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Interacción entre físicos y profesoras de preescolar para desarrollar estándares de ciencia

Interaction between Physicians and Preschool Teachers to Develop Standards of Science

Interação entre físicos e professores de pré-escola para desenvolver padrões científicos

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Resumen

En este artículo se abordaron dos problemáticas en la impartición de ciencias en los niveles básicos en México. Por un lado, la falta de un proceso metodológico que les permita a los profesores de ese nivel abordar las líneas de trabajo que de manera ambigua se proponen ahí; por otra parte, la problemática que tienen los docentes en este nivel para expresar de manera adecuada los conceptos. Como caso de estudio se analizó el nivel preescolar, debido a que es de los primeros momentos en que un niño tiene contacto con esta área del conocimiento de manera formal, y para ello se utilizaron específicamente temas de física.

En este trabajo se muestran los resultados de la interacción entre físicos y profesoras de preescolar mediante la impartición de un microtaller con la intención de generar una idea clara de los fenómenos estudiados. Se utilizaron diversos instrumentos e indicadores de evaluación. En el caso de los conocimientos adquiridos por las maestras de preescolar, se diseñó una rúbrica basada en los niveles de logro contemplativo, reproductivo y productivo de los productos del portafolio de evidencias generadas en el taller. En el caso de la opinión de las profesoras de preescolar sobre la utilidad del taller para su labor docente, se diseñó una rúbrica basada en los niveles de satisfacción en rubros del taller como los contenidos, conocimientos y estrategias usadas. Mediante entrevistas clínicas se estudió la opinión acerca de la interacción entre ambos grupos. Todos los instrumentos utilizados son de carácter cualitativo dado el perfil de la investigación. Se pudo observar que, como resultado del taller, las profesoras de preescolar alcanzaron un lenguaje formal para los diferentes temas de física que se desarrollaron, formularon hipótesis para la explicación de los fenómenos estudiados y emplearon analogías de la vida cotidiana, llegando a niveles de aprendizaje reproductiva más allá del nivel productivo o solo contemplativo. Finalmente, la interacción alcanzada se manifestó como positiva entre ambos grupos, de manera que enriqueció el quehacer profesional mutuo, muestra de ello es el interés de ambos grupos de continuar y profundizar con estas actividades.

Palabras clave: educación preescolar, enseñanza de la física, formación docente.

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Abstract

In this paper, we focused in two problems about teach science in basic level in Mexico. These are lack of a methodological processes that allow to basic level teacher an approach about work lines that are proposed there; on the other hand, the problems that have teachers on this level to expressed correctly the concepts. Like a study case we analyzed preschool level, because is the first time when a child has contact with this knowledge area in a formal way, for this we used particularly themes of physics.

In this paper we show the results of the interaction between physical and preschool teachers, through micro-workshop, seeking to generate a clear idea of the phenomena studied. Various instruments and evaluation indicators were used. In the case of the knowledge acquired by the preschool teachers, a rubric was designed based on the levels of contemplative, reproductive and productive achievement of the products of the evidence portfolio generated in the workshop. In the case of the opinion of the preschool teachers about the usefulness of the workshop for their teaching, a rubric was designed based on the levels of satisfaction in items of the workshop such as the contents, knowledge and strategies used. Through clinical interviews, the opinion about the interaction between both groups was studied. All the instruments used are of a qualitative nature given the profile of the research. It was observed that as a result of the workshop the preschool teachers reached a formal language for the different physics subjects that were developed, formulated hypotheses for the explanation of the phenomena studied and used analogies of everyday life, reaching more reproductive learning levels beyond the productive level or just contemplative. Finally, the interaction reached was expressed as positive between both groups, in a way that enriched the mutual professional work, shows of it is the interest of both groups to continue and deepen with these activities.

Keywords: preschool education, teaching physics, teachers training.

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Resumo

Este artigo abordou dois problemas na entrega da ciência nos níveis básicos no México. Por um lado, a falta de um processo metodológico que permita aos professores desse nível abordar as linhas de trabalho que são propostas ambiguamente; por outro lado, o problema que os professores têm neste nível para expressar adequadamente os conceitos. Como estudo de caso, analisou-se o nível pré-escolar, pois é a primeira vez que uma criança tem contato com essa área do conhecimento de forma formal, e para isso foram utilizados tópicos específicos da física.

Este artigo mostra os resultados da interação entre físicos e professores de pré-escola, dando uma microtaller com a intenção de gerar uma ideia clara dos fenômenos estudados. Vários instrumentos e indicadores de avaliação foram utilizados. No caso do conhecimento adquirido pelos professores da pré-escola, uma rubrica foi concebida com base nos níveis de realização contemplativa, reprodutiva e produtiva dos produtos da carteira de evidências gerada na oficina. No caso da opinião dos professores de pré-escola sobre a utilidade da oficina para o seu ensino, uma rubrica foi desenhada com base nos níveis de satisfação em itens da oficina, como os conteúdos, conhecimentos e estratégias utilizadas. Por meio de entrevistas clínicas, a opinião sobre a interação entre os dois grupos foi estudada. Todos os instrumentos utilizados são de natureza qualitativa, dado o perfil da pesquisa. Observou-se que, como resultado da oficina, os professores de pré-escola chegaram a uma linguagem formal para os diferentes sujeitos de física que foram desenvolvidos, formularam hipóteses para a explicação dos fenômenos estudados e utilizaram analogias da vida cotidiana, atingindo níveis de aprendizagem reprodutiva além do nível produtivo ou apenas contemplativo. Por fim, a interação alcançada foi expressa como positiva entre os dois grupos, de tal forma que enriqueceu o trabalho profissional mútuo, um exemplo disso é o interesse de ambos os grupos em continuar e aprofundar com essas atividades.

