. The posterior probabilities, which express the class memberships, follow a distribution over the c classes among the classified cases possessing a specific response pattern y. The goal is to assign the cases into different classes, where options such as the modal and the proportional assignments are provided [59]. The LCA procedure delivers all-LC solutions requested, and the researcher chooses the best parsimonious model to fit to the empirical data. The model fit is assessed by several indices: Bayesian Information Criterion (BIC), entropy-R^2,

p-value orientations, and the number of parameters [59]. Moreover, LCA's advantage is the option to associate the ensuing clusters that comprise a latent categorical variable with external variables or covariates at any level of measurement. LCA is a valuable tool for a person-centered approach and has been effectively used in educational research to solve theoretical and methodological issues in science education [55,60,61] and educational robotics [62].

In the present study, to facilitate LCA, which assumes that both the observables and the latent variables are categorical, the 5-point Likert scale was reduced to three levels: (i) Values 1 and 2 were characterized as negative attitudes towards ER (i.e., against the use of ER), (ii) Value 3 was perceived as neutral or ambiguous (i.e., skeptical about the use of ER), and (iii) Values 4 and 5 described positive attitudes (i.e., for the use of ER). Appendix A presents the eleven items that were ultimately kept in the model measuring participants' beliefs about ER implementation in preschool classrooms. These were used as input to LCA analysis, which was performed via the Latent GOLD software.

6. Results

6.1. Profiles of Participants According to Their Attitudes on ER

LCA was applied to the total sample with input from the eleven items. The analysis resulted in the two latent-class solutions as the best and most parsimonious model (Table 1).

Table 1. Results of Latent Class Analysis (LCA).

	LL	BIC(LL.)	Npar	L^2	df	p-Value	Class.Err.
1-Cluster	−1955.76	4027.96	22	2213.66	177		0
2-Cluster *	−1729.69	3702.86	46	1761.52	153	0.08	0.0277
3-Cluster	−1679.73	3730.00	70	1661.62	129	0.06	0.0529
4-Cluster	−1632.88	3763.34	94	1567.92	105	0.01	0.0579
5-Cluster	−1596.40	3817.40	118	1494.94	81	0.01	0.0653

* The two-LC solution is chosen as the best parsimonious model.

Figure 1 depicts the conditional probabilities of the two clusters/profiles based on the eleven items. Cluster 1 (65.57% of the sample) includes participants with high conditional probabilities in items that reflect positive attitudes and low conditional probabilities in items that reflect negative attitudes. This group is named "For the use of ER". Cluster 2 (34.43% of the sample) includes participants with low conditional probabilities in the items reflecting positive attitudes, and high conditional probabilities in items that reflect negative or skeptical attitudes. This group is named "Against the use of ER".

Since LCA is model-based, the results can be generalized to the population; the two clusters represent two different trends in participants' attitudes about ER use. The "For the use of ER" and the "Against the use of ER" groups are not entirely consistent in their responses; in both, an influence of skepticism exists. Cluster 2 is expected to exhibit the highest inconsistency. Cumulative conditional probabilities are plotted for all items and each cluster separately to demonstrate the above hypothesis. Figures 2 and 3 depict Cluster 1 and Cluster 2, respectively, while the underlying latent variable's coherence can be visualized by the colored bars. In Figure 2, Cluster 1 includes the participants who are "For the use of Educational Robotics"; it is relatively homogenous, with the lowest occurence of negative attitudes or skepticism. In Figure 3, Cluster 2 includes participants "Against the use of Educational Robotics". However, it is rather inhomogeneous, comprised of fragmented attitudes toward the use of educational robotics. These people express doubt and are uncertain about ER's use, an attitude that needs further interpretation.

