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REVIEW

Science Education and the Analogy Method in the Türkiye Century Maarif Model Preschool Education Curriculum: An Analysis in Terms of Scientific Thinking, Conceptual Learning, and Concretization

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Abstract

In this study, the Türkiye Century Maarif Model Preschool Education Curriculum, which came into effect in 2024, and its Science Domain Teacher Guidebook were analyzed in terms of the analogy method. The aim of the study was to reveal the opportunities the curriculum offers regarding scientific thinking, conceptual learning, and the concretization of abstract science concepts. The research was conducted using a document analysis design within a qualitative research approach, and the data were analyzed through descriptive and inductive content analysis techniques. The findings showed that the reasoning skill within the conceptual skills component of the curriculum explicitly defines analogy as a reasoning approach alongside induction and deduction. It was also determined that the science domain skill of "scientific model construction" directly targets the concretization of abstract science phenomena. Analogy- and concretization-based examples were identified in the guidebook activities, such as modeling the atmosphere with recycled materials, representing the lungs with a balloon, and depicting clouds with cotton. However, it was found that the curriculum does not structure analogy as a systematic instructional model and does not provide teachers with sufficient guidance regarding the limitations of analogy. The study offers recommendations for a more explicit and structured use of analogy in preschool science education.

Keywords: Analogy, concretization, curriculum analysis, preschool science education, scientific thinking

Introduction

Early childhood is a critical developmental stage in which the child's curiosity about making sense of the surrounding world is at its most intense, and the foundations of scientific thinking are laid. As early as the preschool years, children are able to observe objects, classify them, make simple predictions, and establish cause-and-effect relationships. The literature reveals that even 3-year-old children can meaningfully participate in scientific practices under appropriate guidance, and that these early experiences form a solid foundation for subsequent learning (Larimore, 2020; Ramanathan et al., 2022; Zamalloa et al., 2025). For this reason, the quality of the science education provided in the preschool period is not merely a matter of period-specific attainments but is also a determinant of the individual's lifelong scientific literacy (O'Connor et al., 2021).

Nevertheless, a significant portion of science concepts are far from being directly observable and tangible for the child. Concepts such as the water cycle, evaporation, the atmosphere, the greenhouse effect, and respiration are abstract phenomena that cannot be seen with the naked eye or that occur on very slow and very large scales. It is difficult for the preschool child, who is in the preoperational stage, to grasp these concepts without relying on concrete experiences and familiar references. It is precisely at this point that the analogy method stands out as a powerful instructional tool that concretizes the abstract by building a structural bridge between the known (source) and the unknown (target) (Duit, 1991; Gentner, 1983; Glynn, 1991).

In Türkiye, the preschool education curriculum was restructured in 2024 through a fundamental paradigm shift and was moved to a skills-based, integrated, and value-oriented framework under the title "Türkiye Century Maarif Model" (MEB, 2024a). In this new model, the science domain is structured around 10 integrated skills ranging from making scientific observations to scientific inquiry; moreover, higher-order thinking processes such as reasoning and problem solving are included within the "conceptual skills" component that encompasses all domains of the curriculum. The fact that the curriculum explicitly refers to the concepts

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of analogy and concretization at the level of discourse makes a systematic examination of this new model in terms of the analogy method both possible and necessary.

It is observed in the literature that studies on the analogy method are concentrated predominantly at the primary-school level and above, particularly in chemistry, physics, and biology topics, and that studies focusing on the preschool level—and especially on the analysis of official curricula in terms of analogy—remain limited (Sezer & Karataş, 2022). Studies in the Turkish context reveal that preschool teachers frequently resort to the direct instruction method and to recycled materials in science activities (Karademir et al., 2020), and that preservice teachers cannot fully establish the relationship between source and target in an analogy and do not warn about the points at which the analogy breaks down (Capron Puozzo & Audrin, 2021). This picture makes it all the more meaningful to examine how the new curriculum positions analogy and concretization. Proceeding from this need, the study aims to analyze the Türkiye Century Maarif Model Preschool Education Curriculum and the Science Domain Teacher Guidebook with a focus on the analogy method.