Palavras-chave: educação pré-escolar, educação física, formação de professores.

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Introduction

In the preschool education (PEP) programs of the Secretariat of Public Education of Mexico (SEP), the development of four science standards is promoted, namely 1) scientific knowledge, 2) applications of scientific knowledge and technology, 3) skills associated with science and 4) attitudes associated with science (SEP, 2011). In addition, the progression through these standards considers the acquisition of a basic vocabulary to advance in the construction of a scientific language, development of greater capacity to interpret and represent natural phenomena and processes, as well as the growing linkage of scientific knowledge with other disciplines. to explain phenomena and natural processes, and their application in different contexts and situations of social and environmental relevance.

However, in order to develop these skills and reach these standards, there are two problems. First, there are no specific tertiary PEP derivatives that allow preschool teachers to develop the aforementioned science standards. And second, the training in science of basic education teachers, particularly those of pre-school education, is small, which complicates the development of these standards. (This paper will talk about preschool teachers because the vast majority of teachers at this level are women). The objective of this work is to investigate this second problem, from the training of preschool teachers in science and to give a solution option.

The 2011 Preschool Education Program is based on the constructivist methodology, from which the child builds his learning, and the role of the educator is to be a guide, accompanist in the teaching-learning process. In addition, its purpose is that all children who complete the kindergarten have the exit profile that marks the program. The teachers who graduated before 2012 did not have a similar approach, since they were trained based on the 1981 curriculum (Annex 1), in which, in addition, the education of the educators did not involve science content. As of 2012, in response to educational policies and reforms in Mexico, the curriculum for the Bachelor of Early Childhood Education was modified (Annex 2): among the changes it is observed that there are two science-oriented courses: "Exploration of the natural environment in preschool "and" Approach to natural sciences in preschool ". In an interview with pre-school teachers in Mexico City, they stated, among several points, the following:

> Although the new generations have been working with this new curriculum, the "practitioners" (the teachers in training) also do not have the bases to approach with the preschool children a little deeper topics about science in pre-school education, since that they, like the teachers who were trained with the previous plans, do not know, understand or identify the correct way to work with children in the formative field of exploration and knowledge of the environment.

They also stated that "they rarely worked with children, and if they did, they were only isolated experiments without an explanation", as well as "they were interested in participating in the basic physics course to learn".

On the other hand, unfavorable attitudes have been found that teachers at the basic level have towards science (García-Ruiz and Sánchez, 2006), as well as ideas of the same nature that they have about scientists and their work (Briseño and Benarroch, 2013, Guerra, 2006, Guerra y Perales, 2014, Vázquez and Manassero, 1999).

In preschool, teachers think that it is viable to promote scientific vocations in children (Nieto, 2015) through the manipulation of objects and the realization of experiments. However, because they have a very vague idea of what science means, they can not properly guide their students (Pozo and Gómez, 1996, Sañudo and Perales, 2014). To solve this problem, some activity manuals have been prepared to deal with some specific topics in science -as an example, Rodríguez and Botello (2011) -, but in essence it is a compendium of experiments that indicate how to carry out an activity with confusing explanations for the preschool education professional. As a result, the activities become mechanized for those who direct them and for those who carry them out, which has the consequence that they feel incapable of answering all the questions of the children. Likewise, the progression of standards such as the transition from an everyday language to a scientific one is complicated by the acquisition of basic vocabulary or the development of a greater capacity to interpret and represent natural phenomena and processes. As expressed by a preschool director interviewed:

The educators have not had a knowledge base focused on science, only this field was worked with "experiments" that did not have a clear explanation and many times the teacher did not use the appropriate language to explain the experiments to the children, so which also do not have clarity in the questions that must propitiate in the students to achieve the competences that marked the 2011 Preschool Education Program.

It is in this context that this article emerges and the initiative of a group of preschool teachers to meet to find a solution that could correct these shortcomings in the teaching staff, so they approached a group of physics professionals for design and delivery of a science workshop. This group of physicists proposed the topic of electricity, since they know experiences with preschool students in other countries (Starci, 2012, Goldberg, Bendall and Mckean, 2012, Onderova, Jeskova and Kires, 2012, Susman, Rihtarsic, Gostincar and Cepic, 2012).

The research question was as follows: What is the impact of introducing a workshop on electrical phenomena in the training of preschool teachers?

This question generated the following hypothesis: The interaction between physicists and preschool teachers through the electrical phenomena workshop generates a level of productive achievement in teacher training.

The objective of this work, therefore, was to investigate how it favors the training of preschool teachers the interaction with physics professionals from the workshop that consists of a microtema of physics. The planning of the course considered simple experiments, elaboration of evaluation rubrics generated by preschool teachers and by experts for the analysis of conceptual maps generated by those who take the workshop.

Method

This research was developed under the paradigm of qualitative research, in which. according to Hernández, Fernández and Baptista (2010), "it uses data collection without numerical measurement to discover or refine research questions in the interpretation process (p.9)".

The foregoing because measuring the "interaction between physicists and preschool teachers" is a subjective variable and interpretation, as indicated by the same Hernández, Fernández and Baptista (2010):

> The qualitative approach is based on non-standardized or completely predetermined data collection methods. There is no numerical measurement, so the analysis is not statistical. The collection of the data consists of obtaining the perspectives and points of view of the participants (their emotions, priorities, experiences, meanings and other subjective aspects). The interactions between individuals, groups and collectives are also interesting (p. 9).

In particular, the narrative research design was followed, since the key element of the narrative data is personal or group experiences. This narrative should include a chronology of experiences and events. The context is located according to the approach of the problem, the researcher interviews the actors (collects data in the participants' own language).

