Exploration of PYP Practitioner Preschool Teachers' Science Teaching Practices: The Effect of Pedagogical Beliefs

*Ali Yiğit Kutluca - Dilara Aşar**

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Abstract:

Introduction: The aim of this study was to investigate PYP practitioner preschool teachers' science teaching practices in terms of their pedagogical beliefs.

Methods: In this mixed method study, the quantitative data were first collected and analyzed, and then the qualitative data were collected and detailed. Accordingly, Pedagogical Belief Systems Scale (PBSS) was first implemented to 39 preschool teachers. Then, teachers were selected based on their scores from PBSS and included in the qualitative data processes. Data sources in this study are PBSS, Science Teaching Construction Task (STCT) and Classroom Observations. On the other hand, data analysis consisted of three steps. In the first step, quantitative data analysis was performed. Qualitative data analysis was performed in the second and third steps. In the first step of the qualitative data analysis, inductive content analysis was performed based on the constant comparative method on the responses of the teachers in the lower and upper groups to eight questions in STCT. Then, teachers' science teaching practices in their own classrooms were analyzed through analytic rubric and enriched with field notes

Results: The results revealed that PYP practitioner preschool teachers had child-centered pedagogical beliefs. They also performed science teaching activities based on question-answer and deliberative interactions representing child-centered orientation, independently of their pedagogical beliefs.

Discussion: According to the results in this study, the quality of PYP practitioner preschool teachers' theoretical orientations and practical applications for science teaching was independent of their pedagogical beliefs. However, preschool teachers with high pedagogical beliefs put more emphasis on inquiry in their theoretical conceptualizations about science teaching.

* Ali Yiğit Kutluca, Istanbul Aydin University, Faculty of Education, Istanbul, Turkey; alikutluca@aydin.edu.tr

Dilara Aşar, Istanbul Aydin University, Institute of Graduate Studies, Preschool Education, Istanbul, Turkey; dilaraasar@windowslive.com

Limitations: The most important limitation in this study is the population. The first limitation occurs because PYP practitioner preschool education institutions were very limited in Istanbul; PYP practitioner preschool teachers were difficult to reach. The second limitation is that this research relied on only teachers' self-reported views and practices.

Conclusion: Findings in this study is important in terms of describing the quality of preschool science teaching in the context of PYP and how teachers' pedagogical beliefs serve it. Hence, based on the results obtained in the study, it was revealed that PYP practitioner preschool teachers were generally based on child-centered teaching and tended to use inquiry-based pedagogical strategies.

Key words: preschool teacher, PYP, preschool science teaching, pedagogical beliefs.

Introduction

According to modern education programs, it has been argued that reasoning and inquiry skills start from early childhood (National Research Council [NRC], 2012). This emphasis indicates that preschool teachers can integrate children's life experiences into the classroom through questions, research and explanations for a qualified science teaching (NAEYC, 2009). Children's curiosity and enthusiasm to make the world a more predictable place encourage them to explore and make inferences with their experiences. However, preschool teachers have great jobs to provide the transformation of children's curiosity and activities into a scientific effort (Worth, 2010). Preschool science teaching activities involve all kinds of learning that students experience with their senses, and teachers are responsible for guiding this process. Therefore, preschool teachers should have pedagogical competencies with regard to the activities of asking questions, doing research and collecting data. Furthermore, teachers' tendencies, attitudes and pedagogical beliefs towards science teaching are also assumed to be important for a qualified science teaching (Lin, 2011). In this regard, the issue of belief should not be ignored in the investigations on teaching-learning processes. Pajares (1992) indicates that teachers' beliefs have a significant role in decision-making processes regarding the curriculum they will implement and their behaviour in the classroom. Therefore, it can be said that teachers' tendencies and pedagogical beliefs towards the teaching process determine the quality of teaching.