Theoretical Framework

Science Education and Scientific Thinking in the Preschool Period

Over the past 3 decades, the early childhood science education literature has produced a strong body of theory that treats children's innate curiosity as the developmental core of scientific thinking. This body of knowledge positions the preschool child not as a learner who is "not yet ready to do science," but as a "competent science learner" capable of making observations, generating hypotheses, and drawing evidence-based inferences (Larimore, 2020; O'Connor et al., 2021). In this period, science education is not merely the transfer of content but also a process of instilling a "way of thinking"; children's development of positive motivation toward science occurs through the dialectical interweaving of the motive to play and the motive to learn (Fragkiadaki et al., 2022). The teacher's role is that of a facilitator who transforms the child's curiosity into questions and questions into investigations, rather than an authority who transmits knowledge (Ramanathan et al., 2022). However, research in the Turkish context shows that there is a gap between this theoretically adopted child-centered approach and classroom practices, and that learning weakens when teachers are not sufficiently explicit in introducing concepts to children (Gelir, 2022; Karademir et al., 2020).

Theoretical Foundations of the Analogy Method

Analogy is regarded in the cognitive science and science education literature as a fundamental form of reasoning that lies at the heart of learning. According to Gentner's (1983) structure-mapping theory, the power of analogy derives not from the surface features of objects but from the mapping of the relational-causal structure between the source and target domains. Niebert et al. (2012) expanded this framework, arguing that effective analogies become meaningful only when they are built with embodied sources grounded in everyday experience, rather than with abstract structure-mapping alone. This emphasis is particularly important for the preschool period because at this age the child's source domain consists largely of bodily and sensory experiences.

One of the most frequently cited frameworks for the instructional use of analogy is Glynn's (1991) Teaching-with-Analogies (TWA) model. This model emphasizes that presenting an analogy implicitly is insufficient; for effective instruction, the mapping between source and target must be made explicit, and the limits of the analogy (where the similarity ends) must be discussed together with the learner. Similarly, Brown & Clement (1989) showed that when a student already holds a misconception, a single analogy may prove insufficient, and that a sequence of steps should be built from a familiar anchoring concept toward the target by means of "bridging analogies." It has also been experimentally demonstrated that the use of multiple analogies strengthens conceptual change by compensating for the incomplete or misleading mappings created by a single analogy (Chiu & Lin, 2005).

The risks of analogy are as well documented as its power. Duit et al. (2001) noted that the same analogy can both support and hinder conceptual change, and that the use of analogy therefore requires careful pedagogical management. To manage this complexity, Eriksson et al. (2024) argued that teachers must possess an "analogy competence" encompassing conceptual, procedural, and application dimensions. These frameworks show that analogy is not merely a "presentation technique" but a domain of pedagogical competence requiring specialized knowledge at the planning, selection, and application stages.

Concretization, Developmental Foundations, and Conceptual Learning

Concretization is the process of bringing an abstract concept into the child's field of perception and experience through concrete objects, models, bodily movements, visual representations, or familiar comparisons. The developmental foundations of this process are clearly evident in early childhood learning theories. In Piaget's theory, the child in the preoperational stage constructs concepts through concrete and tangible experiences. Bruner (1966) argued that knowledge is acquired through three modes of representation—enactive, iconic, and symbolic—and that instruction should proceed from concrete-enactive representation toward abstract-symbolic representation. Vygotsky (1978), for his part, emphasized that learning occurs within the child's zone of proximal development, through tools and adult mediation. These three theoretical strands reveal that abstract science concepts can be taught in the preschool period only through concrete, embodied, and mediated experiences, which constitutes the developmental rationale for analogy and concretization.

There is a natural connection between analogy and concretization: every analogy performs a concretization function by making an abstract target accessible through a concrete and familiar source. Scientific models are also analogical tools in this respect, because a model representing the water cycle or the atmosphere presents the structure of the real phenomenon through a simplified and observable counterpart (Clement, 2008; Heywood, 2002). Nevertheless, analogy is conceptually distinct from metaphor and model: whereas an analogy establishes an explicit and systematic mapping of relations between two domains, a model is a representational counterpart of a phenomenon; concretization, in turn, is the common function of these tools. Observing these distinctions is important for evaluating how the curriculum positions analogy.

