education sciences

MDPI

Article

Study of Kindergarten Teachers' Intentions to Choose Content and Teaching Method for Teaching Science

Anastasios Zoupidis [1,*], Vasilis Tselfes [2], Penelope Papadopoulou [3] and Petros Kariotoglou [3]

1 Department of Primary Level Education, Democritus University of Thrace, 67100 Alexandroupolis, Greece
2 Department of Early Childhood Education, National and Kapodistrian University, 10679 Athens, Greece; tselfesv@ecd.uoa.gr
3 Department of Early Childhood Education, University of Western Macedonia, 50100 Florina, Greece; ppapadopoulou@uowm.gr (P.P.); pkariotog@uowm.gr (P.K.)
* Correspondence: azoupidis@eled.duth.gr

Abstract: In this paper, we investigate the intentions of kindergarten teachers to use the content and to apply the teaching methods that they acquired in a one-day teacher training seminar. According to the theory of planned behavior, the answer to this research question is directly related to a series of social-psychological personal criteria assessments, such as an assessment of the personal gains or losses, the opinions of important third persons, the teacher's own assessment of the value of the students' learning, and the perceived behavioral control assessment. A total of 114 participants completed a 5-point Likert-scale questionnaire that consisted of two sets of five questions each. The results show that the kindergarten teachers' intentions to use particular content and teaching methods are based on whether they have the skills to apply them successfully, and on their assessment of the ability of their students to acquire meaningful knowledge. The teacher's choice of teaching method is also associated with the assessment of the personal gains or losses, as well as with the opinions of important third persons. Furthermore, the study findings show that there are two distinct categories of kindergarten teachers: those whose teaching is based on the tradition of science education, and those whose teaching is based on the tradition of early childhood education. The teaching implications of the results are also discussed.

Keywords: science education; early childhood education; discovery demonstration and inquiry-based teaching methods; theory of planned behavior; kindergarten teacher training

Citation: Zoupidis, A.; Tselfes, V.; Papadopoulou, P.; Kariotoglou, P. Study of Kindergarten Teachers' Intentions to Choose Content and Teaching Method for Teaching Science. *Educ. Sci.* **2022**, *12*, 198. https://doi.org/10.3390/educsci12030198

Academic Editor: Konstantinos Ravanis

Received: 14 January 2022
Accepted: 7 March 2022
Published: 11 March 2022

1. Introduction

The recommendation that the natural sciences, which include physics and biology, be taught in kindergarten is based on a number of reasons [1] that form a set of science teaching objectives. These objectives are associated with the following:

1. The pupils' development of a positive attitude towards science, starting from their inherent curiosity to observe and wonder about the natural world;
2. The positioning of kindergarten science teaching as the precursor to a better understanding of scientific content and concepts through the pupils' exposure to the scientific approaches to phenomena, and to the use of scientific terms to describe them; and
3. The positioning of kindergarten science teaching as the basis for the cultivation of scientific thinking and its justification.

Kindergarten teachers have undergone studies with regard to, and have experience and knowledge of, a satisfactory range of knowledge in terms of the pedagogical, psychological, and social management of children [2]. However, their knowledge is rather limited in terms of the scientific content and the practices of science [3]. In Greece, the studies on early childhood education, on the corresponding curricula [4–7], and on the guide for kindergarten teachers [8], focus on the pedagogical and developmental goals for children in early childhood education, where the daily teaching program consists of relatively autonomous and short-term activities. In addition to relaxing and fun activities, the science-based exercises are generally based more on empirically established routines (e.g., playing, drawing, discussing, watching the teacher's demonstrations or listening to narratives, etc.) rather than on the content.

These activities are also focused on the goal of constructing more everyday experiential knowledge about the natural world, rather than on scientific knowledge [4,9,10]. However, the abovementioned teaching/learning objectives [1] raise issues within the teacher–pupil relationship that are related to aspects of science—and to the ways in which these aspects are taught—that may not conform to the above pedagogical tradition for a number of reasons:

1. It is expected that pupils develop positive attitudes and views towards science on the basis of those held by their teachers [11]. These attitudes and views have been acquired by teachers as lay adults, rather than as professionals who are trained in science;
2. The pupils' understanding of the content, which has inevitably been transformed didactically, is directly related to the science education issues of various subject areas (e.g., physics, chemistry, biology) that usually focus on the different structures and natures of the subject contents, and on the related teaching methods. These subject contents and teaching methods are, in practice, more likely to be transformed by the teachers' own general pedagogical views and goals, than to be used on the basis of the contemporary didactics of the various subject areas;
3. Scientific thinking and its justification are based on the structure of recognized scientific practices [12]. In this way, they tend to be inconsistent with the dominant narrative discourse in early childhood education, which often guides thought and explanation teleologically, or suffices to recognize the causes of individual events, which are simply ordered in time [13]. This is a discrepancy that kindergarten teachers (who, from their pedagogical education, have learned to work primarily with an inductive type of methodology) have been asked to manage.

The above three reasons correlate: (a) The positive attitudes that pupils should develop towards science with their kindergarten teachers' approaches to the nature of science; (b) The pupils' understanding of the content with the teaching methods that are implemented by the teachers; and (c) The scientific practices that the teachers are expected to teach with the forms of speech that they adopt when teaching their students about scientific thinking and argumentation. These correlations are to be striven for by professional kindergarten teachers, who should change, or rearrange, some of their established practices. Questions arise as to whether a simple process of teacher training is sufficient to overcome these difficulties, and as to whether this process should take into account additional important variables that should be adjusted accordingly, such as those that emerge within the dynamics of their profession [14].

In this paper, on the basis of the discussions that took place at a one-day teacher training seminar on the teaching methods for physics and biology, we attempted to investigate the intentions of kindergarten teachers to use the content of these two science subjects, as well as the particular method, discovery demonstration and/or inquiry-based, that they applied in their teaching practice. The aim was not to evaluate the effectiveness of the seminar, but rather to identify any modifications and improvements that could be made.

2. Research Framework, Questions, and Hypotheses

The study involved 114 kindergarten teachers, who voluntarily attended a one-day teacher training seminar on the issues that were being discussed and developed in the fields of physics and biology education. These issues were concerned with the understanding of both the subject contents and the relevant teaching methods, the cultivation of scientific discourses and practices, as well as with assessing whether the knowledge that is learned by pupils is considered meaningful (attitude).

The seminar consisted of two parts of approximately equal durations (6 h in total): brief theoretical lectures, which were followed by workshops on the science teaching issues that were relevant to both the subject contents and the practices [15]. The topics covered were: "Didactic Transformation of Physics' Content and Inquiry: Applications in kindergarten education"; "Difficulties in managing elementary biological concepts in kindergarten education"; and "Control of variables strategy in kindergarten education". The purpose of the short lectures that preceded the workshops was to present to and prepare the kindergarten teachers on: (a) The basic concepts of science education, such as the didactic transformation of the content, and the ideas and difficulties of children in understanding the concepts and processes of physics or biology; and (b) The corresponding scientific procedures and/or practices (inquiry, the control-of-variables strategy, etc.), which were conducted only for the physics content because of time constraints.