Design of the investigation

A group of physicists was formed by four professors from the National Polytechnic Institute (IPN), two of them doctors from the School of Physics and Mathematics, another teacher from the Interdisciplinary Professional Unit in Engineering and Advanced Technology and, finally, a doctor from Center for Research in Applied Science and Advanced Technology; all of them with more than 20 years of experience in teaching and research, particularly in educational research with respect to the learning of physics in different educational levels. And a group of three teachers who work at the preschool level, two as teachers and one director in Mexico City; all of them with more than 10 years of experience in this level and with postgraduate studies in educational physics. This interaction was possible due to contact with one of the teachers who was doing postgraduate studies in educational physics, who served as a link between the two groups. The group of professors exposed the problems they face at that level when trying to develop the science standards demanded by the SEP (2011). From the above, the proposal to design a microtaller that would help them face the problems raised arose. The subject of electricity was suggested, since it is consistent with the field of knowledge formation of the world that is addressed in preschool, what the teachers liked; also because in the literature this topic is widely reported internationally (Akarsu, 2007, Sariyaka, 2007, Atwood, Christopher, Combs and Roland, 2010, Konyulu and Dökme, 2011).

The research was developed in two stages. In the first stage, after the first contact between the group of physicists and the preschool teachers, a diagnostic questionnaire was constructed to identify the level of knowledge and training needs. This questionnaire was applied to a sample

group of 15 preschool teachers from Mexico City. Some questions of the questionnaire were the following: What is science for you? Have you participated in projects that help you integrate scientific issues with your students? How do you feel when you approach scientific topics in your class? With what physics topics would you like your students to learn / play? Would you like to learn about physics? On what?

Based on the answers to the questionnaire, the group of physicists worked on the proposal of the microtaller, its implementation and the creation and application of instruments for its evaluation.

The second stage consisted in the analysis of the evidence from the workshop, which were obtained through video recordings, evidence portfolios and interviews of both the group of physicists and the preschool teachers participating in the workshop.

The program of the workshop

For the content of the workshop, the group of physicists considered a time of 40 hours (face-to-face and non-face-to-face) in which preschool teachers would question the importance of carrying out different experimental activities related to electricity and analyze experiences that would allow conclusions to be drawn. on the origin and concept of electric charge.

As subjects, Coulomb's law and its relationship with the concept of force, the concept of an electric field based on analogies, defining what is an insulator and a conductor, as well as introducing in a basic way Ohm's law, the symbology were proposed of voltage and electrical current and finally propose in a simple way electrical circuits by series and parallel arrangements. From the above described, the proposal of the program to be developed was made, which is shown in table 1.

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Tabla 1. Programa del Taller de Física para Preescolar

Título: TALLER DE FÍSICA PARA PREESCOLAR	
Tipo de programa de formación: TALLER Nivel académico del programa: CURSO DE FORMACIÓN.	Destinatarios: PROFESORAS DE NIVEL PREESCOLAR Modalidad: MIXTO
Contenido, temática o asignatura: MICROTEMA DE FÍSICA (ELECTRICIDAD) PARA SU ENSEÑANZA EN EL NIVEL PREESCOLAR A PARTIR DE EXPERIMENTOS SENCILLOS. Propósito general: QUE EL DOCENTE DE PREESCOLAR PUEDA RELACIONAR CONCEPTOS DE ELECTRICIDAD BÁSICA A TRAVÉS DE EXPERIMENTOS SENCILLOS.	
Competencias a desarrollar: - Reconocer la presencia de fenómenos eléctricos en la naturaleza mediante experimentos sencillos relacionados con la vida cotidiana, definiendo los conceptos involucrados en la electricidad e identificando las posibles relaciones entre las variables eléctricas. - Relacionar las variables electrostáticas y eléctricas presentes en experimentos relacionados con la vida cotidiana generalizando los fenómenos para identificar las leyes que las rigen. - Explicar el funcionamiento de distintas configuraciones de circuitos eléctricos, operando con diferentes configuraciones de circuitos eléctricos e ilustrando la aplicación de las leyes de la electricidad. - Aplicar los conocimientos de electricidad para la elaboración de diferentes configuraciones de circuitos eléctricos proponiendo experimentos eléctricos y electrostáticos relacionados con la vida cotidiana.	
Temas o contenidos a desarrollar: 1. CONCEPTOS DE ELECTROSTÁTICA. 2. FUERZA ELÉCTRICA Y LEY DE COULOMB. 3. DEFINICIÓN DE CORRIENTE, VOLTAJE Y RESISTENCIA. 4. CONFIGURACIÓN DE LOS CIRCUITOS. 5. LEY DE OHM.	

Tema	**Estrategia de aprendizaje**	**Horas**
1. Introducción 1.1. Introducción e importancia de la electricidad en la vida diaria	Conociendo nuestro entorno Lluvia de ideas	1
2. Electrostática 2.1. Distinguir las diferentes formas de electrización	Pelos de punta Exploración de las diferentes formas de electrización (actividad transversal).	2
2.2. Evidenciar la presencia de fuerzas	Electrizando Indagación experimental: Pegado de un globo en una pared y porqué se pega un cabello en un globo, acercamiento de dos globos frotados y sin frotar.	3
2.3. Identificar el origen atómico de la electrización	Manos a la obra	3