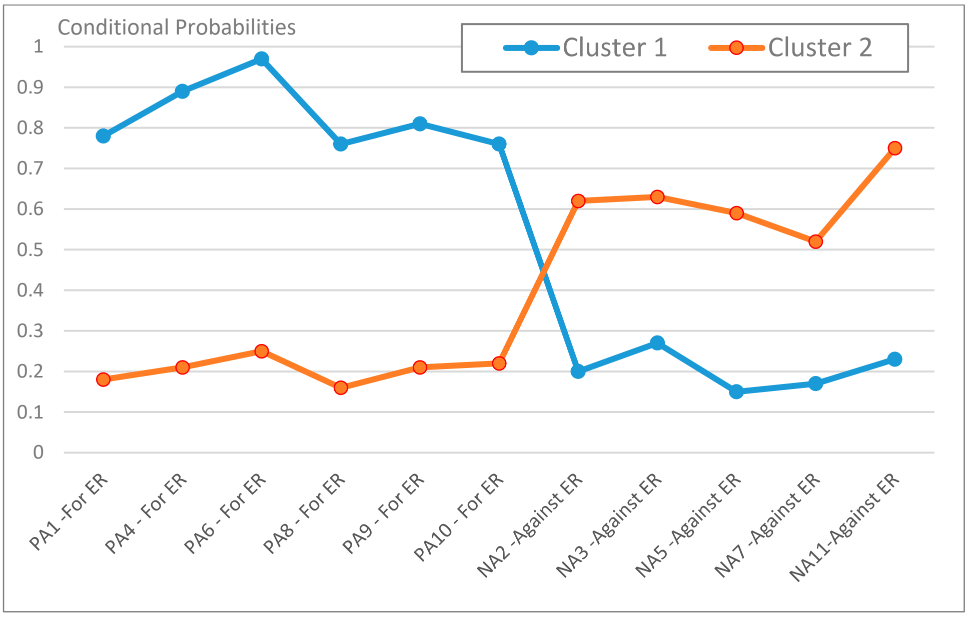

Figure 1. Conditional probabilities for the two Clusters in the eleven items.

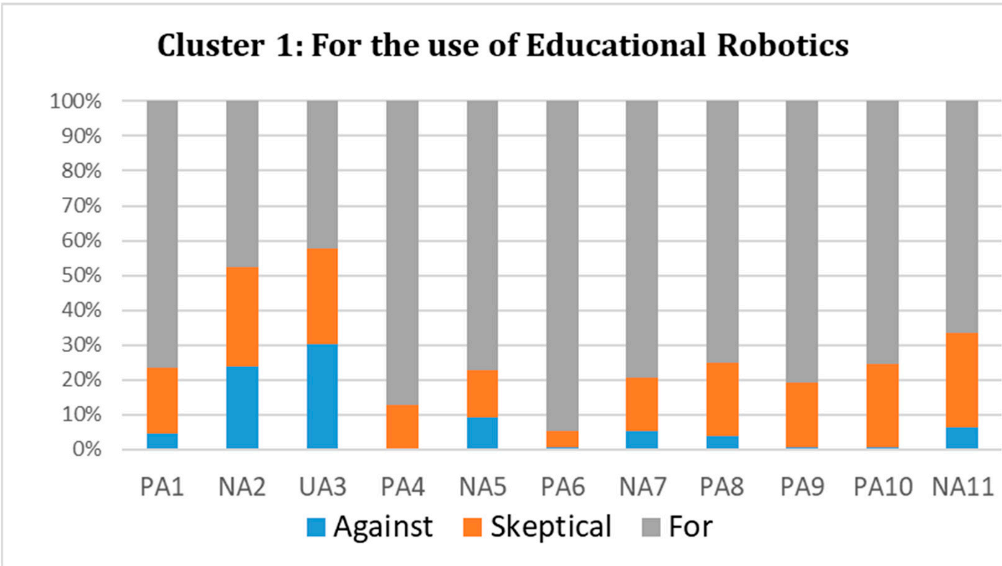

Figure 2. Cluster 1—"For the use of Educational Robotics": cumulative conditional probabilities for the eleven items.

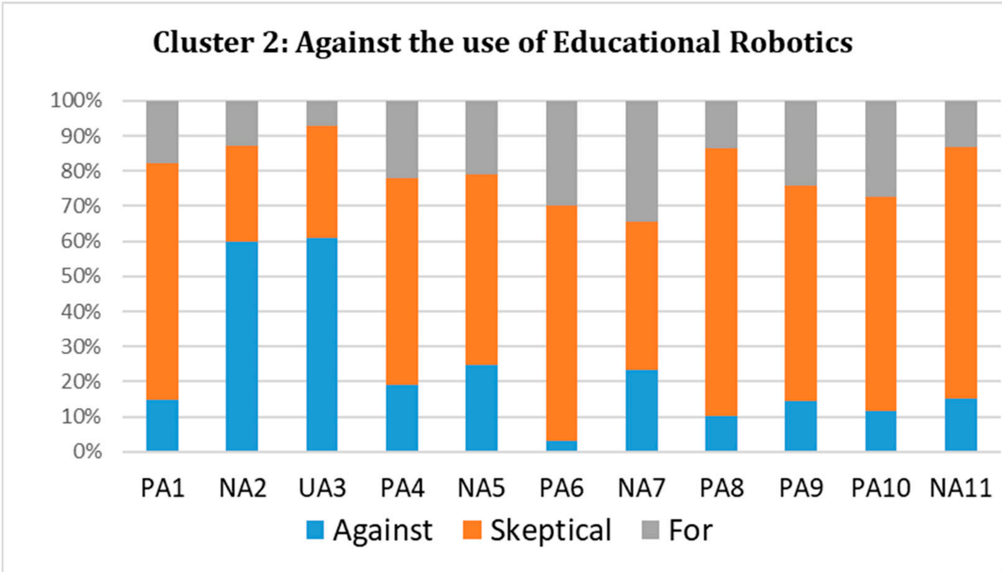

Figure 3. Cluster 2—"Against the use of Educational Robotics": cumulative conditional probabilities for the eleven items.