Specifically, in the theoretical sessions about biology, the teachers were given to understand the difficulties that exist in the comprehension of the terms used, as well as in the general misconception in the wider society with regard to biological concepts, processes, and practices (e.g., evolution, ecological relations, environmental problems). In the workshop sessions, in pairs or groups of three, the participants worked through the issues from a worksheet, which was discussed afterwards in plenaries. The worksheet was used to guide the pair/group discussion. The focus was on the types of speech used by kindergarten teachers, which, on the one hand, could give rise to or foster the pupils' misunderstanding, and, on the other, could, in itself, be laden with personal values that may unintentionally be imparted to the pupils. The teachers also performed exercises on confronting the children's difficulties and misunderstandings, with an emphasis on the presentation and discussion of the concepts and processes (the content issues).

Specifically, in the theoretical sessions about physics, the teachers were introduced to two teaching approaches: the "discovery demonstration" and "inquiry-based" teaching methods. In each case, emphasis was given to the content management in relation to the teaching processes and the relevant scientific practices. The examples that were given demonstrated the scope of each teaching approach and pointed out their differences. In the workshop sessions, the teachers were given the opportunity to investigate specific physics concepts (e.g., floating/sinking phenomena, static electricity, friction, etc.) through the application of both methods. With the "discovery demonstration" approach, the physics issues were examined by using experimental procedures that followed the "predict–observe–explain" model [16], while, at the same time, simple questions were applied (e.g., "Why do bodies float?", and "What is it that makes one body float while another sinks?"), the answers of which involve only one factor. In the "inquiry-based" approach, the physics issues were examined by using experimental procedures that were based on the use and understanding of scientific reasoning as a way of teaching the control-of-variables strategy, while open-ended questions were applied, the answers of which consisted of more than one factor [17], which created a more complex framework for solving the problem. (An example of this type of problem is, "One of your classmates claims that heavy objects sink. Can you suggest an experiment to check this assumption?") An important feature of the inquiry-based approach is that, in addition to the experiments that can lead to safe conclusions, the experiments that did not meet this condition were also discussed, either because other variables apart from the one being studied were changed, or because there was no change to the variable under study in two trials of an experiment. One of the seminar's main goals was to show that the inquiry-based learning method, through the control-of-variables strategy, is an innovative and effective method for early childhood science teaching. More specifically, the aim was for kindergarten teachers to understand certain aspects of the CVS method itself; to be aware of the difficulties in understanding and implementing the method, not only for themselves, but also for their pupils; and to recognize and accept that it is an important method to understand and apply, even for kindergarten-aged children.

The inherent question that arose in the training seminar was whether the teachers would apply the didactic issues that were discussed when they returned to their classes. It was hypothesized that the answer to this question would differ in accordance with:

- The content (C) being categorized into either that of physics or biology;
- The teaching methods (TMs), either discovery demonstration (DD) or inquiry-based (I-B), which were analyzed and made distinct for the physics content;
- The teachers' beliefs about the content (physics or biology) and the teaching method (DD or I-B) to be used in terms of the pupils' ability to acquire meaningful knowledge (SL).

According to the theory of planned behavior [18–20], the answer to this research question (i.e., the kindergarten teachers' intentions to choose the subject content and to use specific teaching methods) is directly related to a series of social-psychological personal criteria.

More specifically, the teachers' intentions (in other words, their behavioral intentions (BIs)) to engage in specific ways and with specific actions in their future teaching practices are related to:

A. The assessment of their personal gains or losses: the attitude (AT) criterion;
B. The assessment of the views of third persons who are important to them: the subjective norm (SN) criterion;
C. The assessment of their personal competencies with regard to the control of, "what do I do in teaching": the perceived behavioral control (PBC) criterion.

Finally, because teachers seem to choose what they will teach on the basis of the value that they estimate it has to their pupils' learning [21,22], we assumed that the intentions of the kindergarten teachers would also depend on the following variable:

D. Whether the pupils learn meaningful knowledge from the content that they are taught, or from the way that they are taught it (SL).

Therefore, the research questions are as follows: Do the teachers' intentions differ when they opt in favor of physics or biology content in their classrooms? Do the teachers' intentions differ when they choose between the discovery demonstration and the inquiry-based learning methods to teach physics content? To what extent do these differences depend on the teachers' assessments of their personal gains or losses (AT), on the positive or negative opinions of important third persons (SN), on the assessments of their perceived ability to control (PBC) the teaching process, and on their assessments of how much meaningful knowledge the children eventually learn (SL). These questions are schematically represented in Figure 1.

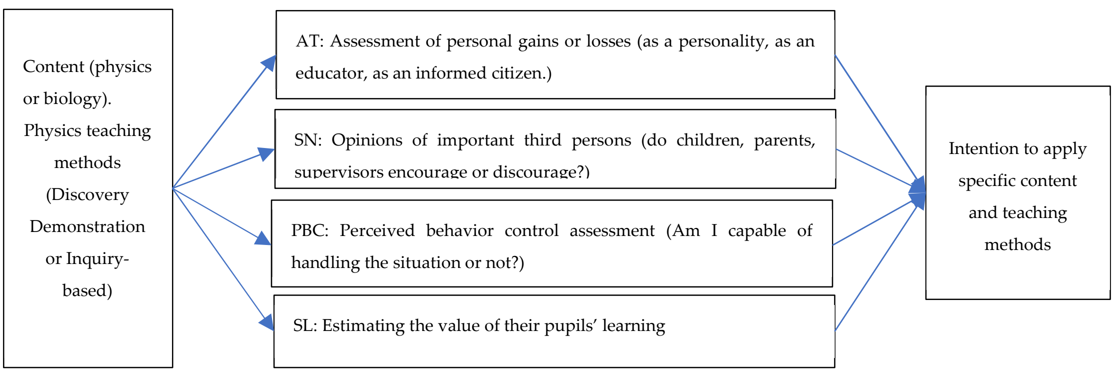

Figure 1. The factors that influence teachers' intentions to apply specific content and teaching methods.

The answer to these questions may enable us to devise and test the modifications in early childhood science education that will trigger educational discussions, starting with the subject contents (nature, teaching, learning) and the teaching methods, that will have an impact on the professional culture of kindergarten teachers.

More specifically, we assume that the intentions of kindergarten teachers to apply activities with science content is indirectly influenced, in a complex way, by the teachers' views on: (A) The content to be taught; and (B) The relevant teaching methods.