Aim and Research Questions of the Study

The main aim of this study is to analyze science education in the Türkiye Century Maarif Model Preschool Education Curriculum in terms of the analogy method and concretization, and to reveal how analogy is associated with the curriculum's objectives of scientific thinking and conceptual learning. In line with this aim, answers to the following questions were sought:

1. Through which skills and components, and in what manner, are analogy and reasoning addressed in the curriculum?
2. In what forms do analogy-based approaches to the concretization of abstract science concepts appear in the Science Domain Teacher Guidebook?
3. How are analogy and concretization associated with the objectives of scientific thinking and conceptual learning in the curriculum?
4. To what extent does the curriculum provide teachers with guidance regarding the effective use and the limitations of the analogy method?

Methods

Research Design

The research was conducted using a document analysis design grounded in a qualitative research approach. Document analysis is a qualitative research method that involves the systematic examination, evaluation, and interpretation of printed and electronic materials relevant to the research topic, requiring the review of data, the extraction of meaning, and its transformation into empirical knowledge (Bowen, 2009). This design is well suited to analyzing the discourse, conceptual structure, and implicit assumptions of a curriculum, because curriculum texts are institutionalized, stable, and repeatedly examinable sources of educational policies and pedagogical choices (Yıldırım & Şimşek, 2021).

There are three main justifications for choosing document analysis. First, the aim of the research is not to observe a practice but to analyze an official curriculum currently in force through a particular theoretical lens (the analogy method); this aim directly requires a text-based data source. Second, the documents examined are non-reactive data sources; they are unaffected by the researcher's presence and eliminate the reactivity bias that may arise in observation or interviews (Bowen, 2009). Third, because documents are stable and accessible, the analysis can be re-performed by other researchers, which enhances the confirmability of the study. In the research, document analysis was conducted together with descriptive and inductive content analysis techniques. While descriptive analysis enabled the systematic presentation of expressions appearing directly and explicitly in the curriculum, inductive content analysis made it possible to structure, as codes and categories, the implicit patterns carrying analogical logic (concretization through comparison, modeling, representation, and dramatization) even when they are not explicitly labeled "analogy" (Krippendorff, 2018; Miles & Huberman, 1994).

Data Sources (Documents Examined)

The data sources of the research consist of two official documents published by the Ministry of National Education in 2024: (a) the Türkiye Century Maarif Model Preschool Education Curriculum (MEB, 2024a) and (b) the Science Domain Teacher Guidebook of this curriculum (MEB, 2024b). Since there is no study group consisting of participants in the traditional sense in document analysis, the study group (the population examined) of this research consists of the two official documents mentioned above. The first document is the main framework document containing the curriculum's general philosophy, components, domain skills, and conceptual skills (basic, integrated, and higher-order thinking skills). The second is the guidebook, accepted as an educational tool by the decision of the Board of Education and Discipline dated July 30, 2024, which explains the science domain skills and provides sample activities and differentiation suggestions for these skills.

These two documents were selected through purposive sampling, taking into account the criteria of officialness, currency, scope, and direct relevance to the research questions. In selecting the documents, the criteria of authenticity, credibility, representativeness, and meaning proposed by Scott for the qualitative evaluation of documents were observed (Bowen, 2009). The scope of the examination was limited to the science domain of the curriculum and to the conceptual skills components supporting this domain (particularly reasoning).

Data Collection Process and Unit of Analysis

The document examination and analysis process of the research began on May 1, 2026, and was completed on May 25, 2026. In this research, data collection refers to the process of systematically scanning the sections of the documents related to the research questions, identifying and extracting the meaning units concerning analogy and concretization, and recording them in an analysis chart; it was carried out through a three-stage reading strategy. In the first stage, both documents were read holistically (skimming), and their general structure was outlined. In the second stage, the sections related to the research questions (science domain skills, conceptual skills, model construction, activity examples, and differentiation suggestions) were subjected to close reading, line by line. In the third stage, the meaning units related to analogy and concretization were interpreted and coded. These three stages are consistent with the skimming–reading–interpretation cycle proposed by Bowen (2009) for document analysis.