y entender el concepto de electrostática.	A partir de diversos experimentos de frotación se muestra la presencia del fenómeno de electrización, empleando diversos materiales tales como confeti, papel aluminio y agua.	
2.4. Concepto de polarización	El fantasma eléctrico Se experimentó con el péndulo electrostático sin carga y con carga y diversos tipos de electroscopios, para observar el fenómeno de polarización. Además, se discutió la polarización en diversos materiales, a saber, agua, aluminio y confeti.	3
2.5. Fuerza eléctrica 2.5.1. Fuerza de origen eléctrico y su efecto a distancia por la presencia de un campo 2.5.2 Fuerzas de atracción y repulsión (ley de Coulomb)	Comiendo con Coulomb Se experimentó con popotes cargados eléctricamente por frotación para sentir y ver la presencia de una fuerza eléctrica. Se introdujo el concepto de campo eléctrico.	4
3. **Definiciones de corriente, voltaje y resistencia** 3.1 Cargas libres en un campo eléctrico y su aplicación en el entorno cotidiano	¿Por qué cayó el ahorcado? Mediante analogías con el entorno se explica lo que sucede con las cargas libres en presencia de un campo eléctrico y se introduce la idea de movimiento de cargas.	4
3.2 Clasificación de los materiales en conductores y aislantes	¿De dónde salen las cargas? Mediante el uso de un circuito eléctrico con una lámpara alimentada por una pila, se prueban diferentes materiales para mostrar quién permite el paso de la corriente al encender la lámpara, lo que permite identificar a los materiales que conducen la corriente eléctrica y los que son aislantes. Posteriormente, se mostró el circuito eléctrico y su circuito equivalente hidráulico. Además, se introdujo la nomenclatura de los circuitos eléctricos.	3
3.3 Asociar el concepto de almacenamiento de cargas con voltaje	¡Ponte las pilas! Se realiza la analogía entre los tanques de agua como almacenes y las pilas eléctricas. Lo que se asocia con la variación del flujo de agua y de la corriente eléctrica.	2
3.4 Asociar la oposición del movimiento de cargas a la definición de resistencia	Se realiza la analogía entre el flujo de agua y corriente eléctrica que transita por una manguera al disminuir o aumentar su diámetro Lo que se asocia con el concepto de resistencia.	3
4. Configuración de circuitos eléctricos 4.1 Manejo de los equipos que facilitan la medición de corriente, voltaje y resistencia	Mi polímetro Se describe el uso del multímetro y sus partes principales.	3

4.2 Circuito serie y sus relaciones entre corriente voltaje y resistencia 4.3 Circuito paralelo y sus relaciones entre corriente voltaje y resistencia	La escalera de la navidad Se hace uso del multímetro para poder medir las variables de resistencia, voltaje y corriente para las configuraciones de serie y paralelo	3
5. Ley de Ohm 5.1 Reconocer la relación que existe entre corriente, resistencia y voltaje	¡A medir! Se analizan las mediciones de corriente, voltaje y resistencia realizadas para relacionarlas concluyendo la ley de Ohm	3
5.2 Concluir la ley de Ohm.	¡A saltar! Se utilizaron diferentes materiales La definición de carga podemos entender porque algunos materiales pueden adquirir carga y para ello se emplearán algunos experimentos. Papelitos, globos, electroscopio, soporte. Evidenciar que existe una transferencia de carga por frotamiento Mostrar que también que la fuerza eléctrica supera al peso del confeti. Evidenciar que la fuerza eléctrica supera a la fuerza de la gravedad o peso. Evidenciar que siempre existe una fuerza de atracción entre el objeto cargado eléctricamente y el confeti.	3
Recursos didácticos a utilizar		
Facilitador	Recursos audiovisuales, Pizarrón, plumines, Varilla de vidrio, piel de conejo, franela, electroscopio, multímetro, leds, focos, interruptores, alambres, plastilina Play Dooh, lápiz, clips, pilas, portapilas, interruptores. Kit electrostático que consta de: péndulo electrostático, popotes, papel aluminio y confeti, trozo de plastilina, hilo, esfera de unicel, regla de plástico, un globo.	
Participante	Kit electrostático que consta de: péndulo electrostático, popotes, papel aluminio y confeti, trozo de plastilina, hilo, esfera de unicel, regla de plástico, un globo. Kit de circuito: base de cartón, un apagador sencillo, dos lámparas, cables, dos pilas, portapilas, materiales conductores y aislantes, multímetro con cables. Pizarrón, plumines.	

Fuente: Elaborada por el grupo de físicos que formó parte de esta investigación

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Workshop evaluation

On the part of the preschool group, a rubric was developed and applied to evaluate the levels of achievement achieved in the workshop, with respect to the following criteria: content, domain of the topic, strategies and organization, in a way that was consistent with what was requested by the SEP (Tonucci, 2006). This rubric is shown in figure 1.

Figura 1. Rúbrica de evaluación del taller

RUBRICA

CURSO-TALLER DE FÍSICA PARA EDUCADORAS

Tarea de Desempeño: CREAR UN CURSO-TALLER DE CIENCIAS, ENFOCADO A PROFESORAS DE JARDIN DE NIÑOS, CON LA FINALIDAD DE LOGRAR LA COMPRENSIÓN DE CONCEPTOS DE FÍSCA, QUE APOYEN EN LA ENSEÑANZA DE LAS CIENCIAS NIVEL PREESCOLAR.