In terms of the content to be taught (A), the teachers share the public's perceptions towards the scientific content that has pervaded society and the daily lives of citizens, in addition to having been shaped by their general and professional education.

Internationally, the so-called "exact" sciences (mathematics, physics, and chemistry), while they are considered difficult to grasp, are still highly regarded as valuable by the general public [23]. On the other hand, biology, which, since the end of the 20th century has been considered a complex science, is becoming an emerging science in the wider community [24]. Biology is the science that raises the issues that are extremely important to our society (such as health, ecology, etc.). Consequently, biology acts to fuse, on the one hand, the relationship between the public understanding (see "scientific literacy") and the appreciation of science and scientists [25,26], and, on the other hand, the relationship between the public acceptance of scientific views and the functioning of democracy [27]. The educational value of both of these issues has been highlighted, beyond any doubt, by the current pandemic.

Generally, in education, the images of these sciences, which make strong associations between science and society, have remained more or less constant since the 1960s [24]. Although the sciences are considered to be cognitively difficult subjects, they are, nevertheless, deemed interesting (with biology, it seems, as the most interesting) [24]. In many societies, these science subjects are mainly thought to be more popular with, and useful for, boys, while biology is considered useful for girls as well. Biology, therefore, seems to be one of the most popular courses among students generally [24], and students hold very positive attitudes towards this school subject [24].

Thus, we assumed that the intentions of teachers to choose to teach the contents of either physics or biology (or both) for their lessons would be influenced by two factors: one is related to how "difficult" the subject matter is, and the other is related to the "utility" of the subject matter. With regard to the subject's difficulty, we assumed that teachers would assess this on the basis of their perceived behavioral control (PBC) skills and on the student learning (SL), whereas, with regard to the subject's usefulness, we assumed that this would be assessed mainly on the basis of the student learning (SL). Additionally, we expected that kindergarten teachers would be likely to differ in their intentions to choose content from physics or biology, as the perceived difficulty of physics, and the perceived usefulness of biology, may influence their assessments of the personal gains or losses (AT), as well as those of the opinions of important third persons (SN).

In terms of the teaching—and learning—of sciences (B), kindergarten teachers are in a position where they are required to deal with two relatively different educational traditions, that of early childhood education and that of science education [28]. However, the kindergarten teachers in Greece attempt to teach physics or biology without possessing sufficient content knowledge of either subject [29–31]. Furthermore, the kindergarten teachers' knowledge and experience are inadequate with regard to the use of scientific models to describe and explain real natural systems [32], and to the use of scientific practices and argumentation [33,34]. They are, it seems, fully aware that teaching some of these scientific models and practices is a professional obligation, as it is part of the early childhood education curricula in Greece. It has been shown, however, that the frequency with which such approaches are incorporated into their teaching does not depend on either the teachers' experiences or the curriculum [21]. Thus, it would be safe to assume that the kindergarten teachers' intentions to include scientific content and practices in their everyday teaching are strongly influenced by the traditions of early childhood education and science education, as well as by their personal teaching approaches.

One would expect that those teachers who are more dependent on early childhood learning approaches would not differentiate between the contents of physics or biology, and that they would adopt general pedagogical practices in teaching this subject matter, as they would any other. These pedagogical practices are implemented in a natural language and are evaluated as effective if they follow narrative structures [13,35–37], or if they connect narratives with paradigmatic and experiential evidence [38]. There are indications [39] that this general pedagogical approach, which transforms the content through a science narrative and "transfers" the scientific models to students (sometimes successfully and sometimes not), is used widely by teachers. We find it in the texts of children's books on science that are published in abundance, and that are also distributed in schools. For example, in Greece, there is a wide variety of books, games, and toys for children that present and explain scientific issues, most of which are translations from other languages.

In the early childhood educational approach, the contents of the various science subjects are presented in simplified narrative language structures, in contrast to the older classes of primary school, where this content is mainly transferred through formal language structures.

Thus, in the results of the research, we would expect that there would be a significant number of kindergarten teachers who would not discern any differentiation in their intentions to apply one or the other of the two teaching models (DD or I-B). This is despite having participated in the training seminar, where they had recently had the two teaching methods, within the framework of the content of a single science subject (physics), presented to them and discussed.

In contrast, we expected that the teachers who focused more on the didactic approach of science education, which they learned in their undergraduate and/or postgraduate studies, as well as in the seminar that is covered in this study, would exhibit individual differences in their intentions as to the teaching method that they chose to apply. The source of these differences is considered to lie in the so-called "disunity of science", in the educational context [40]. The extensive range of topics in the fields of physics and biology that are proposed for the curricula display fundamental methodological and epistemological differences [41], which cannot be ignored in the didactic approach taken. For example, certain aspects of the experimental practices that are implemented with the objective of demonstrating the scientific confirmation of established conceptual models of physics are taught without regard to the teaching method. These aspects, depending on the teaching method that is applied, are used to generate conceptual conflict, to demonstrate evidence that guides the students' "discovery" of a conceptual model, or to explore the dynamics of a system in order to reinforce that the students' initial views are compatible with scientific ones, and so on.

These experimental practices cannot, however, be applied to the teaching of the classical models of biology, where the systems that are studied are open and are, therefore, complex, self-organized, and historical [41]. For instance, it is not possible to design experiments that demonstrate how things or processes evolve on the basis of the dynamics of the conceptual models of biology within the teaching time that is available. Although snapshots of the evolutions of the systems to be taught/learned can be observed (with photographs or a microscope), and field research can be organized, it is impossible for experiments that represent the dynamics of evolution, climate change, heredity, reproduction, genetics, and ecosystems to be presented in the school classroom or science lab, or to be conducted in vivo. Thus, it seems that both the conceptual conflict and discovery demonstration methods are rather weak approaches for biology education. This is why we consider that, from the teaching methods that are used in physics, only inquiry-based learning is effective for biology education. The field research also proposes this method as a didactic approach to biology [42].

Thus, in the results of this study, we would expect a significant number of kindergarten teachers who are more influenced by science education to state that their intentions would be to apply both of the teaching methods (discovery demonstration and inquiry-based) that were presented in the seminar on physics. We expected these preferences to be indiscriminately influenced by all of the variables of our model. More specifically, we expected the teachers' assessments of their perceived ability to control (PBC) the application of the teaching methods, and those that refer to how much meaningful knowledge the students learn (SL), to be dominant (e.g., "I choose the discovery demonstration or inquiry-based teaching methods because I can apply them successfully, that is, I can apply them in a way that students would learn" (success criterion). In addition, we also expected that the teachers' assessments of their personal gains or losses (AT), as well as those that refer to the opinions of important third persons (SN), would have positive influences on the results (e.g., "When I teach successfully, I feel good in the classroom, and important third persons would approve"). Finally, we expected that the kindergarten teachers who chose the biology content would be more likely to choose the inquiry-based teaching method for physics on the basis of their assessments that they can also successfully teach physics with the I-B approach in the same way that they used it to teach biology (PBC).