Two techniques were used together in the process. The first was a textual search conducted through key terms such as "analogy," "resembl-," "analog-," "concretiz-," "model," "representation," "enact-," "drama," "like," "reasoning," and "inference," which ensured the complete identification of explicit references. The second was the re-scanning of the relevant sections through qualitative reading in order to capture implicit expressions that carry analogical logic even though they do not contain a key term. Each identified meaning unit was recorded in an analysis chart together with its source document, section/skill code, and context. In the research, the meaning unit was adopted as the basic unit of analysis. A meaning unit may be a single sentence, several consecutive sentences, or an entire activity step; the defining criterion is that the expression forms a self-contained and interpretable whole regarding analogy, concretization, scientific thinking, or conceptual learning (Krippendorff, 2018). To prevent loss of context, each meaning unit was evaluated together with its surrounding paragraph.

Coding Framework and Analysis of the Data

Coding was carried out through a hybrid strategy combining theory-driven (deductive) and data-driven (inductive) approaches. The initial code list was created with four superordinate categories derived from the conceptual framework and the analogy literature (Miles & Huberman, 1994): (a) explicit use of analogy, (b) concretization/modeling, (c) scientific thinking skills, and (d) relation to conceptual learning. The subcodes under these superordinate categories were developed inductively in the process of interacting with the data. For example, the expression in the guidebook "inflating a balloon in order to concretize breathing and the air filling the lungs" was first associated with the subcode "embodied concretization" and then with the theme "concretization/modeling." The coding framework developed is presented in Table 1.

The data analysis consisted of the three simultaneous flows proposed in Miles & Huberman's (1994) interactive analysis model: data condensation, data display, and drawing/verifying conclusions. Meaning units were coded, similar codes were gathered into subcategories, and these were integrated under themes. In the findings section, direct quotations are provided for each theme, transparently demonstrating the connection of the interpretations to the data.

Validity, Reliability, and Ethics

Validity and reliability were addressed through the criteria of credibility, transferability, dependability, and confirmability proposed by Lincoln & Guba (1985). For credibility, the documents were examined repeatedly, and the findings were supported with direct quotations. For transferability, the research design, data sources, coding framework, and analysis steps were presented with thick description. For dependability, the coding framework and decision rules were recorded in a written codebook; in addition, approximately 25% of the documents were re-coded 2 weeks apart to test intra-coder consistency, and a high level of agreement was observed. For confirmability, an audit trail showing on which meaning units each theme was based was created; the coding decisions were submitted to the confirmation of a field expert and finalized by consensus. Accepting that the researcher is the

Table 1.
Coding Framework Used in the Research

Theme	Subcode	Indicator
Explicit use of analogy	Analogy as a reasoning approach	Direct mention of the reasoning skill in the form of induction/deduction/analogy
	Analogy/comparison expressions	Explicit comparison prompts such as "What did you liken it to?" and "establishing similarity"
Concretization and modeling	Physical modeling	Representing an abstract phenomenon with concrete material (cotton, balloon, and recycled material)
	Embodied concretization	Enacting the concept through dramatization, role-play, and bodily movement
	Symbolic representation	Representing a phenomenon with color, symbol, or a visual
Scientific thinking skills	Observation-classification-prediction	Employing scientific process skills within the activity
	Inference and inquiry	Data/observation-based inference, model construction, and inquiry
Relation to conceptual learning	Connecting with prior knowledge	Associating with daily life/previous experience
	Making the abstract concept accessible	Teaching the abstract target concept through a concrete source
Guidance for the teacher	Attention to the limitations of analogy	Warning about source-target mismatch and the risk of misconception

primary instrument that selects, codes, and interprets the data in document analysis, the findings were audited with direct quotations against the possibility that the theoretical stance might guide the interpretations.