NIVELES DE LOGRO	NOVATO	APRENDIZ	VETERANO	MAESTRO
CRITERIOS				
CONTENIDO	No existe relación con los aprendizajes esperados del Programa de Educación Preescolar	Se enfoca a un aspecto especifico relacionado con el Programa de Educación Preescolar.	Se menciona algunos aspectos relacionados con el Programa de Educación Preescolar.	Se relaciona directamente con el Campo Formativo, Competencias y Aprendizajes Esperados del Programa de Educación Preescolar
CONTENIDO	No hay relación con los estándares curriculares de Ciencias en el nivel preescolar. • Conocimiento científico • Aplicaciones del conocimiento científico y la Tecnología. • Habilidades asociadas a la ciencia. • Actitudes asociadas a la ciencia.	Apoya a desarrollar uno de los estándares curriculares de ciencias en el nivel Preescolar. • Conocimiento científico • Aplicaciones del conocimiento científico y la Tecnología. • Habilidades asociadas a la ciencia. • Actitudes asociadas a la ciencia.	Apoya a relacionar parte de los estándares curriculares de Ciencias en el nivel Preescolar. • Conocimiento científico • Aplicaciones del conocimiento científico y la Tecnología. • Habilidades asociadas a la ciencia. • Actitudes asociadas a la ciencia.	Apoya al desarrollo de los estándares curriculares de Ciencias en el nivel Preescolar. • Conocimiento científico • Aplicaciones del conocimiento científico y la Tecnología. • Habilidades asociadas a la ciencia. • Actitudes asociadas a la ciencia.
DOMINIO DEL TEMA	Desconoce los temas y conceptos que plantea dentro del curso.	Conoce algunos temas y conceptos que plantea dentro del curso, se le dificulta bajar el nivel para que pueda ser comprendido y trabajado por maestras de educación preescolar.	Conoce los temas y conceptos que plantea dentro del curso, y trata de bajar el nivel para que pueda ser comprendido y trabajado por maestras de educación preescolar.	Conoce y domina los temas y conceptos que plantea dentro del curso, y baja el nivel para que pueda ser comprendido y trabajado por maestras de educación preescolar.
ESTRATEGIAS	Plantea estrategias poco interesantes y estimulantes y no pueden aplicarse con alumnos de nivel preescolar.	Plantea algunas estrategias interesantes y estimulantes que pueden o no ser aplicadas con alumnos de nivel preescolar	Plantea estrategias interesantes y estimulantes y la mayoría pueden ser aplicadas con alumnos de nivel preescolar	Plantea estrategias interesantes y estimulantes que pueden ser aplicadas con alumnos de nivel preescolar
ORGANIZACIÓN	No utiliza el tiempo adecuadamente, quedando conceptos confusos y no aclara dudas.	Utiliza el tiempo para que las profesoras asimilen conceptos, alargando los periodos de las estrategias y no aclara dudas.	Permite a las profesoras asimilar los conceptos y aclarar dudas.	Utiliza el tiempo adecuadamente, permitiendo a las profesoras asimilar los conceptos y aclarar dudas.

Fuente: Elaborada por las profesoras de preescolar que participaron en esta investigación

To evaluate the understanding of physics concepts in preschool teachers, the group of physicists proposed a portfolio of evidences (mental map, notes, planning exposition of their model class). The evaluation of this was done through a rubric that considers the level of achievement achieved versus the competencies described above (see table 2).

Tabla 2. Rúbrica de niveles de logro

Nivel de logro	Productivo	Reproductivo	Contemplativo
Rubro	Relacionar las variables electrostáticas y eléctricas presentes en experimentos relacionados con la vida cotidiana generalizando los fenómenos para identificar las leyes que las rigen. Reconocer la presencia de fenómenos eléctricos en la naturaleza definiendo los conceptos involucrados.	Reconoce y relaciona las variables electrostáticas y eléctricas presentes en experimentos, pero no las relaciona con la vida cotidiana.	Conoce las variables electrostáticas y eléctricas presentes en experimentos. Reconocer la presencia de fenómenos eléctricos en la naturaleza.
Mapa mental			
Participación	Aplicar los conocimientos de electricidad para la elaboración de diferentes configuraciones de circuitos eléctricos proponiendo experimentos eléctricos y electrostáticos relacionados con la vida cotidiana. Relacionar las variables electrostáticas y eléctricas presentes en experimentos relacionados con la vida cotidiana. Explicar el funcionamiento de distintas configuraciones de circuitos eléctricos.	Aplicar los conocimientos de electricidad para la elaboración de diferentes configuraciones de circuitos eléctricos proponiendo experimentos eléctricos y electrostáticos relacionados con la vida cotidiana. Reconoce las variables electrostáticas y eléctricas presentes en experimentos, pero no las relaciona con la vida cotidiana.	Reconoce las variables electrostáticas y eléctricas presentes en experimentos.
Apuntes	Relacionar las variables electrostáticas y eléctricas presentes en experimentos relacionados con la vida cotidiana generalizando los fenómenos para identificar las leyes que las rigen. Reconocer la presencia de fenómenos eléctricos en la naturaleza mediante experimentos sencillos	Relacionar las variables electrostáticas y eléctricas presentes en experimentos. Reconocer la presencia de fenómenos eléctricos en la naturaleza mediante experimentos sencillos.	Tiene problemas para relacionar y reconocer las variables electrostáticas y eléctricas presentes en experimentos sencillos.

	relacionados con la vida cotidiana, definiendo los conceptos involucrados en la electricidad e identificando las posibles relaciones entre las variables eléctricas.		
Exposición	Aplicar los conocimientos de electricidad para la elaboración de diferentes configuraciones de circuitos eléctricos proponiendo experimentos eléctricos y electrostáticos relacionados con la vida cotidiana. Reconocer la presencia de fenómenos eléctricos y electrostáticos en la naturaleza mediante experimentos relacionados con la vida cotidiana, definiendo los conceptos involucrados en la electricidad e identificando las posibles relaciones entre las variables eléctricas. Explicar con el lenguaje especializado el funcionamiento de distintas configuraciones de circuitos eléctricos, operando con ellos e ilustrando la aplicación de las leyes de la electricidad. Relacionar las variables electrostáticas y eléctricas presentes en experimentos relacionados con la vida cotidiana generalizando los fenómenos para identificar las leyes que las rigen.	Reconocer la presencia de fenómenos eléctricos y electrostáticos en la naturaleza mediante experimentos relacionados con la vida cotidiana, definiendo los conceptos involucrados en la electricidad e identificando las posibles relaciones entre las variables eléctricas. Relacionar las variables electrostáticas y eléctricas presentes en experimentos relacionados con la vida cotidiana. Tiene dificultad con el lenguaje especializado al explicar los fenómenos eléctricos y electrostáticos.	Reconocer la presencia de fenómenos eléctricos y electrostáticos en la naturaleza, pero no identifica las posibles relaciones entre las variables eléctricas. Utiliza el lenguaje ordinario durante este proceso.