3. Methodology

After the conclusion of the seminar, the 114 participants completed a 5-point Likert -scale questionnaire, which was divided into two sets of items (see Appendix A). In each of the sets of questions, the first item focused on investigating the teachers' intentions to choose the contents and the teaching methods that were discussed during the seminar. Specifically, the first item of the first set focused on investigating the intentions of the teachers to choose the content for their teaching from the two distinct scientific areas (physics or biology), and the first item of the second set focused on investigating their intentions to choose a teaching method (discovery demonstration or inquiry-based) when using the physics content, as the seminar focused on the teaching methods only for the physics content. In the second item of each set of questions, the teachers assessed the value of the students' learning outcomes (SL: student learning), depending on the physics or biology content (for the first set of questions), or on the teaching method that they adopted (discovery demonstration or inquiry-based, for the second set of questions) when they implemented the physics content. The last three items in each set of questions investigated the teachers' planned future actions, according to the theory of planned behavior [18–20]. Specifically, the three variables that were examined were the teachers' assessments of: (a) Their personal gains or losses (AT: attitude); (b) The opinions of important third persons who approved or disapproved of their behavior (SN: subjective norm); and (c) Their ability to control the teaching process (PBC: perceived behavioral control).

No demographic data were included in the questionnaire, as the participants made up a relatively homogeneous sample: they were all women with more than 5 years of teaching experience, and who were all teaching in the same geographical area (Florina, Western Macedonia, Greece).

Finally, the reliability/internal consistency test on the answers to the questionnaire [43,44] produced significantly different values for the Cronbach's alpha coefficient in the two distinct sets of questions. The value related to the first set of questions (the content choice intention) was ac = 0.542, whereas the value related to the second set of questions (the teaching method choice for physics) was atm = 0.760. We thus proceeded with our analysis while bearing in mind that our data reflected the fact that the views of the teachers were internally consistent mainly with regard to the teaching method choices, and less with regard to the issue of the content choice.

The data were analyzed following:

1. A descriptive analysis, in terms of the main research questions of the study, with the aims of, first, investigating the kindergarten teachers' intentions to choose specific content (physics and/or biology) and to use specific teaching methods (discovery demonstration and/or inquiry-based) when they teach physics, and second, investigating the teachers' assessments about whether their pupils acquired meaningful knowledge from the content (physics and/or biology) from what they were taught, or

from the way they were taught (discovery demonstration and/or inquiry-based), in terms of the physics content;

2. A factor analysis of the teachers' responses in order to investigate if there are specific ways of thinking when the teachers choose content or a teaching method. The results of this analysis might offer interpretations as to the differences in the values of the Cronbach's alpha coefficients in relation to the different possible ways that teachers think;
3. A linear regression analysis on the variables of the theory of planned behavior and the assessments of the student learning (SL), which, according to our theoretical model, determines the kindergarten teachers' intentions to choose a specific subject's content or a teaching method. This analysis is focused on investigating the weight and the significance that each variable of our theoretical model had on the teachers' thinking when they chose the content or the teaching method.

4. Results

4.1. Descriptive Analysis

With regard to the teachers' intentions to use physics or biology content in their lessons, and to their intentions to use the descriptive demonstration or the inquiry-based method when teaching physics, the results show (Tables 1–3) that, through their choices, all of the possible combinations of both of these factors came up (Table 1). Please note, that the teachers' responses for both sets of questions in Tables 1–3 correspond to an aggregate percentage of "only" and "mostly" choices on the Likert scales. As can be seen in Table 1, the highest total percentage (66.7%) was the teachers' intentions to use both physics and biology content equally in their lessons, and by using the two method choices. In addition, there is a significantly higher total percentage for the teachers' intentions to teach the physics content with both or either method (26.3%), in contrast to their intentions to teach the biology content with either method, with a total of just 7%.

Table 1. Frequencies/percentages of teachers' choice of content (physics or biology) and teaching method (discovery demonstration or inquiry-based).

Subject Content Chosen by Teachers	Method Chosen byTeachers to Teach Physics	Frequency (Percentage)
Physics	Discovery demonstration (DD) Inquiry-based (I-B) Both DD and I-B equally	8 (7.0%) 3 (2.6%) 19 (16.7%)
Total		30 (26.3%)
Biology	Discovery demonstration (DD) Inquiry-based (I-B) Both DD and I-B equally	3 (2.6%) 3 (2.6%) 2 (1.8%)
Total		8 (7.0%)
Both physics and biology equally	Discovery demonstration (DD) Inquiry-based (I-B) Both DD and I-B equally	18 (15.8%) 19 (16.7%) 39 (34.2%)
Total		76 (66.7%)

Table 2 presents the teachers' assessments on how meaningful the students' learning was in relation to the teachers' choices of either physics or biology content. Three-fourths of the kindergarten teachers (75.4%) assessed that the students' learning was meaningful for both sciences, regardless of their intentions to choose the content (physics, biology, or content from both subjects equally, at 19.3, 3.5, and 52.6%, respectively).

Table 3 presents the teachers' assessments on how meaningful the students' learning was in relation to the teachers' choices of teaching method when the teachers chose to teach physics. In this case, 43.9% of the kindergarten teachers assessed the students' learning of physics as meaningful, regardless of their intentions to choose a specific teaching method (discovery demonstration, inquiry-based, or both methods equally, at 7.9, 4.4, and 31.6%, respectively). In addition, there is a substantial percentage of the teachers who assessed the students' learning of physics to be meaningful only with the discovery demonstration approach (30.7%) or the inquiry-based method (25.7%), regardless of their intention to choose a teaching method.

Table 2. Teachers' assessments of students' learning in relation to content selection.

Teachers' Choice of Content	Subjects Assessed as Meaningful by Teachers in Terms of Student Learning	Frequency (Percentage)
Physics	Physics Biology Physics and Biology Equally	8 (7.0%) 0 22 (19.3%)
Total		30 (26.3%)
Biology	Physics Biology Physics and Biology Equally	0 4 (3.5%) 4 (3.5%)
Total		8 (7%)
Physics and Biology Equally	Physics Biology Physics and Biology Equally	5 (4.4%) 11 (9.7%) 60 (52.6%)
Total		76 (66.7%)

Table 3. Assessments of students' learning of physics in relation to selection of teaching method.