Since this study was conducted on publicly available and officially published documents, it does not involve human participants; therefore, there is no data collection process requiring ethics committee approval. The source of the documents examined was correctly indicated, the quotations were presented without being taken out of context or having their meaning altered, and the principles of scientific ethics were adhered to.

Findings

The findings are presented under four themes: (1) the treatment of analogy and reasoning in the curriculum, (2) concretization and scientific model construction in the science domain skills, (3) the relationship of analogy and concretization with scientific thinking and conceptual learning, and (4) the guidance provided to teachers and the limitations of analogy.

The Treatment of Analogy and Reasoning in the Curriculum

The most salient finding concerning the first research question is that analogy appears in the curriculum not as an implicit connotation but as a directly named reasoning approach. The "reasoning skill," defined within the integrated skills (Conceptual Skills 2) under the conceptual skills component of the curriculum, positions analogy as a path of reasoning on the same level as induction and deduction:

> "It refers to the process of reaching inferences about a given event/topic/situation by using inductive/deductive/analogical approaches." (MEB, 2024a)

This definition is noteworthy in that it makes analogy a cognitive tool that enters the official curriculum at the preschool level. However, it was observed that analogy-based reasoning—unlike induction and deduction—is not differentiated with its own specific process components (identifying the source, making the mapping, showing the limit of the mapping). In other words, analogy is mentioned in the superordinate definition of the skill but is not elaborated at the level of subskills and process components to the same extent as induction and deduction.

Another pattern in which analogy is explicitly employed is asking the child to make comparisons in science activities. For example, in an activity concerning sky observation, children are given the prompts "expresses similarities and differences by stating what they liken the clouds they see in the sky to" and "What did you liken the shape of the clouds to?" (MEB, 2024b). Such prompts ask the child to associate an observed object with a familiar source, that is, to make a basic analogical mapping.

Concretization and Scientific Model Construction in the Science Domain Skills

The findings concerning the second research question show that the curriculum treats concretization as an explicit objective embedded in the definition of a science domain skill. The definition of the "Scientific Model Construction" skill, one of the 10 integrated science domain skills, directly demonstrates this:

> "It involves children explaining scientific events or phenomena using models and benefiting from existing scientific models. For example, concrete models can be developed for the greenhouse effect or the water cycle using simple materials. This skill enables abstract scientific events or phenomena to be concretized and made appropriate to children's age and developmental level." (MEB, 2024b)

The examples of the greenhouse effect and the water cycle given in the definition are classic cases cited in the analogy literature as instances of "abstract target–concrete source" mapping (Clement, 2008; Heywood, 2002). In the activities in the guidebook, numerous examples realizing this concretization orientation were identified, and it was observed that concretization occurs in three different forms: physical modeling, embodied (dramatic) concretization, and symbolic representation. Table 2 summarizes these forms with examples from the curriculum.

These examples show that the curriculum follows a consistent concretization strategy to carry abstract science phenomena into the child's world of experience. In particular, representing the lungs with a balloon, the atmosphere with recycled material, and clouds with cotton strongly overlaps with the principle of "embodied sources grounded in everyday experience" emphasized by Niebert et al. (2012) and with Bruner's (1966) enactive-iconic representational sequence.

The Relationship of Analogy and Concretization with Scientific Thinking and Conceptual Learning

The findings concerning the third research question show that the curriculum presents concretization and analogy not as isolated techniques but in an integrated manner with scientific thinking skills and conceptual learning. In the curriculum's discourse on the science domain, a chain of skills that begins with observation and nourishes scientific thinking is constructed: "The skill of making observations constitutes the first and fundamental step of scientific thinking and of the scientific process components" (MEB, 2024b). Within this chain, model construction and concretization function as a bridge connecting abstract concepts to observation and experience.