Subsequently, the effects of some independent variables on the resultant profiles were examined when used as dependent variables. Table 2 summarizes these effects, where only the status of employment and the Knowledge of Educational Robotics are observed as potential predictors of the participants' cluster memberships. Cluster 1 ("For the use of Educational Robotics" profile) is associated with Knowledge of Educational Robotics ($b = 0.469$, $p < 0.001$); thus, most probably, those who possess a higher knowledge of ER are positive in using robotics in the educational process.

Table 2. The effect of covariates on the resultant cluster memberships.

Covariates	Cluster 1 For ER	Cluster 2 Against ER
Status		
In-Service teachers	0.166	−0.166
Pre-service teachers	−0.166	0.166
Knowledge of Sciences	0.164	−0.164
Knowledge of Programming	−0.103	0.103
Knowledge of Robotics	−0.356	0.356
Knowledge of Educational Robotics	0.469 *	−0.469 *

* $p < 0.001$.

6.2. Effects of Covariates on In-Service Teacher Profiles

Next, an LCA was applied to the in-service teachers separately; this part of the sample is more heterogeneous in terms of demographic characteristics and individual differences, and thus it is of special interest. Table 3 depicts these effects. Age and teaching experience have negative effects on the membership in Cluster1 ($b = -0.475$, $p < 0.001$ and $b = -0.388$, $p < 0.05$ (one-tail), respectively) and positive effects on Cluster 2. Most probably, older teachers and those with more years of teaching experience are negative or skeptical about ER's use. However, those with higher knowledge of ER are positive in using it in the educational process ($b = 0.691$, $p < 0.001$). No differences were detected between teachers serving in urban and non-urban areas and between teachers with undergraduate and post-graduate degrees.

Table 3. The effect of covariates on the resultant profiles for in-service teachers.

Covariates	Cluster 1 For ER.	Cluster 2 Against ER.
Experience		
0–5 years	0.249	−0.249
6–15 years	0.138	−0.138
>16 years	−0.388 **	0.388 **
Age	−0.475 ***	0.475
School District		
Urban	0.043	−0.043
Cities	−0.042	0.042
Degree		
B.Sc.	−0.056	0.056
M.Sc.	0.056	−0.056
Knowledge of Educational Robotics	0.691 ***	−0.691 ***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

7. Discussion and Conclusions

During the past decade, the interest in ER has created a significant body of literature supporting implementing this type of activity in the preschool classroom. It has been acknowledged that ER creates an educational context that is both enjoyable and engaging and that promotes STEM education and enhances the learning process [52,63]. As crucial factors in this process, educators are the target group of the present study, which focuses on the in-service and pre-service early childhood teachers' attitudes towards ER. An LCA measurement model was applied to identify statistically different individuals according to their pattern of responses. The two clusters detected correspond to two different mindsets as far as the use of ER is concerned. Cluster 1 was relatively homogeneous and included those who share a positive attitude toward ER, while Cluster 2 appeared heterogeneous, comprising participants with inconsistent responses, including negative, positive, and skeptical thinking. In addition, external variables such as age, years of teaching experience, and technological competence were associated with the cluster memberships. These covariates could be considered primary determinants or influential factors of attitudes towards ER technology adoption in education. Pre-service and in-service teachers appear to possess similar thinking on the issue in question. On the other hand, age and teaching experience negatively affect ER attitudes, while ER knowledge has a positive effect.

Robotics has been found to add value in educational processes when incorporated into early learning classrooms in a holistic manner; ER can promote a collaborative, student-centered environment. However, proper integration of ER in curriculums requires a conscious and concerted effort to design activities suitable for each grade, based on the latest knowledge on child development and learning [40].

Following the publication of a significant body of related studies, it is widely acknowledged that merely introducing ER material and tools is insufficient to obtain students' full potential in terms of educational and cognitive benefits. The essential factors that may lead to the successful integration of ER in the classroom are the educational philosophy, the curriculum itself, and the learning environment. Simultaneously, a crucial parameter is a shift in focus from technology itself to the curriculum [9,37,40]. The missing link is the quality of training provided to teachers to attain a high proficiency level in integrating new media successfully in the classroom. This is what the findings of the present endeavor suggest; these findings can complement the data used for decision-making on teacher education curricula.