Fuente: Elaborada por el grupo de físicos que participaron en esta investigación

For the rubric, the levels of achievement were considered following Moltó's definition (2003) of a person's performance levels. Next, we will make a brief characterization of these.

Contemplative

This is the lower level of action. It takes place in the person as a reflection of reality, as a copy as faithful as possible of that reality. In contemplation, action is active, which implies a certain

elaboration of what is contemplated, although not all the relationships that can be reflected are established.

At this level, the person can not make use of the knowledge or the actions and operations that he plans to carry out. In it he requires for his help action. For example, in the case of carrying out a task of introducing new knowledge the level of action of the learner is contemplative.

Reproductive

It is when the person is able to reproduce an object, a knowledge or a way of acting previously contemplated by it. Some of the performances in the realization of exercises tasks performed in classes or extra class are examples of this type of performance

Productive

It is when the person is able to produce an object, knowledge or way of acting, which is new for her or for society. The teaching-learning process usually occurs when the learner comes by himself to a new knowledge or procedure for him or designs a new object.

Results

Based on the answers given by the preschool teachers participating in the initial questionnaire, it was found that for them science is in principle a remote issue. A subject that, although they consider important, do not develop regularly in their classes due to their poor training in this, so they consider it "difficult". Since at the same time they consider science as important and attractive for children, they would like to be more trained in branches and topics of this topic that can lead directly to the classroom, in particular they pointed to electricity as "very attractive" for children. The team of physicists, then, taking up these answers, set out to design a workshop that would cover these expectations, as presented in the previous sections.

In the first topic the workshop started with the questions, have you asked what would happen if we did not have electricity or electricity? and what works with it of what we have in our environment? with the idea of sensitizing the participants of the importance of electricity in daily

life and justifying why it is important to study electrical phenomena. It was argued that one could not work at night, food would decompose, the use of technologies would not be possible, among others.

Topics two, three, four and five were divided into three parts each (see table 1): experimentation, formal theoretical explanation of the concepts and evidence of knowledge production by the teachers.

When starting with some electricity phenomena, it was observed that the preschool teachers spoke in a natural language -as defined by Barojas (2007) -, for example, of a type of energy to refer to electrical phenomena as "there is an energy that it causes the hair to stick "to a rubbed balloon or by" the presence of air "(see figure 2). They also suggested that "the balloon is charged with energy, the energy is stronger than gravity". The above is classified in a level of contemplative achievement, according to the knowledge rubric (table 2), in the exhibition category.

In this regard, physicists relied on the ideas they identified and were guided on the concept of force and energy from their previous conceptions. He called attention to the group of physicists the association that the preschool teachers did with respect to the relationship that exists between force and distance, since, by experience, reaching this level of abstraction is complicated, which, according to the rubric , took the teachers to a productive level of achievement.

In addition, they recognized the presence of the electric force that was given by friction remembering their previous ideas. With the above, it was notorious that the level of reproductive achievement was reached.

Figura 2. Experimentos con globos y papel para observar fenómenos eléctricos

Fuente: Elaboración propia

In addition to their experimental observations, they formulated some hypotheses that led them to think that in the case of the attraction of confetti papers or aluminum foil, the observed phenomenon was the result of "that the lightest object is the one that is attracted". This led physicists to propose an experiment, with objects of equal mass, to refute the aforementioned hypothesis.

The degree of curiosity shown by preschool teachers was of great interest, since the group of physicists is not accustomed to observing such a level where they regularly perform. When commenting with the preschool teachers, they were justified in the following way: "Because this is how they work with children". This implies a step from the purely contemplative level, that is, only observing what is shown by physicists, at a reproductive level where they generate hypotheses.

The teachers related the topics to their daily experience, which led them, thanks to this, to a level of productive achievement. The expositions of the teachers in this stage of the workshop were full of questions, for example, when the atomic origin of the subject was analyzed, where their interest led them to question whether the subject had those characteristics and what was its configuration, all of which It was very pleasing, as they took this idea to ask questions such as "What is cancer?", where many of the answers were given with analogies, which led to a clear idea. This was analyzed from the mental maps, the notes and the participation of the teachers. There were also other important conclusions, such as the formation of crystalline networks. At this point