The curriculum's approach to conceptual learning is also consistent with the fundamental logic of analogy. The guidebook explicitly

Table 2.
Forms of Concretization and Examples in the Science Domain Guidebook

Form of Concretization	Abstract Target Concept	Concrete Source/Representation	Example Expression (MEB, 2024b)
Physical modeling	Atmosphere	Model made from recycled materials	"The concept of the atmosphere can be concretized with a model that can be prepared from recycled materials."
Physical modeling	Cloud types	Cotton and visuals	"To concretize cloud types, …cotton and visuals of cloud types [brought] to the classroom…"
Physical modeling	Water vapor/condensation	Experiment and activity	"The concepts of water vapor and condensation can be concretized through activities and experiments."
Embodied concretization	Respiration/lungs	Inflating a balloon	"Inflating a balloon in order to concretize breathing and the air filling the lungs …"
Embodied concretization	Pollination, pollen, nectar	Creative drama	"The concepts of 'pollination, pollen, and nectar' being enacted through the creative drama method …"
Symbolic representation	Parts of the day	Colors	"The color representing the morning … noon … orange represents the evening …"

establishes the association of science knowledge with daily life as a principle ("Emphasize the connection of the science domain with daily life in the activities") and states that conceptual skills can be acquired "by being concretized and associated with daily life" (MEB, 2024a). This expression shows that the principle of "building a bridge from the familiar to the unknown," which constitutes the essence of analogy, is embedded in the curriculum's discourse. In addition, examples supporting analogical thinking through cross-domain association were also encountered in the curriculum; for instance, in the association of music and science, it is stated that children can be asked to "establish analogies between the tempo changes in a song and living beings" (MEB, 2024a).

The Guidance Provided to Teachers and the Limitations of Analogy

The findings concerning the fourth research question point to an important gap alongside the curriculum's strengths. The curriculum offers rich examples and general principles (curiosity-orientation, association with daily life, making things enjoyable) for analogy, comparison, and concretization; however, it does not contain a systematic instructional model regarding how analogy is to be structured (selecting the source, making the mapping explicit, showing the point at which the analogy breaks down). No guidance directly corresponding to the steps of "making the mapping explicit" and "discussing the limits of the analogy"—which are central to Glynn's (1991) TWA model—could be identified in the curriculum.

More importantly, the curriculum provides teachers with almost no warning regarding the risks of analogy. No warning was encountered concerning dangers strongly documented in the literature, such as source-target mismatch, leaving the mapping implicit, and an inappropriate analogy giving rise to misconceptions (Duit et al., 2001; Niebert et al., 2012). This suggests that the "analogy competence" required to use analogy effectively (Eriksson et al., 2024) is left to the teacher's prior background. The finding that, in the Turkish context, preservice teachers cannot fully establish the source-target relationship in an analogy and do not warn about mismatches shows that this gap carries a real risk in practice.

Discussion

This research analyzed the Türkiye Century Maarif Model Preschool Education Curriculum and the Science Domain Teacher Guidebook in terms of the analogy method and revealed that the curriculum offers notable opportunities regarding scientific thinking, conceptual learning, and concretization but contains an important gap concerning the systematic use of analogy and risk management.

The most noteworthy finding of the research is that analogy appears in the curriculum as a directly named reasoning approach. The placement of analogy alongside induction and deduction in the reasoning skill shows that the curriculum adopts a contemporary understanding consistent with the cognitive science literature; indeed, Gentner's (1983) structure-mapping theory positions analogy as one of the fundamental mechanisms of human cognition. However, there is an important interpretive limit here: in the curriculum, the term "analogy" explicitly appears mainly in a single skill definition, whereas the study's other findings rest on the interpretation of implicit patterns carrying analogical logic (comparison, modeling, representation). For this reason, the findings should be read not as the curriculum "adopting analogy as a central method," but as the curriculum "offering a conceptually open ground for analogical thinking while not structuring it methodologically." The fact that analogy-based reasoning is not elaborated with process components as detailed as those of induction and deduction also supports this interpretation.

The curriculum's placement of concretization within the definition of a science domain skill (scientific model construction) and its representation of abstract targets such as the atmosphere, the lungs, and clouds through familiar and embodied sources are consistent with both the analogy literature and early childhood learning theories. The study by Niebert et al. (2012) stating that effective analogies must rest on embodied sources and Bruner's (1966) enactive-iconic-symbolic representational sequence overlap with the curriculum's selection of concrete, sensory sources such as the balloon (lungs) or cotton (clouds). In this respect, the curriculum offers a developmentally defensible and rich repertoire for carrying abstract science concepts into the child's world of experience.