It is imperative to mention that, before designing and introducing an ER, STEM, CT integrated curriculum that effectively accommodates preschoolers' needs, it is essential to understand the complex challenges teachers face in their daily teaching practice. These challenges include inadequate training, strict curricula, flawed methodologies, limited educational content, and lack of infrastructure [64]. As new technologies emerge, teachers need the appropriate training to learn about new forms of educational technology. In this way, they can effectively integrate technology into instruction to ensure that student learning is more engaged in promoting problem solving, critical thinking, and collaboration, broadening educational opportunities for students, independent of their age [17]. Making that shift is a considerable challenge for many education practitioners, as was found in previous works, because each tool requires a deeper understanding of its pedagogical potential and classroom deployment options as well as the necessary facilities; this suggests that there is a significant gap between teachers' ability to use technology and actual technology use [65]. Teachers in early childhood environments need further training, mentoring, and professional development to effectively adopt new assets and design and implement inquiry activities using educational robotics for learning science [66]. Given that educators' self-efficacy, pedagogical beliefs, and need for professional development are known factors that influence their motivation, behavior, and teaching strategies, these factors should be elaborated and developed in training programs [40,53].

Interestingly, no differences in ER implementation attitudes were found between in-service and pre-service teachers in the present study. This finding shows that both groups share common mindsets. This study also proposes that professional development programs should provide the trainees with analogous skills and knowledge of the potentially useful age-appropriate applications of ER, irrespective of the target group. The familiarization of teachers with the technology is a mediating factor that will enhance positive attitudes, which in turn will reinforce motivation for engagement with innovative teaching methods on a developmentally appropriate level [67]. Furthermore, it will encourage trainees to explore, investigate, and discuss the types of ER activities involved in different classroom learning settings [25,33].

In the present research, the results of the LC model-based cluster analysis, which can be generalized to the population, indicate that, in this transitional period of fundamental educational transformations, there is a significant division of the early childhood teachers with mixed or incoherent attitudes toward ER use. It is interesting, however, that there is no consistent trend against educational robotics. Cluster 2, the segment with an inhomogeneous attitudinal profile, reflects those stances with internal controversies, which were found to associate with certain individual differences, such as age and lack of education on ER. The implications are direct for university curricula for teachers' pre-service or in-service training, including the appropriate ER and STEM practicum courses, in conjunction with peer group learning settings and mentor support to develop the appropriate pedagogical content knowledge.

8. Limitations and Directions of Future Research

This study has some limitations, stemming from its exploratory character, suggesting directions for future research. LCA was implemented for the first time in this type of data; thus, replicating the findings is needed with additional and larger data sets to establish empirical evidence that can support theory development. Towards this direction, the questionnaire constructed for the initially conceived needs of the research could be extended to wide-ranging instruments capturing additional aspects of attitudes or the related psychological constructs affecting preschool teachers' involvement in ER use. Interviews with participants might attain produce the necessary in-depth information on pre-service teacher perceptions about the issue under investigation. Furthermore, it should be stated that, in this context, the present inquiry cannot establish causal relationships between external variables and the ensuing cluster memberships, even though they were hypothesized as such. It is pertinent to say that LCA has no restriction regarding the variables' distribution characteristics; nevertheless, the limitation due to the assumption of linearity remains. Another theoretical issue that is not addressed in the present research but instead emerges a posteriori is a reasonable explanation of the existing inconsistent attitudinal profiles, that is, whether questions were answered based on mere ignorance or on pre-existing misapprehensions or dysfunctional beliefs [68] about Educational Robotics and their potential role in preschool education. In conjunction with the person-centered approach, similar questions open a new area for future investigations focusing on robotics and human perceptions and actions [69].