It is known that a significant portion of private schools in Turkey implement the existing curriculum and also turn to international programs in order to become more known at the local level. One of the major programs, that give importance to evaluations within the framework of international standards in terms of purpose, content, process and output, is the International Baccalaureate

Organization (IBO) programs. Primary Years Programme (PYP), which covers the education process between the ages of 3-12, is the program of IBO implemented within the scope of preschool education. The role of the teacher is important in the PYP program. Places where children can carry out the research, investigation and playing activities they need to know world are provided. Various resources are provided for literacy, art, skill-based activity, creative game, science and technology. Through PYP, children are supported to make choices, use materials creatively, make inquiries, work cooperatively, and gain the ability to continue and make sense of their interests (IBO, 2012). It can be argued that the implementation of these tasks by the teacher believingly will bring positive results. The principle that a purposeful and structured research is strong is at the center of the PYP philosophy. Therefore, PYP involves commitment to the concept-oriented curriculum that supports inquiry (Walker, 2004). One of the most important features of PYP is that it adopts an understanding that places the child at the center (Morrissey, Rouse, Doig, Chao, & Moss, 2014). The purpose of PYP is to create an interesting, relevant, challenging and compelling interdisciplinary curriculum. Students start the learning process with their prior knowledge they have acquired previously, and they learn this knowledge by composing it with the knowledge on the lines of the curriculum (IBO, 2012). In PYP, students plan their own inquiries by answering the question "What do I want to learn?" and they are invited to advance research, experiments, observations and analyses that will help responding and to investigate and analyze the topics of interest in order to reach the conclusion of the inquiry. This process meets the standards specified for an effective science teaching in the literature (Harlen, 2013; Worth, 2010). Based on this information, it can be said that preschool teachers who practice PYP use different strategies and follow certain stages while creating PYP unit and PYP questioning programs compared to other teacher groups. In parallel with it, it can be stated that PYP practitioner preschool teachers make step-by-step and strategic planning in research-inquiry and discovery-based practices while creating the student profile and explaining risk-taking strategies compared to the teachers of other programs.

Science education in early childhood

One of the strongest themes according to the standards set on the basis of modern education systems is that all children can learn science and all children have the opportunity to become scientifically literate (NRC, 2012). Young children are called innate scientists because of their innate curiosity. Children's curiosity and enthusiasm for learning lead them to explore the world and draw conclusions from their experience (Worth, 2010; Koutníková, 2017). Nevertheless, studies on scientific thoughts of young children have shown that young children have the ability to think scientifically and understand the scientific concepts (Eshach, 2006; Jones, Lake, & Lin, 2008). However,

although children collect information similarly to scientists, children should participate in scientific reasoning and teaching processes in order to further improve their thoughts about science (Gopnik, 2012). It is very important for learning outcomes to enrich science education with games, to make it more interesting through interactive learning and to adjust its complexity and difficulties according to age and stages of development. These processes indicate future education trends (Murray, 2019).

Therefore, a qualified science teaching should focus on phenomena as part of children's daily lives. Focusing on experiences or phenomena requires a child-centered and inquiry-based science teaching practice (Gustavsson & Pramling, 2014). In this process, child-child and teacher-child interactions should reach the highest level in order to achieve meaningful learning. In brief, early childhood science education should support children's understanding of the changes occurring in their immediate world through research and inquiry, which means that science practices are carried out by integrating natural phenomena with context-based experiences.

The teacher's role and pedagogical beliefs

Preschool science teaching includes the activities related to the structuring of scientific knowledge rather than the direct transfer of the conceptual content. Here, it is focused on children's discovery of scientific concepts (Duschl, Schweingruber, & Shouse, 2007). According to Tu and Hsiao (2008), the role of teachers in preschool science teaching is to develop play-based activities to support children's learning of science, to be involved in these activities socially and to ask questions in order to encourage critical thinking. Teachers' interactions with the children and the quality of the questions they ask facilitate the cognitive development of children. Research has demonstrated that teacher-child verbal interaction, especially asking questions, is a key component that leads to positive outcomes for cognitive level of children (Anderson & Gullberg, 2014; Toyama, 2016; Wood & Hedges, 2016). Good questions improve children's observation skills and problem-solving skills and encourage them to share their ideas. In order to achieve it, preschool teachers should have a child-centered orientation rather than absolute subject matter knowledge, which is therefore related to the fact that teachers integrate subject matter knowledge with their beliefs and pedagogical content knowledge (Fleer, 2009). Teachers' pedagogical beliefs express their teaching and learning approaches in the classroom (Liu, 2011; Khader, 2012). Teachers' pedagogical beliefs have an effect on their decisions in the stage of designing teaching (Hamlin & Wisneski, 2012; Duran & Mertol, 2020). Therefore, especially preschool teachers' opinions on how to achieve learning ideally during science teaching and the structure of teaching should be based on a solid pedagogical belief which also depends on the fact that teachers value science, ask thought-provoking questions and have a child-centered pedagogical orientation.