Method Chosen by Teachers to Teach Physics	Method Assessed as Meaningful by Teachers in Terms of Students' Learning of Physics	Frequency (Percentage)
Discovery demonstration (DD)	Discovery demonstration (DD) Inquiry-based (I-B) Both DD and I-B equally	17 (14.9%) 3 (2.6%) 9 (7.9%)
Total		29 (25.4%)
Inquiry-based (I-B)	Discovery demonstration (DD) Inquiry-based (I-B) Both DD and I-B equally	4 (3.5%) 16 (14.0%) 5 (4.4%)
Total		25 (21.9%)
Both DD and I-B equally	Discovery demonstration (DD) Inquiry-based (I-B) Both DD and I-B equally	14 (12.2%) 10 (8.8%) 36 (31.6%)
Total		60 (52.6%)

4.2. Factor Analysis

On the basis of the factor analysis (see Table 4), the teachers seemed to make their choices following three independent ways of thinking, which explain 56.7% of the variance:

1. A compact and purely didactic way of thinking, which refers to the teaching of the physics content and which is indicated in Table 4 by the "Teaching Approach" factor, which explains 24.6% of the variance. In accordance with this way of thinking, whichever method that the participants chose to teach physics, they consistently linked their preferences to all four of the variables of our theoretical model. Specifically, the teachers' choices were significantly linked to: (a) Meaningful student learning (SL) (in terms of the teaching method); (b) The significant personal gains or losses (AT) (in terms of the teaching method); (c) The important third-persons opinions (SN)

(in terms of the teaching method)); and (d) The perceived behavioral control (PBC) of the method. This behavior was expected because of the high Cronbach's alpha index that is related to the second set of questions (i.e., atm = 0.760). In addition, the results reveal a sophisticated way of thinking. The kindergarten teachers that follow this way of thinking combine their intentions to teach physics with all of the variables that are introduced by the theory of planned behavior [18–20], as well as with their assessments about the students' meaningful learning via the various teaching methods;

2. A partial-variable approach to the content, which is not linked to its selection, and that is based on the following way of the teachers' thinking: "I consistently choose content (physics and/or biology) for my teaching for which I have the skills to teach (PBC) (in terms of the content), and from which I assess whether my students will acquire meaningful knowledge" (SL) (in terms of the content). This way of thinking is indicated in Table 4 by the "Content Choice" factor, and it explains 18.9% of the variance. This approach of alternatively choosing either physics or biology content links the teachers' choices only to the internal relations of teaching and learning: the students' learning, and the teacher's ability to teach;
3. A personal approach to content, which is not linked to its selection, according to which any intention that the teacher has to choose physics of biology content entails personal gains or losses (AT) (in terms of the content), and important third-person opinions (SN) (in terms of the content). This way of thinking is indicated in Table 4 by the "Personal Gain and Recognition" factor, and it explains 13.2% of the variance, which indicates that the teachers approach the content as an independent social and professional variable (i.e., they expect profits and/or recognition when they choose content). On the other hand, the fact that there is no correlation between the last two ways of thinking (2 and 3) in approaching the content explains the relatively small Cronbach's alpha index that is related to the first set of questions (i.e., ac = 0.542), which indicates that there is no consistency between these two ways of thinking.

Table 4. Independent factors of teachers' views.

	Teaching Approach Factor	**Content Choice Factor**	**Personal Gain and Recognition Factor**
I intend to choose physics and/or biology content.	0.068	**0.712**	0.113
I achieve significant student learning (SL-Content).	0.077	**0.778**	0.084
I achieve significant personal gains or losses (AT-Content).	−0.056	0.401	**0.668**
Important third persons would approve it (SN-Content).	0.118	−0.131	**0.704**
I can control the teaching process (PBC-Content).	−0.063	**0.721**	−0.181
I intend to choose the discovery demonstration and/or inquiry-based teaching method to teach physics content.	**0.754**	−0.031	−0.074
I achieve significant student learning (SL-Teaching method).	**0.704**	0.249	−0.118
I achieve significant personal gains or losses (AT-Teaching method).	**0.711**	0.021	0.237
Important third persons would approve of it (SN-Teaching method).	**0.588**	0.079	−0.490
I can control the teaching method in my lessons (PBC-Teaching method).	**0.714**	−0.109	0.110

Extraction method: principal component analysis. Rotation method: varimax with Kaiser normalization. [a] Rotation converged in 5 iterations. Total variance explained: 56.7%.

Overall, the factor analysis shows that the teachers who participated in the seminar chose the method for teaching the physics content by taking into account all of the variables of our hypothesis. In contrast, when the teachers are prompted to choose the content, they are only influenced by the internal relations of teaching and learning (i.e., the students' learning and the teacher's ability to teach).

4.3. Linear Regression Analysis

Tables 5 and 6 present the results of the linear regression that investigated our hypothesis of the linear correlation of the teachers' intentions to choose the content and/or the teaching method with the three variables of the theory of planned behavior (AT, SN, and PBC), and with the variable of the assessment of the students' meaningful learning (SL).

Table 5. Factors that affect content choice.

Reasons That Teachers Choose Physics and/or Biology Content				
Model		**Standardized Coeff. Beta**	**t**	**Sig.**
1	I achieve significant student learning (SL-Content).	0.457	4.228	0.000
	I achieve significant personal gains or losses (AT-Content).	0.238	2.223	0.028
	Important third persons would approve of it (SN-Content).	0.096	1.046	0.298
	I can control the teaching process (PBC-Content).	0.192	2.374	0.019

a. Dependent variable: E1; b. linear regression through the origin; c. adjusted R square = 0.929; sig. = 0.000.

Table 6. Factors that affect teaching-method choice for physics content.

Reasons for Choosing the Discovery Demonstration and/or Inquiry-Based Teaching Method, for Teaching Physics Content			
Model	**Standardized Coeff. Beta**	**t**	**Sig.**
I achieve significant student learning (SL-Teaching method).	0.242	2.785	0.006
I achieve significant personal gains or losses (AT-Teaching method).	0.172	1.779	0.078
Important third persons would approve of it (SN-Teaching method).	0.281	2.924	0.004
I can control the teaching method in my lessons (PBC-Teaching method).	0.292	3.338	0.001

a. Dependent variable: E6. b. Linear regression through the origin. c. Adjusted R square = 0.921; sig. = 0.000.

The results show that, when teachers express their intentions to choose the content (Table 5), their views are primarily dominated by their assessment that the students will acquire meaningful knowledge (SL-Content; $\beta = 0.457$, $p < 0.001$), and secondarily by the possible personal gains or losses (AT-Content; $\beta = 0.238$, $p < 0.05$). The assessment of the personal ability to control the teaching process (PBC-Content, $\beta = 0.192$, $p < 0.05$) seems to be less important, while the opinions of important third persons (SN-Content, $\beta = 0.096$, $p = 0.298$) do not seem to play an important role. In other words, the teachers' intentions towards the content selection is mainly explained by the variables that construct the "Content Choice Factor" (Table 4), but also secondarily by the teachers' assessments of their personal gains or losses (AT-Content).