Author Contributions: Formal analysis, D.S.; Methodology, J.V.; Project administration, S.P. and M.K.; Writing—review & editing, E.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Kalogiannakis, M.; Papadakis, S. Combining Mobile Technologies in Environmental Education: A Greek Case Study. *Int. J. Mob. Learn. Organ.* **2017**, *11*, 108–130. [CrossRef]
2. Karakoyun, F.; Lindberg, O.J. Preservice Teachers' Views about the Twenty-First Century Skills: A Qualitative Survey Study in Turkey and Sweden. *Educ. Inf. Technol.* **2020**, *25*, 2353–2369. [CrossRef]
3. Mertala, P. Digital Technologies in Early Childhood Education—A Frame Analysis of Preservice Teachers' Perceptions. *Early Child. Dev. Care* **2019**, *189*, 1228–1241. [CrossRef]
4. Papadakis, S.; Vaiopoulou, J.; Kalogiannakis, M.; Stamovlasis, D. Developing and Exploring an Evaluation Tool for Educational Apps (ETEA.) Targeting Kindergarten Children. *Sustainability* **2020**, *12*, 4201. [CrossRef]
5. Kaya, E.; Newley, A.; Deniz, H.; Yesilyurt, E.; Newley, P. Introducing Engineering Design to a Science Teaching Methods Course Through Educational Robotics and Exploring Changes in Views of Preservice Elementary Teachers. *J. Coll. Sci. Teach.* **2017**, *47*, 66–75. [CrossRef]
6. MacDonald, A.; Huser, C.; Sikder, S.; Danaia, L. Effective Early Childhood STEM Education: Findings from the Little Scientists Evaluation. *Early Child. Educ. J.* **2020**, *48*, 353–363. [CrossRef]
7. Bustamante, A.S.; Schlesinger, M.; Begolli, K.N.; Golinkoff, R.M.; Shahidi, N.; Zonji, S.; Riesen, C.; Evans, N.; Hirsh-Pasek, K. More Than Just a Game: Transforming Social Interaction and STEM Play With Parkopolis. *Dev. Psychol.* **2020**, *56*, 1041–1056. [CrossRef] [PubMed]
8. Yıldırım, B. Preschool STEM Activities: Preschool Teachers' Preparation and Views. *Early Child. Educ.* **2021**, *49*, 149–162. [CrossRef]
9. Alimisis, D. Educational Robotics: Open Questions and New Challenges. *Themes Sci. Technol. Educ.* **2013**, *6*, 63–71.
10. Mondada, F.; Chevalier, M.; Riedo, F. Pedagogical Uses of Thymio II: How Do Teachers Perceive Educational Robots in Formal Education? How Do Teachers Perceive Educational Robots in Formal Education? A Study Based on the Thymio Robot*. *IEEE Robot. Autom. Mag.* **2016**, *23*, 16–23.
11. Dorouka, P.; Papadakis, S.; Kalogiannakis, M. Tablets and Apps for Promoting Robotics, Mathematics, STEM Education and Literacy in Early Childhood Education. *Int. J. Mob. Learn. Organ.* **2020**, *14*, 255–274. [CrossRef]
12. Rose, S. *Developing Children's Computational Thinking Using Programming Games*; Sheffield Hallam University: Sheffield, UK, 2019.
13. Chan, K.K. Using Tangible Objects in Early Childhood Classrooms: A Study of Macau Pre-Service Teachers. *Early Child. Educ. J.* **2020**, *48*, 441–450. [CrossRef]
14. Sullivan, A.A.; Bers, M.U.; Mihm, C. Imagining, Playing, and Coding with KIBO: Using Robotics to Foster Computational Thinking in Young Children. In Proceedings of the International Conference on Computational Thinking Education 2017, Hongkong, China, 13–15 July 2017; Kong, S.C., Sheldon, J., Kwok, R., Li, K.Y., Eds.; The Education University of Hong Kong: Hong Kong, China, 2017; pp. 110–115.
15. Kalogiannakis, M.; Ampartzaki, M.; Papadakis, S.; Skaraki, E. Teaching Natural Science Concepts to Young Children with Mobile Devices and Hands-on Activities. A Case Study. *Int. J. Teach. Case Stud.* **2018**, *9*, 171–183. [CrossRef]
16. Vidal-Hall, C.; Flewitt, R.; Wyse, D. European Early Childhood Education Research Journal Early Childhood Practitioner Beliefs about Digital Media: Integrating Technology into a Child-Centred Classroom Environment. *Eur. Early Child. Educ. Res. J.* **2020**, *28*, 167–181. [CrossRef]
17. Casey, J.E.; Pennington, L.K.; Mireles, S.V. Technology Acceptance Model: Assessing Preservice Teachers' Acceptance of Floor-Robots as a Useful Pedagogical Tool. *Technol. Knowl. Learn.* **2020**, 1–16. [CrossRef]
18. Bers, M.U. *Blocks to Robots Learning with Technology in the Early Childhood Classroom*; Teachers College Press: New York, NY, USA, 2008.
19. Çetin, M.; Demircan, H.Ö. Empowering Technology and Engineering for STEM Education through Programming Robots: A Systematic Literature Review. *Early Child Dev. Care* **2020**, *190*, 1323–1335. [CrossRef]