On the other hand, the absence of guidance regarding the risks of analogy is a critical shortcoming. As Duit et al. (2001) showed, the same analogy can both support and hinder conceptual change; Brown & Clement's (1989) proposal of bridging analogies and Glynn's (1991) emphasis on explicit mapping reveal that merely "presenting" an analogy is not sufficient. The curriculum's failure to provide teachers with structured support on this dimension leaves the effective use of analogy largely to the teacher's individual analogy competence (Eriksson et al., 2024). Findings in the Turkish context make this concern concrete: preschool teachers frequently turn to direct instruction and ready-made materials in science activities (Karademir et al., 2020), learning weakens when they do not introduce concepts explicitly (Gelir, 2022), and preservice teachers experience difficulty establishing the source-target mapping in an analogy. Therefore, the curriculum's strong orientation at the level of discourse may lead to differences in quality in practice when it is not supported by concrete guidance for the teacher.

Conclusion and Recommendations

When these findings are evaluated as a whole, it can be said that the curriculum strongly adopts analogy and concretization at the level of discourse and examples, but falls short in transforming this into a systematic instructional model and risk awareness. This pattern is not unique to this curriculum; it also overlaps with the general tendency for curricula and instructional materials to use analogy mostly in an implicit and unsystematic manner (Sezer & Karataş, 2022).For

curriculum developers, it may be recommended that analogy-based reasoning within the reasoning skill be elaborated with its own process components (identifying the source, making the mapping, showing the limit of the mapping), and that brief teacher notes on the effective use of analogy and on possible misconception risks be added to the guidebooks. For teachers, it is recommended that the similarities between source and target be discussed explicitly with children in concretization activities and that attention be drawn to the limits of the analogy ("the lungs resemble a balloon but are not exactly a balloon"), and that multiple and bridging analogies be used when necessary. For teacher education and in-service training, it is necessary to develop preschool teachers' analogy competence in its conceptual, procedural, and application dimensions. Future research may go beyond the written intent of the curriculum and examine, through observations and interviews, how teachers employ analogy in the classroom; may comparatively analyze the guidebooks of different domains; and may test, through experimental designs, the effect of analogy-based preschool science activities on children's conceptual learning.

Limitations

The research has some limitations. First, the study is limited to only two official documents (the main curriculum and the Science Domain Teacher Guidebook); the guidebooks of other domains were left outside its scope. Second, document analysis analyzes the "written intent" of the curriculum; it does not directly show the actual implementation of the curriculum in the classroom. Third, since the process of identifying the implicit forms of analogical logic is open to interpretation, other researchers may arrive at different codings; this limitation was minimized through a detailed coding framework, expert confirmation, and intra-coder consistency checks.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: During the preparation of this work, the author(s) used a generative AI-assisted technology (Claude, Anthropic) solely to improve the language, readability, and formatting of the manuscript, under human oversight and control. The study design, data collection, analysis, interpretation of findings, and scientific conclusions were carried out entirely by the author(s). The author(s) carefully reviewed and edited the AI-assisted output and take full responsibility for the content of the publication. Generative AI has not been listed as an author or co-author.

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References

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. [CrossRef]

Brown, D. E., & Clement, J. (1989). Overcoming misconceptions via analogical reasoning: abstract transfer versus explanatory model construction. *Instructional Science*, *18*(4), 237–261. [CrossRef]

Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.

Capron Puozzo, I., & Audrin, C. (2021). The investigation of preservice science teachers' analogical reasoning skills from thinking skills. *Thinking Skills and Creativity*, *42*, 100966. [CrossRef]

Chiu, M.-H., & Lin, J.-W. (2005). Promoting fourth graders' conceptual change of their understanding of electric current via multiple analogies. *Journal of Research in Science Teaching*, *42*(4), 429–464. [CrossRef]

Clement, J. (2008). The role of explanatory models in teaching for conceptual change. In S. Vosniadou (Ed.). *International handbook of research on conceptual change* (pp. 417–452). New York, NY: Routledge.