On the other hand, when the teachers express their intentions to choose a teaching method for the physics content (Table 6), all of the variables that construct the "Teaching Approach" factor (Table 4) play significant roles, in the following order: the teacher's ability to implement and control the method (PBC-Teaching method; β = 0.292, $p < 0.05$); the opinions of important third persons (SN-Teaching method; β = 0.281, $p < 0.05$); the teachers' assessments in terms of the students' meaningful learning (SL-Teaching method; β = 0.242, $p < 0.05$); and the teachers' possible personal gains or losses (AT-Teaching method; β = 0.172, $p < 0.05$).

5. Discussion

The results of the study present a number of interesting points for discussion. They show that there was a smaller difference in the kindergarten teachers' intentions to choose the content (physics or biology), and a more important difference in their choice of teaching method (discovery demonstration or inquiry-based for the physics content). However, it seems that when it came to implementing the content and/or method, there was no difference in the teachers' ways of thinking.

On the one hand, whether the teachers chose content from physics or biology, or from both subjects equally, there was a common rationale behind all of the options, which is described by the "Content Choice" factor, which arose as a way of thinking from the factor analysis. The findings suggest that the kindergarten teachers chose the subject content that they had the skills to teach successfully (PBC), which, in light of effective teaching, is equivalent to the fact that the students are learning meaningful knowledge (SL). In this case, our hypothesis (that the "difficulty" and the "utility" of the subject matter of physics and/or biology may activate normative (SN) and personal (AT) factors that eventually influence the kindergarten teachers' intentions to choose the content [24–27]) does not show up. To the contrary, the two factors, SN and AT, seem to develop as independent social and professional variables, which means that the kindergarten teachers tend to focus on the expected recognition and personal profits (the "Personal Gain and Recognition" factor).

On the other hand, the common rationale behind the way that the kindergarten teachers chose the method—whether discovery demonstration (DD) or inquiry-based (I-B), or both methods equally—with which to teach physics is described by the "Teaching Approach" factor. This, in combination with the results of the linear regression, suggest a similar, albeit stronger reasoning than that for the choice of content. In other words, the teaching method was chosen on the bases of the teachers' consideration as to whether they had the skills to apply it successfully (PBC), and of their consideration as to whether their students would, thus, learn meaningful knowledge (SL). This reasoning is further enhanced by the teachers' assessments of whether important third persons would approve of their use of the particular method(s) (SN), and whether they would "enjoy themselves" teaching (AT). Therefore, our main hypothesis, that normative (SN) and personal (AT) factors would significantly elaborate the kindergarten teachers' intentions [18–20], seems to be brought about when they choose the teaching method.

Thus, overall, it would appear that the kindergarten teachers' intentions to use certain content and particular teaching methods seem to be based on a simple and straightforward rationale: "I choose to do what I have the skills to do successfully, and I do it in a way that my pupils will learn." Apart from this, their choice of teaching method(s) (but not of the content) is also associated with their assessment of the personal gains or losses, as well as of the opinions of important third persons.

These results also explain, to some extent, the quantitative differences in the descriptive analysis. One finding from the quantitative analysis is that the majority of kindergarten teachers chose the "both physics and biology equally" content option for their classroom teaching material. Similarly, when asked which subject's content they believed the students would gain the most meaningful knowledge from, the vast majority chose "both physics and biology equally". These choices were expected because, when teachers deal with the content of various subjects, they take into account their own didactic approach ("I can teach this content and my students will learn") instead of considering the contents' epistemological differences. This finding also explains the almost four-fold difference between their preferences for physics content over biology. In other words, the kindergarten teachers seem to have an internally consistent way of thinking about teaching the physics content, which is the "Teaching Approach" factor, as well as about the recent examples of the specific applications that they acquired in the seminar. It also offers an interpretation for the lower percentages of the "both physics and biology equally" option in terms of the teaching method choice for physics.

Overall, these results, which are due to the consistent didactic thinking of teachers, do not seem to be dominated by any particular preference. They also do not confirm our hypothesis that the teachers who chose biology would tend to choose the inquiry-based method to teach the physics content; this is most likely due to the fact that the low percentage of teachers who chose the biology content does not allow for a reliable analysis. Nevertheless, the study findings show that there were two distinct categories of kindergarten teachers. On the one hand, there were those whose teaching was based on the tradition of science education and who chose to apply either the discovery demonstration or inquiry-based teaching method. On the other hand, there were the teachers who opted to use the two teaching methods equally, irrespective of the content, and whose teaching was based in early childhood education.

6. Implications

On the basis of the above results, we consider that the organization of the training seminar should focus on the issues that could: (a) Upgrade the tradition of early childhood education, which kindergarten teachers are already familiar with, to a tradition that incorporates science education; and (b) Enrich the didactic approaches that kindergarten teachers use successfully with the epistemological aspects of the various science subject contents, which would reveal the role of the nature of science in teaching and learning.

More specifically, for each of the above cases:

1. The incorporation of the science education tradition, and, consequently, the use of a variety of teaching methods by kindergarten teachers, could be promoted by organizing training seminars that include activities that are either based on narrative texts from children's books, or on popular activities for kindergarten children that are readily found on the Internet. These should be adapted to the teaching methods and proposals of science education, as well as to research-based didactically transformed content [35,38]. It is also equally important for scientific descriptions to be rearranged into a narrative style. For example, from a "[...] and, [...] and, [...] and [...], therefore [...]" type of description, to a "[...] and [...], but [...], therefore [...]" type of description [45]. (For instance, from a description such as, "I have a plastic bottle of water, and I open a hole in it, and I notice that water is running out of the hole, therefore [...]", to a description such as, "Water is running out of the hole in a plastic bottle, but if I close the mouth of the bottle, it stops running, therefore [...]");
2. The epistemological aspects of physics and biology, as well as the images that the public has of them, can be distinct parts of the seminar discussions, and can be combined with the scientific practices that concern them. These scientific practices, on the basis of the particular teaching approaches, determine the ways in which the students learn [34,46,47]. The hypothetico-inductive method is promoted by the inductive inquiry-based teaching method, and it promotes learning through observation, categorization, and hypothesis construction. The scientific method of laboratory validation is promoted by the discovery demonstration teaching method, and it enhances learning through the empirical investigation of specific claims. The historical scientific method is also promoted by the inquiry-based teaching method, and it supports learning through the collection and conceptualization of time-dispersed data. In this case, it is important to convince kindergarten teachers that the different scientific methods are not graded as better or worse. With this logic, there are no better or worse teaching methods, just as there are no better or worse ways of learning. There are only different scientific and teaching methods, and different ways of learning, all of which are equally important and useful.