20. Dunphy, L. A Picture Book Pedagogy for Early Childhood Mathematics Education. In *STEM Education across the Learning Continuum: Early Childhood to Senior Secondary*; Springer: Singapore, 2020; pp. 67–85.
21. Digital Education Action Plan. In *2021–2027: Resetting Education and Training for the Digital Age*; European Commission: Brussels, Belgium, 2020.
22. Hamed, S.; Ezquerra, Á.; Porlán, R.; Rivero, A. Exploring Pre-Service Primary Teachers' Progression towards Inquiry-Based Science Learning. *Educ. Res.* **2020**, *62*, 357–374. [CrossRef]
23. Papadakis, S.; Zaranis, N.; Kalogiannakis, M. Parental Involvement and Attitudes towards Young Greek Children's Mobile Usage. *Int. J. Child. Comput. Interact.* **2019**, *22*, 100144. [CrossRef]
24. Heikkilä, M. What Happens When the Robot Gets Eyelashes? Gender Perspective on Programming in Preschool. In *STEM Education Across the Learning Continuum: Early Childhood to Senior Secondary*; Springer: Singapore, 2020; pp. 29–44.
25. Román-Graván, P.; Hervás-Gómez, C.; Martín-Padilla, A.H.; Fernández-Márquez, E. Perceptions about the Use of Educational Robotics in the Initial Training of Future Teachers: A Study on STEAM Sustainability among Female Teachers. *Sustainability* **2020**, *12*, 4154. [CrossRef]
26. Morgan, P.L.; Farkas, G.; Hillemeier, M.M.; Maczuga, S. Science Achievement Gaps Begin Very Early, Persist, and Are Largely Explained by Modifiable Factors. *Educ. Res.* **2016**, *45*, 18–35. [CrossRef]
27. Sullivan, A.; Sullivan, A.; Bers, M. Computer Science Education in Early Childhood: The Case of ScratchJr. *J. Inf. Technol. Educ. Innov. Pract.* **2019**, *18*, 113–138. [CrossRef]
28. Çiftçi, A.; Topçu, M.S.; Foulk, J.A. Pre-Service Early Childhood Teachers' Views on STEM Education and Their STEM Teaching Practices. *Res. Sci. Technol. Educ.* **2020**, 1–27. [CrossRef]
29. Papadakis, S.; Kalogiannakis, M.; Zaranis, N. The Effectiveness of Computer and Tablet Assisted Intervention in Early Childhood Students' Understanding of Numbers. An Empirical Study Conducted in Greece. *Educ. Inf. Technol.* **2018**, *23*, 1849–1871. [CrossRef]
30. Heikkilä, M.; Mannila, L. Debugging in Programming as a Multimodal Practice in Early Childhood Education Settings. *Multimodal Technol. Interact.* **2018**, *2*, 42. [CrossRef]
31. Di Battista, S.; Pivetti, M.; Moro, M.; Menegatti, E. Teachers' Opinions towards Educational Robotics for Special Needs Students: An Exploratory Italian Study. *Robotics* **2020**, *9*, 72. [CrossRef]
32. Di Lieto, M.C.; Inguaggiato, E.; Castro, E.; Cecchi, F.; Cioni, G.; Dell'Omo, M.; Laschi, C.; Pecini, C.; Santerini, G.; Sgandurra, G.; et al. Educational Robotics Intervention on Executive Functions in Preschool Children: A Pilot Study. *Comput. Hum. Behav.* **2017**, *71*, 16–23. [CrossRef]
33. Sangkawetai, C.; Neanchaleay, J.; Koul, R.; Murphy, E. Predictors of K-12 Teachers' Instructional Strategies with ICTs. *Technol. Knowl. Learn.* **2020**, *25*, 149–177. [CrossRef]
34. Negrini, L. Teachers' Attitudes towards Educational Robotics in Compulsory School Gli Atteggiamenti Degli Insegnanti Della Scuola Dell'obbligo Nei Confronti Della Robotica Educativa. *Ital. J. Educ. Technol.* **2020**, *28*, 77–90.
35. Seow, P.; Looi, C.K.; Wadhwa, B.; Wu, L.; Liu, L. Computational Thinking and Coding Initiatives in Singapore. In Proceedings of the International Conference on Computational Thinking Education 2017, Hongkong, China, 13–15 July 2017; Kong, S.C., Sheldon, J., Kwok, R., Li, K.Y., Eds.; The Education University of Hong Kong: Hong Kong, China, 2017; pp. 164–167.
36. Toh, L.P.E.; Causo, A.; Tzuo, P.W.; Chen, I.M.; Yeo, S.H. A Review on the Use of Robots in Education and Young Children. *J. Educ. Technol. Soc.* **2016**, *19*, 148–163.
37. Castro, E.; Cecchi, F.; Salvini, P.; Valente, M.; Buselli, E.; Menichetti, L.; Calvani, A.; Dario, P. Design and Impact of a Teacher Training Course, and Attitude Change Concerning Educational Robotics. *Int. J. Soc. Robot.* **2018**, *10*, 669–685. [CrossRef]
38. Reich-Stiebert, N.; Eyssel, F. Robots in the Classroom: What Teachers Think About Teaching and Learning with Education Robots. In *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*; Springer: Berlin/Heidelberg, Germany, 2016; Volume 9979 LNAI, pp. 671–680. [CrossRef]
39. Cormas, P.C. Preservice Teachers' Beliefs in a Mathematics/Science Course. *Res. Sci. Technol. Educ.* **2020**, 1–17. [CrossRef]
40. Mcclure, E.R.; Guernsey, L.; Clements, D.H.; Bales, S.N.; Nichols, J.; Michael, N.K.-T.; Levine, H. *STEM Starts Early: Grounding Science, Technology, Engineering, and Math. Education in Early Childhood*; Joan Ganz Cooney Center at Sesame Workshop: New York, NY, USA, 2017. Available online: http://www.joanganzcooneycenter.org (accessed on 23 March 2021).
41. Papadakis, S.; Orfanakis, V. The Combined Use of Lego Mindstorms NXT and App. Inventor for Teaching Novice Programmers. *Adv. Intell. Syst. Comput.* **2017**, *560*, 193–204.
42. Kenny, J. Preparing Pre-Service Primary Teachers to Teach Primary Science: A Partnership-based Approach. *Int. J. Sci. Educ.* **2010**, *32*, 1267–1288. [CrossRef]
43. Kenny, J. A Partnership Based Approach to Professional Learning: Pre-Service and In-Service Teachers Working Together to Teach Primary Science. *Aust. J. Teach. Educ.* **2009**, *34*, 1–22. [CrossRef]
44. Tang, A.L.L.; Tung, V.W.S.; Cheng, T.O. Teachers' Perceptions of the Potential Use of Educational Robotics in Management Education. *Interact. Learn. Environ.* **2020**, 1–12. [CrossRef]
45. Li, K.; Li, Y.; Franklin, T. Preservice Teachers' Intention to Adopt Technology in Their Future Classrooms. *J. Educ. Comput. Res.* **2016**, *54*, 946–966. [CrossRef]
46. Williams, M.E. An Examination of Technology Training Experiences from Teacher Candidacy to In-Service Professional Development. *J. Instr. Pedagog.* **2017**, *19*, 1–20.