Significance of the study

In the studies on preschool science teaching, it has been reported that science knowledge of teachers is an important factor for qualified learning of children (Nihlfors 2008; Gitomer & Zisk, 2015). However, subject matter knowledge is not the only requirement. The studies also indicate that preschool teachers' pedagogical content knowledge and pedagogical orientation affect children's learning (Fleer, 2009; Thulin & Redfors, 2017). Sheridan et al. (2009) argued that the pedagogical awareness of preschool teachers is one of the most important predictors of qualified teaching. It has been revealed that teachers who are learning-oriented and child-centered design more qualified teaching. A child-centered and research-inquiry oriented science teaching approach put forward here is one of the most important features of PYP (Morrissey et al. 2014). When these features are considered, science teaching practices of PYP practitioner teachers are expected to be more child-centered (IBO, 2012). However, studies on preschool science teaching in which this expectation can be tested are quite limited in the available literature (e.g. Twigg, 2010). Furthermore, there is very limited empirical knowledge about how and to what extent a qualified science teaching activity within the context of preschool teacher education is affected by these knowledge domains. It has been reported in the studies that preschool teachers are inadequate in terms of science content knowledge, pedagogical strategies and experiences (Garbett, 2003; Thulin & Redfors, 2017). On the other hand, although there are theoretical conceptualizations about the interaction between pedagogical beliefs and science teaching practices in the literature, no empirical study was found. Based on all these rationales, how PYP practitioner preschool teachers' pedagogical beliefs on learning and teaching affect their science teaching practices was investigated in this study.

1 Methodology

This study is a mix type research that contains qualitative and quantitative research methods together. The main hypothesis of this approach is the use of qualitative and quantitative research approaches by combining their various elements for broad and deep understanding and verification purposes (Creswell & Plano-Clark, 2017). Thus, both data triangulation (Fielding, 2012) that increases the credibility of the research results and the principle of complementarity (Giannakaki, 2005) which represents rich and detailed data by measuring the investigated problems from different perspectives were implemented. Furthermore, the strategies proposed by Lincoln and Guba (1985) were implemented to ensure the validity and reliability of qualitative data. Accordingly, the researcher who was actively involved in the data collection process from the beginning to the end, he works in a school that implements PYP. Thus, he collected deep focused data from the participants with whom he interacted for a long time through interviews and observations. Furthermore, the expert opinion consulted was during the application of qualitative data collection

tools used in this study and data analysis. Finally, the transferability criteria were fulfilled by describing the results reached in detail through direct quotations.

In this study, the quantitative data were first collected and analyzed, and then the qualitative data were collected and detailed. This type of research is called sequential transformation design (Creswell & Plano-Clark, 2017). Accordingly, firstly, quantitative data from PYP practitioner preschool teachers were collected and analyzed through PBSS. Then, lesson plan interviews were conducted with the teachers selected according to their scale scores, and their classroom teaching was observed.

1.1 Participants

This study was conducted with the participation of 39 preschool teachers working in preschool education institutions affiliated to the Ministry of National Education (MoNE) in the 2019-2020 academic year in Istanbul. The participants were selected by the criterion sampling method, one of purposeful sampling methods. The main purpose in criterion sampling is that the participants represent a predetermined profile (Patton, 2014). The criteria mentioned in this study were the fact that teachers had different seniority, were PYP practitioners, had performed PYP teaching for at least one year, and had at least three years of professional experience. Based on these criteria, PBSS was first implemented to 39 teachers selected from five different private preschool education institutions. Then, teachers were selected based on their scores from PBSS and included in the qualitative data processes.