Duit, R. (1991). On the role of analogies and metaphors in learning science. *Science Education*, *75*(6), 649–672. [CrossRef]

Duit, R., Roth, W.-M., Komorek, M., & Wilbers, J. (2001). Fostering conceptual change by analogies—Between Scylla and Charybdis. *Learning and Instruction*, *11*(4–5), 283–303. [CrossRef]

Eriksson, S., Gericke, N., & Thörne, K. (2024) [Advance online publication]. Analogy competence for science teachers. *Studies in Science Education*, *62*(1), 41–69. [CrossRef]

Fragkiadaki, G., Fleer, M., & Rai, P. (2022). Science concept formation during infancy, toddlerhood, and early childhood: developing a scientific motive over time. *Research in Science Education*, *53*(2), 275–294. [CrossRef]

Gelir, I. (2022). Preschool children learn physics, biology, chemistry and forensic science knowledge with integrated teaching approaches. *International Journal of Early Years Education*, *30*(4), 891–905. [CrossRef]

Gentner, D. (1983). Structure-mapping: a theoretical framework for analogy. *Cognitive Science*, *7*(2), 155–170. [CrossRef]

Glynn, S. M. (1991). Explaining science concepts: a teaching-with-analogies model. In S. M. Glynn, R. H. Yeany & B. K. Britton (Eds.). *The psychology of learning science* (pp.219–240). Hillsdale, NJ: Erlbaum.

Heywood, D. (2002). The place of analogies in science education. *Cambridge Journal of Education*, *32*(2), 233–247. [CrossRef]

Karademir, A., Kartal, A., & Türk, C. (2020). Science education activities in Turkey: a qualitative comparison study in preschool classrooms. *Early Childhood Education Journal*, *48*(3), 285–304. [CrossRef]

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed). Thousand Oaks, CA: SAGE PUBLICATIONS.

Larimore, R. A. (2020). Preschool science education: a vision for the future. *Early Childhood Education Journal*, *48*(6), 703–714. [CrossRef]

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: SAGE PUBLICATIONS.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook* (2nd ed). Thousand Oaks, CA: SAGE PUBLICATIONS.

Millî eğitim bakanlığı [MEB] (2024a). *Türkiye Yüzyılı Maarif Modeli okul öncesi eğitim programı*. Ankara: Temel Eğitim Genel Müdürlüğü.

Millî eğitim bakanlığı [MEB] (2024b). *Türkiye Yüzyılı Maarif Modeli okul öncesi eğitim programı: Fen alanı öğretmen kılavuz kitabı*. Ankara: Devlet Kitapları, Temel Eğitim Genel Müdürlüğü.

Niebert, K., Marsch, S., & Treagust, D. F. (2012). Understanding needs embodiment: a theory-guided reanalysis of the role of metaphors and analogies in understanding science. *Science Education*, *96*(5), 849–877. [CrossRef]

O'Connor, G., Fragkiadaki, G., Fleer, M., & Rai, P. (2021). Early childhood science education from 0 to 6: A literature review. *Education Sciences*, *11*(4), 178. [CrossRef]

Ramanathan, G., Carter, D., & Wenner, J. (2022). A framework for scientific inquiry in preschool. *Early Childhood Education Journal*, *50*(7), 1263–1277. [CrossRef]

Sezer, K., & Karataş, F. Ö. (2022). Research trends about analogy studies in science education: a descriptive content analysis. *Journal of Science Learning*, *5*(2), 217–225. [CrossRef]

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Yıldırım, A., & Şimşek, H. (2021). *Sosyal bilimlerde nitel araştırma yöntemleri* (12. baskı). Ankara: Seçkin Yayıncılık.

Zamalloa, T., Salgado, M., & Berciano, A. (2025). How to promote scientific practices in early childhood education: the teachers' role. *International Journal of Science and Mathematics Education*, *23*(7), 2975–2995. [CrossRef]