47. Duran, E.; Ballone-Duran, L.; Haney, J.; Beltyukova, S. The Impact of a Professional Development Program Integrating Informal Science Education on Early Childhood Teachers' Self-Efficacy and Beliefs About Inquiry-Based Science Teaching. *J. Elem. Sci. Educ.* **2009**, *21*, 53–70. [CrossRef]
48. Zhang, M.; Passalacqua, S.; Lundeberg, M.; Koehler, M.J.; Eberhardt, J.; Parker, J.; Urban-Lurain, M.; Zhang, T.; Paik, S. "Science Talks" in Kindergarten Classrooms: Improving Classroom Practice through Collaborative Action Research. *J. Sci. Teach. Educ.* **2010**, *21*, 161–179. [CrossRef]
49. Goebel, C.A.; Umoja, A.; DeHaan, R.L. Providing Undergraduate Science Partners for Elementary Teachers: Benefits and Challenges. *CBE Life Sci. Educ.* **2009**, *8*, 239–251. [CrossRef] [PubMed]
50. Schollaert, R. Continuing Professional Development for the 21st Century: Setting the Scene for Teacher Induction in a New Era. In *Beginning Teachers: A Challenge for Educational Systems–CIDREE Yearbook*; Patrick Picard, L.R., Ed.; École normale supérieure de Lyon Institut Français de l'Éducation: Lyon, France, 2011.
51. Atmatzidou, S.; Demetriadis, S. Advancing Students' Computational Thinking Skills through Educational Robotics: A Study on Age and Gender Relevant Differences. *Rob. Auton. Syst.* **2016**, *75*, 661–670. [CrossRef]
52. Vidakis, N.; Barianos, A.K.; Trampas, A.M.; Papadakis, S.; Kalogiannakis, M.; Vassilakis, K. Generating Education In-Game Data: The Case of an Ancient Theatre Serious Game. In Proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019), Heraklion, Greece, 2–4 May 2019; pp. 36–43.
53. Chen, Y.L.; Huang, L.F.; Wu, P.C. Preservice Preschool Teachers' Self-Efficacy in and Need for STEM Education Professional Development: STEM Pedagogical Belief as a Mediator. *Early Child. Educ. J.* **2021**, *49*, 137–147. [CrossRef]
54. Nosetti, L.; Paglietti, M.G.; Brunetti, L.; Masini, L.; La Grutta, S.; Cilluffo, G.; Ferrante, G.; Zaffanello, M.; Verrillo, E.; Pavone, M.; et al. Application of Latent Class Analysis in Assessing the Awareness, Attitude, Practice and Satisfaction of Paediatricians on Sleep Disorder Management in Children in Italy. *PLoS ONE* **2020**, *15*, e0228377. [CrossRef] [PubMed]
55. Stamovlasis, D.; Papageorgiou, G.; Tsitsipis, G.; Tsikalas, T.; Vaiopoulou, J. Illustration of Step-Wise Latent Class Modeling With Covariates and Taxometric Analysis in Research Probing Children's Mental Models in Learning Sciences. *Front. Psychol.* **2018**, *9*, 532. [CrossRef] [PubMed]
56. Stamovlasis, D.; Vaiopoulou, J.; Papageorgiou, G. A Comparative Evaluation of Dissimilarity-Based and Model-Based Clustering in Science Education Research: The Case of Children's Mental Models of the Earth. *Int. J. Data Anal. Tech. Strateg.* **2020**, *12*, 247–261. [CrossRef]
57. Dziak, J.J.; Lanza, S.T.; Tan, X. Effect Size, Statistical Power, and Sample Size Requirements for the Bootstrap Likelihood Ratio Test in Latent Class Analysis. *Struct. Equ. Model. A Multidiscip. J.* **2014**, *21*, 534–552. [CrossRef]