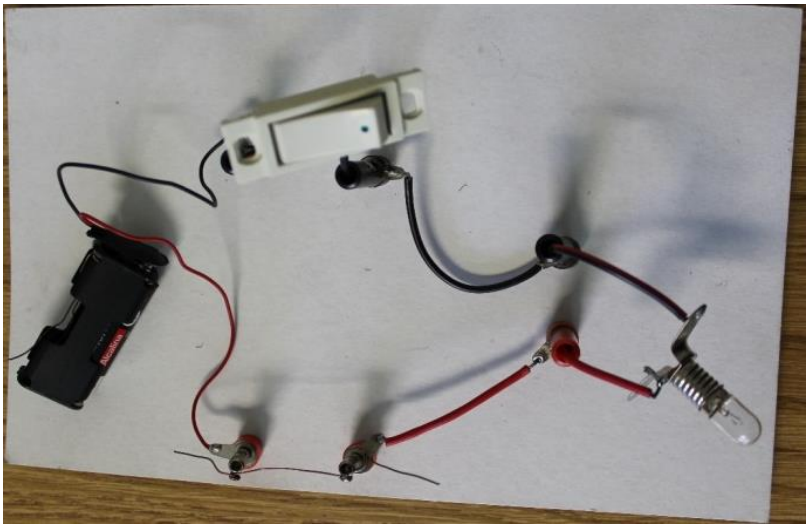
the teachers talked about a "neural network" analogy and the interconnections of the forces that unite the atoms. Likewise, the type of questioning on very diverse subjects of physics was very fruitful, in which the importance of the knowledge of the atom stands out, mainly in the exhibition of them, which, again, arrives at a productive level of achievement, according to the rubric.

The load transfer was analyzed from the use of the electroscope and the electric pendulum. This activity showed an advance in the transition from natural language to formal language by preschool teachers. Another intervention that we found interesting was the following question: "Do the electrons jump when there is no contact between the materials?", Since this question was a trigger for the group of physicists to introduce the topic of polarization.

Through the use of the electric pendulum and the electrometer, the phenomenon of polarization was reinforced. When they were asked to explain the phenomena seen in the pendulum, it was evident that their vocabulary had been enriched by the terms of electricity. Also, when analyzing the forces of attraction and repulsion, they came to the conclusion that with different loads attractive forces were obtained and that this was a result of the materials, and affirmed "that the type of material used to load the objects does influence" . These two activities show how they went from the contemplative level (seen in the initial questionnaire) to the reproductive and even productive levels.

Covered the topics from one to three, went to the next level of experiments, where they were provided with an electrical circuit (like the one shown in Figure 3). From this circuit they were able to identify their component parts and classify some materials as conductors and insulators. In addition, these actions made it easier to understand the concept of electric current, as evidenced by the notes and participations.

Figura 3. Circuito eléctrico



Fuente: Elaboración propia

In addition to the above, measurements were made with a multimeter to identify the magnitudes of resistance, voltage and current. What was new for them, since they are not used to using this equipment in their teaching and, in addition, helped answer the concerns that were generated until then in the workshop. The voltage applied to the circuit was also varied to observe the existing relationships between current, voltage and resistance (Ohm's law). Finally, the two basic configurations in circuits were analyzed: series and parallel. At this point, the teachers reached a productive level by showing their own initiative, since they made a mixed circuit configuration (not included in the workshop program) and sought to verify their own hypotheses. With this activity the workshop was concluded.

At the end of the workshop, the teachers - using the rubric designed for it (figure 1) - evaluated the different aspects of it. In a general way, they considered that the workshop reached the level of teacher achievement, since it contributed elements for the development of their didactic plans directed to the formative field of knowledge of the natural world, which their training as preschool teachers does not consider. On the other hand, they considered that the level of veteran in content management by physicists was reached by supporting and relating the curricular standards in sciences in the preschool, this because physicists do not have experience in that level.

Regarding mastery of the subject, they considered that it is at the teacher level, since the preschool teachers liked that the physicists "landed" at the preschool level the subjects that they considered "complex".

However, they considered that the strategies were at an apprentice level, since, despite being interesting and stimulating, it was not clear if they could be applied at the preschool level.

Finally, with respect to the organization, the level of teacher was reached because the time was used appropriately, doubts were answered and an environment conducive to the exchange of ideas was generated.

Conclusions

In this paper, the interaction between physicists and preschool teachers was analyzed for the latter's training in the development of science standards, through a workshop on topics of physics, particularly electrostatics and electricity, as a first case study.

It was possible to observe the analysis of the rubric of levels of achievement that in the workshop the preschool teachers reached a level of productive achievement, since, for example, they went from informal to formal language for the different topics that were developed, they formulated hypotheses for the explanation of the phenomena studied and used analogies of everyday life. On the other hand, the preschool teachers showed a proactive attitude, and reached a productive level when carrying out activities not planned in the program; an example of this was the realization of mixed circuits.

On the other hand, from the analysis of the evaluation rubric of the workshop it was concluded that this contributed elements for the development of the didactic planning directed to the formative field of knowledge of the natural world, and that supports the curricular standards in sciences in the preschool. They considered that the strategies are interesting and stimulating, although there was still the question of whether they could be applied at the preschool level. However, the preschool teachers enriched the physicists with the analogies of daily life at that level, in order to improve this aspect in future editions of the workshop.

Finally, as a result of this work, it is concluded that the interaction between physicists and preschool teachers is positive, since it enriches the mutual professional activity, an example of this

is the interest of both groups to continue and deepen with these activities, and even expand it to all levels of basic education.

As future work it would be interesting to study the impact in classroom that this workshop has. That is, how the preschool teachers carry, through didactic transposition to the classroom and didactic planning, what they learned in this workshop. On the other hand, it is important to mention that both the design of the workshop and its development was based on the Early Childhood Education Program 2011, however, for the school year that begins in 2018, this changed, which, for future editions of the workshop, It should be considered.