Author Contributions: Conceptualization, A.Z., V.T., P.P. and P.K.; methodology, A.Z., V.T., P.P. and P.K.; data analysis, A.Z., V.T., P.P. and P.K.; writing—original draft preparation, A.Z., V.T., P.P. and P.K.; writing—review and editing, A.Z., V.T., P.P. and P.K.; project administration, A.Z., V.T., P.P. and P.K. 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: Not applicable.

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

Appendix A. The Questionnaire

Appendix A.1. First Set of Items—Content

I consider that it is possible to implement activities with content:

Only from Physics	Mostly from Physics	From Physics and Biology Equally	Mostly from Biology	Only from Biology

I consider that the knowledge that my pupils learn is more meaningful when they participate in activities with content:

Only from Physics	Mostly from Physics	From Physics and Biology Equally	Mostly from Biology	Only from Biology

I consider that, as a person/citizen and a teacher, I gain more when the content of the activities that I organize for my pupils is:

Only from Physics	Mostly from Physics	From Physics and Biology Equally	Mostly from Biology	Only from Biology

I consider that important third persons (pupils, pupils' parents, supervisors, etc.) would approve when the content of the activities that I organize for my pupils is:

Only from Physics	Mostly from Physics	From Physics and Biology Equally	Mostly from Biology	Only from Biology

I consider that I am more capable of organizing and implementing teaching activities when the content of the activities is:

Only from Physics	Mostly from Physics	From Physics and Biology Equally	Mostly from Biology	Only from Biology

Appendix A.2. Second Set of Items—Teaching Methods When the Content Is Physics

The teaching method that I consider most adoptable for activities with content from physics is:

Only Discovery Demonstration	Mostly Discovery Demonstration	Equally Discovery Demonstration and Inquiry-based	Mostly Inquiry-based	Only Inquiry-based

I consider that the knowledge that my pupils learn is more meaningful when the teaching method of the activities with the physics content is:

Only Discovery Demonstration	Mostly Discovery Demonstration	Equally Discovery Demonstration and Inquiry-based	Mostly Inquiry-based	Only Inquiry-based

I consider that, as a person/citizen and a teacher, I gain more when the teaching method of the activities with the physics content is:

Only Discovery Demonstration	Mostly Discovery Demonstration	Equally Discovery Demonstration and Inquiry-based	Mostly Inquiry-based	Only Inquiry-based

I consider that important third persons (pupils, pupils' parents, supervisors, etc.) would approve when the teaching method of the activities with the physics content is:

Only Discovery Demonstration	Mostly Discovery Demonstration	Equally Discovery Demonstration and Inquiry-based	Mostly Inquiry-based	Only Inquiry-based

I consider that I am more capable of organizing and implementing teaching activities when the teaching method of the activities with the physics content is:

Only Discovery Demonstration	Mostly Discovery Demonstration	Equally Discovery Demonstration and Inquiry-based	Mostly Inquiry-based	Only Inquiry-based

References

1. Eshach, H.; Fried, M.N. Should Science be Taught in Early Childhood? *J. Sci. Educ. Technol.* **2005**, *14*, 315–336. [CrossRef]
2. Cullen, J. Massey University Children's knowledge, teachers' knowledge: Implications for early childhood teacher education. *Aust. J. Teach. Educ.* **1999**, *24*, 2. [CrossRef]
3. Barenthien, J.; Lindner, M.A.; Ziegler, T.; Steffensky, M. Exploring preschool teachers' science-specific knowledge. *Early Years* **2018**, *40*, 335–350. [CrossRef]
4. Greek Ministry of Education and Religion. Interdisciplinary Unified Curriculum Framework—Kindergarten Curriculum. 2002. Available online: http://www.pi-schools.gr/programs/depps/ (accessed on 4 January 2022).
5. Greek Ministry of Education and Religion. Kindergarten Curriculum, 1st Part. 2011a. Available online: http://ebooks.edu.gr/info/newps/Προσχολική%20-%20Πρώτη%20Σχολική%20Ηλικία/1ο%20Μέρος.pdf (accessed on 20 December 2021).
6. Greek Ministry of Education and Religion. Kindergarten Curriculum, 2nd Part. 2011b. Available online: http://ebooks.edu.gr/info/ newps/Προσχολική%20-%20Πρώτη%20Σχολική%20Ηλικία/2ο%20Μέρος.pdf (accessed on 20 December 2021).
7. Greek Ministry of Education and Religion. Curriculum for Pre-School Education. 2021. Available online: https://ean.auth.gr/wp-content/uploads/2021/11/programma_spo-udwn_2021.pdf (accessed on 20 December 2021).
8. Greek Ministry of Education and Religion. Teacher Guide, for the Kindergarten Curriculum. 2011. Available online: http://ebooks.edu.gr/info/newps/Προσχολική%20-%20Πρώτη%20Σχολική%20Ηλικία/Οδηγός%20για%20Νηπιαγωγείο.pdf (accessed on 20 December 2021).
9. French, L. Science as the center of a coherent, integrated early childhood curriculum. *Early Child. Res. Q.* **2004**, *19*, 138–149. [CrossRef]
10. Andersson, K.; Gullberg, A.; Danielsson, A.T.; Scantlebury, K.; Hussénius, A. Chafing borderlands: Obstacles for science teaching and learning in preschool teacher education. *Cult. Stud. Sci. Educ.* **2019**, *15*, 433–452. [CrossRef]
11. Bencze, L.; Bowen, M.; Alsop, S. Teachers' tendencies to promote student-led science projects: Associations with their views about science. *Sci. Educ.* **2006**, *90*, 400–419. [CrossRef]
12. Lawson, A.E. The Nature and Development of Scientific Reasoning: A Synthetic View. *Int. J. Sci. Math. Educ.* **2004**, *2*, 307–338. [CrossRef]
13. Norris, S.P.; Guilbert, S.M.; Smith, M.L.; Hakimelahi, S.; Phillips, L.M. A theoretical framework for narrative explanation in science. *Sci. Educ.* **2005**, *89*, 535–563. [CrossRef]