58. Clogg, C.C. Latent Class Models. In *Handbook of Statistical Modeling for the Social and Behavioral Sciences*; Springer: Boston, MA, USA, 1995; pp. 311–359.
59. Bakk, Z.; Tekle, F.B.; Vermunt, J.K. Estimating the Association between Latent Class Membership and External Variables Using Bias-Adjusted Three-Step Approaches. *Sociol. Methodol.* **2013**, *43*, 272–311. [CrossRef]
60. Vaiopoulou, J.; Stamovlasis, D.; Papageorgiou, G. New Perspectives for Theory Development in Science Education: Rethinking Mental Models of Force in Primary School. *Prog. Educ.* **2017**, *47*, 1–16.
61. Vaiopoulou, J.; Papageorgiou, G. Primary Students' Conceptions of the Earth: Re-Examining a Fundamental Research Hypothesis on Mental Models. *Presch. Prim. Educ.* **2018**, *6*, 23–34. [CrossRef]
62. Sapounidis, T.; Stamovlasis, D.; Demetriadis, S. Latent Class Modeling of Children's Preference Profiles on Tangible and Graphical Robot Programming. *IEEE Trans. Educ.* **2019**, *62*, 127–133. [CrossRef]
63. Vlasopoulou, M.; Kalogiannakis, M.; Sifaki, E. Investigating Teachers' Attitudes and Behavioral Intentions for the Impending Integration of STEM Education in Primary Schools. In *Handbook of Research on Using Educational Robotics to Facilitate Student Learning*; IGI Global: Hershey, PA, USA, 2021; pp. 235–256.
64. Reinoso, R.; Delgado-Iglesias, J.; Fernández, I. Pre-Service Teachers' Views on Science Teaching in Early Childhood Education in Spain. *Eur. Early Child. Educ. Res. J.* **2019**, *27*, 801–820. [CrossRef]
65. Levy, R.; Kucirkova, N. New Technologies in the Primary and Early Years Classroom. In *Beginning Teaching, Beginning Learning: In Early Years and Primary Education*; Payler, J., Moyles, J., Georgeson, J., Eds.; Open University Press/McGraw Hill: London, UK, 2017.
66. Kalogiannakis, M.; Tzagkaraki, E.; Papadakis, S. A Systematic Review of the Use of BBC Micro: Bit in Primary School. In Proceedings of the 10th Virtual Edition of the International Conference New Perspectives in Science Education, Florence, Italy, 18–19 March 2021; Filodiritto-Pixel: Florence, Italy, 2021; pp. 379–384.
67. Papadakis, S.; Vaiopoulou, J.; Sifaki, E.; Stamovlasis, D.; Kalogiannakis, M.; Vassilakis, K. Factors That Hinder In-Service Teachers from Incorporating Educational Robotics into Their Daily or Future Teaching Practice. In Proceedings of the 13th International Conference on Computer Supported Education (CSEDU 2021), Prague, Czech Republic, 23–25 April 2021; Csapó, B., Uhomoibhi, J., Eds.; Online Streaming: Setúbal, Portugal, 2021; pp. 55–63.
68. Stamovlasis, D.; Vaiopoulou, J. The Role of Dysfunctional Myths in a Decision-Making Process under Bounded Rationality: A Complex Dynamical Systems Perspective. *Nonlinear Dyn. Psychol. Life Sci.* **2017**, *3*, 267–288.
69. Tzagkaraki, E.; Papadakis, S.; Kalogiannakis, M. Exploring the Use of Educational Robotics in Primary School and Its Possible Place in the Curricula. In *Advances in Intelligent Systems and Computing*; Malvezzi, M., Alimisis, D., Moro, M., Eds.; Springer Nature Switzerland AG: Cham, Switzerland, 2021.