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Anexo 1

1.er Semestre	2.º Semestre	3.er Semestre	4.º Semestre
Matemáticas Psicología Evolutiva Teorías Educativas (Bases epistemológicas) Seminario de Desarrollo Económico, Político y Social de México (Antecedentes) Español I Observación de la Práctica Educativa I Educación para la Salud I Apreciación y Expresión Artísticas	Estadística Psicología Evolutiva II Teorías Educativas II (Axiología y Teleologías) Seminario de Desarrollo Económico, Político y Social de México II (época actual) Español II Observación de la Práctica Educativa II Educación para la Salud II (Higiene Escolar) Apreciación y Expresión Artísticas II	Psicología Educativa Tecnología Educativa I Problemas Económicos, Políticos y Sociales de México Literatura Infantil I Introducción al Laboratorio de Docencia Psicología Evolutiva III Apreciación y Expresión Artísticas III Investigación Educativa I	Investigación Educativa II Psicología del Aprendizaje Tecnología Educativa II Problemas Económicos, Políticos y Sociales de México II Infantil II Laboratorio de Docencia I Contenido de Aprendizajes de Educación Preescolar I Educación Física I
5.º Semestre	**6.º Semestre**	**7.º Semestre**	**8.º Semestre**
Laboratorio de Docencia II Psicología Social Planeación Educativa El Estado Mexicano y el Sistema Educativo Nacional Teatro Infantil I Educación Tecnológica I Contenidos de Aprendizaje de Educación Preescolar II Educación Física II	Laboratorio de Docencia III Diseño Curricular Sociología de la Educación Teatro Infantil II Educación Tecnológica II Contenidos de Aprendizaje de Educación Preescolar III Educación Física III	Seminario de Pedagogía Comparada Laboratorio de Docencia IV Evaluación Educativa Comunidad y Desarrollo Prevención y Detección de Alteraciones en el Desarrollo del Niño Contenidos de Aprendizaje de Educación Preescolar IV Diferencial I	Seminarios de Modelos Educativos Contemporáneas Seminario de Aportes de la Educación Mexicana a la Pedagogía Laboratorio de Docencia V Seminario de Administración Educativa Seminario de Identidad y Valores Nacionales Seminario de Prospectiva de la Política Educativa Seminario de Administración de Instituciones Preescolares Seminario de Responsabilidad Social del Licenciado en Educación Preescolar Seminario de Elaboración del Documento Recepcional Contenidos de Aprendizaje de la Educación Preescolar V Diferencial II

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Anexo 2

1.° Semestre	2.° Semestre	3.° Semestre	4.° Semestre	5.° Semestre	6.° Semestre	7.° Semestre	8.° Semestre
El sujeto y su formación profesional como docente 4/4.5	**Planeación educativa** 4/4.5	**Adecuación curricular** 4/4.5	**Teoría pedagógica** 4/4.5	**Herramientas básicas para la investigación educativa** 4/4.5	**Filosofía de la educación** 4/4.5	**Planeación y gestión educativa** 4/4.5	**Trabajo de titulación** 4/3.6
Psicología del desarrollo infantil (0-12 años) 4/4.5	**Bases psicológicas del aprendizaje** 4/4.5	**Ambientes de aprendizaje** 4/4.5	**Evaluación para el aprendizaje** 4/4.5	**Atención a la diversidad** 4/4.5	**Diagnóstico e intervención socioeducativa** 4/4.5	**Atención educativa para la inclusión** 4/4.5	
Historia de la educación en México 4/4.5			**Educación histórica en el aula** 4/4.5	**Educación histórica en diversos contextos** 4/4.5			
Panorama actual de la educación básica en México 4/4.5	**Prácticas sociales del lenguaje** 6/6.75	**Desarrollo del pensamiento y lenguaje en la infancia** 6/6.75	**Desarrollo de competencias linguísticas** 6/6.75	**Literatura infantil y creación literaria** 6/6.75	**El niño como sujeto social** 4/4.5	**Formación ciudadana** 4/4.5	**Práctica profesional** 20/6.4
Pensamiento cuantitativo 6/6.75	**Forma espacio y medida** 6/6.75	**Procesamiento de información estadística** 6/6.75	**Educación física** 4/4.5	**Educación artística (música, expresión corporal y danza)** 4/4.5	**Educación artística (artes visuales y teatro)** 4/4.5	**Educación geográfica** 4/4.5	
Desarrollo físico y salud 6/6.75	**Exploración del medio natural en**	**Acercamiento a las ciencias naturales en**	**Optativo** 4/4.5	**Optativo** 4/4.5	**Optativo** 4/4.5	**Optativo** 4/4.5	

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	el preescolar 6/6.75	**el preescolar** 6/6.75					
Las TIC en la educación 4/4.5	**La tecnología informática aplicada a los centros escolares** 4/4.5	**Inglés A1** 4/4.5	**Inglés A2** 4/4.5	**Inglés B1-** 4/4.5	**Inglés B1** 4/4.5	**Inglés B2-** 4/4.5	
Observación y análisis de la práctica educativa 6/6.75	**Observación y análisis de la práctica escolar** 6/6.75	**Iniciación al trabajo docente** 6/6.75	**Estrategias de trabajo docente** 6/6.75	**Trabajo docente e innovación** 6/6.75	**Proyectos de intervención socioeducativa** 6/6.75	**Práctica profesional** 6/6.75	
38 h	36 h	36 h	36 h	36 h	30 h	30 h	24 h
						266 horas	282 créditos

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Rol de Contribución	Definición (solo poner nombre del autor)
Conceptualización	Miguel Olvera Aldana
Metodología	Leonor Pérez-Trejo 50% Arturo Méndez-Sánchez 50%
Software	No aplica
Validación	Mario Humberto Ramírez Díaz
Análisis Formal	Leonor Pérez-Trejo 50% Arturo Méndez-Sánchez 50%
Investigación	Leonor Pérez-Trejo 25% ,Arturo Méndez-Sánchez 25%, Miguel Olvera Aldana 25%, Mario Humberto Ramírez Díaz 25%
Recursos	No aplica
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