14. Martínez-Bello, V.E.; Bernabé-Villodre, M.D.M.; Lahuerta-Contell, S.; Vega-Perona, H.; Giménez-Calvo, M. Pedagogical Knowledge of Structured Movement Sessions in the Early Education Curriculum: Perceptions of Teachers and Student Teachers. *Day Care Early Educ.* **2020**, *49*, 483–492. [CrossRef]
15. NGSS Lead States. *Next Generation Science Standards: For States, by States*; The National Academies Press: Washington, DC, USA, 2013.
16. White, R.; Gunstone, R. *Probing Understanding*; Routledge: London, UK, 2014. [CrossRef]
17. Van der Graaf, J.; Segers, E.; Verhoeven, L. Scientific reasoning abilities in kindergarten: Dynamic assessment of the control of variables strategy. *Instr. Sci.* **2015**, *43*, 381–400. [CrossRef]
18. Ajzen, I.; Fishbein, M. Attitudes and the attitude–behavior relation: Reasoned and automatic processes. *Eur. Rev. Soc. Psychol.* **2000**, *11*, 1–33. [CrossRef]
19. Ajzen, I. Attitudes. *Annu. Rev. Psychol.* **2001**, *52*, 27–58. [CrossRef] [PubMed]
20. Ajzen, I. Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior. *J. Appl. Soc. Psychol.* **2002**, *32*, 665–683. [CrossRef]
21. Saçkes, M. How often do early childhood teachers teach science concepts? Determinants of the frequency of science teaching in kindergarten. *Eur. Early Child. Educ. Res. J.* **2012**, *22*, 169–184. [CrossRef]
22. Park, M.-H.; Dimitrov, D.M.; Patterson, L.G.; Park, D.-Y. Early childhood teachers' beliefs about readiness for teaching science, technology, engineering, and mathematics. *J. Early Child. Res.* **2016**, *15*, 275–291. [CrossRef]
23. Seakins, A.; Hobson, M. Public understanding of science. In *Science Education*; Taber, K., Akpan, B., Eds.; Sense Publishers: Rotterdam, The Netherlands, 2017; pp. 443–454.
24. Osborne, J.; Simon, S.; Collins, S. Attitudes towards science: A review of the literature and its implications. *Int. J. Sci. Educ.* **2003**, *25*, 1049–1079. [CrossRef]
25. Dommett, K.; Pearce, W. What do we know about public attitudes towards experts? Reviewing survey data in the United Kingdom and European Union. *Public Underst. Sci.* **2019**, *28*, 669–678. [CrossRef] [PubMed]
26. Nielsen, K.H. Between understanding and appreciation. Current science communication in Denmark. *J. Sci. Commun.* **2005**, *4*, A02. [CrossRef]
27. Howell, E.L.; Wirz, C.D.; Scheufele, D.A.; Brossard, D.; Xenos, M.A. Deference and decision-making in science and society: How deference to scientific authority goes beyond confidence in science and scientists to become authoritarianism. *Public Underst. Sci.* **2020**, *29*, 800–818. [CrossRef]
28. Garbett, D. Science Education in Early Childhood Teacher Education: Putting Forward a Case to Enhance Student Teachers' Confidence and Competence. *Res. Sci. Educ.* **2003**, *33*, 467–481. [CrossRef]
29. Kallery, M.; Psillos, D. What happens in the early years science classroom? *Eur. Early Child. Educ. Res. J.* **2002**, *10*, 49–61. [CrossRef]
30. Kallery, M. Early years teachers' late concerns and perceived needs in science: An exploratory study. *Eur. J. Teach. Educ.* **2004**, *27*, 147–165. [CrossRef]
31. Gracia, A.L.C.; Peña, B.M.; Hernández, J.M.C.; Quílez, M.J.G.; Gómez, M.G. Inquiry in classrooms: What do future primary teachers say about experimental activities and formative needs? In *Science Education Research: Pre-Service and in-Service Teacher Education, Proceedings of the ESERA 2009, Istanbul, Turkey, 31 August–4 September 2009*; Taşar, M.F., Çakmakcı, G., Eds.; Pegem Akademi: Ankara, Turkey, 2010; pp. 151–155.
32. Kampourakis, K.; Reiss, M. (Eds.) *Teaching Biology in Schools: Global Research, Issues, and Trends*; Taylor and Francis: New York, NY, USA, 2018.
33. Kallery, M.; Psillos, D.; Tselfes, V. Typical Didactical Activities in the Greek Early-Years Science Classroom: Do they promote science learning? *Int. J. Sci. Educ.* **2009**, *31*, 1187–1204. [CrossRef]
34. Gerde, H.K.; Schachter, R.E.; Wasik, B.A. Using the Scientific Method to Guide Learning: An Integrated Approach to Early Childhood Curriculum. *Day Care Early Educ.* **2013**, *41*, 315–323. [CrossRef]
35. Sackes, M.; Trundle, K.C.; Flevares, L.M. Using Children's Literature to Teach Standard-Based Science Concepts in Early Years. *Day Care Early Educ.* **2009**, *36*, 415–422. [CrossRef]
36. Avraamidou, L.; Osborne, J. The Role of Narrative in Communicating Science. *Int. J. Sci. Educ.* **2009**, *31*, 1683–1707. [CrossRef]
37. Martin, K.; Davis, L.; Sandretto, S. Students as storytellers: Mobile-filmmaking to improve student engagement in school science. *J. Sci. Commun.* **2019**, *18*, A04. [CrossRef]
38. Peterson, S.M. Narrative and Paradigmatic Explanations in Preschool Science Discourse. *Discourse Process.* **2009**, *46*, 369–399. [CrossRef]
39. Tselfes, V. Science in the Greek Kindergarten, that is, in a place with a distinct educational tradition and high pedagogical autonomy. In *The Role of Science in Pre-School Education*; Pantidos, P., Ed.; Publication of New Technologies: Athens, Greece, 2019; pp. 19–36.
40. Galison, P.; Stump, D. *(Eds). The Disunity of Science. Boundaries, Contexts and Power*; Stanford University Press: Redwood City, CA, USA, 1996.
41. Cleland, C.E. Methodological and Epistemic Differences between Historical Science and Experimental Science. *Philos. Sci.* **2002**, *69*, 474–496. [CrossRef]
42. Lederman, N. Nature of Scientific Knowledge and Scientific Inquiry in Biology Teaching. In *Teaching Biology in Schools: Global Research, Issues, and Trends*; Kampourakis, K., Reiss, M., Eds.; Taylor and Francis: New York, NY, USA, 2018; pp. 233–252.

43. Gardner, P.L. Measuring attitudes to science: Unidimensionality and internal consistency revisited. *Res. Sci. Educ.* **1995**, *25*, 283–289. [CrossRef]
44. Taber, K.S. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Res. Sci. Educ.* **2018**, *48*, 1273–1296. [CrossRef]
45. Olson, R. *Houston, We Have a Narrative. Why Science Needs Story*; The University of Chicago Press: Chicago, IL, USA; London, UK, 2015.
46. Zimmerman, C. The development of scientific thinking skills in elementary and middle school. *Dev. Rev.* **2007**, *27*, 172–223. [CrossRef]
47. Cocchi, L.; Passaro, S.; Caratori Tontini, F.; Ventura, G. Volcanism in slab tear faults is larger than in island-arcs and back-arcs. *Nat. Commun.* **2017**, *8*, 1451. [CrossRef] [PubMed]