1.1.1 Determination of sub-samples

PYP practitioner preschool teachers who participated in the study were divided into two subgroups (upper and lower) based on their scores from PBSS. Among the participants selected according to deviant case sampling, which is one of the purposeful sampling methods, those in the lower group represented teacher-centered belief systems and those in the upper group represented child-centered belief systems. The paths followed in determining the sub-samples are as follows:

1. PBSS was first implemented to 39 PYP practitioner preschool teachers.
2. Two formulas were used by determining the average and standard deviations of the scores obtained from PBSS (Fraenkel, Wallen, & Hyun, 2006).

Arithmetic mean + Standard Deviation / 2 < UPPER GROUP

Arithmetic mean - Standard Deviation / 2 > LOWER GROUP

In this way, a total of four participants were selected from the lower and upper groups representing at least 10% of the total participants, and the qualitative processes were carried out with the participation of these teachers (Sandelowski, 1995). Information about the participants is presented in Table 1.

Table 1

Participant features

<i>Teacher*</i>	<i>School Type</i>	<i>Level of Children</i>	<i>Age</i>	<i>Professional Experience</i>	<i>PYP Experience</i>	<i>PBSS Score</i>
T _{upper1}	Private School	60-72 months	32	10 years	2 years	109
T _{upper2}	Private School	36-48 months	37	14 years	2 years	104
T _{lower1}	Private School	48-60 months	39	16 years	2 years	77
T _{lower1}	Private School	60-72 months	43	23 years	2 years	71

* Teachers were given a pseudonym for this study.

All preschool teachers aged between 32 and 43 years were women. Furthermore, it is observed that all of the participants with different professional experience in preschool education had two years of PYP experience. The schools where the participants work are located in the European side of Istanbul, a metropolitan city of Turkey. All schools have a wide range of instructional and technological opportunities, and the infrastructures of the schools support reform-based initiatives in terms of the instruction in which students are included.

1.2 Data collection

The data collection tools used in this study were Pedagogical Belief Systems Scale (PBSS), Science Teaching Construction Task (STCT) and Classroom Observations. The data collection process lasted for a total of six weeks. At first, PBSS was directed to all participants. Then, semi-structured interviews accompanied by STCT were conducted with the participants who were in the lower and upper groups according to their pedagogical beliefs. The statements of teachers, who answered the questions in the form, were recorded with a voice recorder in order to obtain the data more properly. It took approximately 50-60 minutes for each teacher to respond to the STCT. Finally, the teachings of preschool teachers, who filled out the lesson plan, in their classrooms were observed. The courses lasted for approximately 20-51 minutes. The researchers did not interfere with teaching during the observations. The observations were also supported by field notes. Data collection tools are presented in detail below.

1.2.1 Pedagogical Belief Systems Scale (PBSS)

PBSS, which was developed by Chan, Tan and Khoo (2007) and adapted to Turkish Soysal, Radmard, & Kutluca (2018) by performing its validity and reliability, was used to determine participants' pedagogical beliefs on learning and teaching. While high total scores obtained from this five-point Likert scale consisting of a total of 26 items, indicate that preschool teachers have a tendency towards a more child-centered belief system; lower scores reveal that the tendencies of the pedagogical belief system are more teacher-centered. The

lowest and highest scores that can be obtained from the scale, which is scored between 1-5, are 26 and 130, respectively. The mean value for this scale is 78.

1.2.2 Science Teaching Construction Task (STCT)

Based on the rationale that teacher knowledge was complex (Loughran, Mulhall, & Berry, 2004) and therefore could not be determined with a single tool (Baxter & Lederman, 1999), the theoretical aspect of PYP practitioner preschool teachers' instructional practices about science teaching was first determined. For this purpose, the STCT, which was developed by Loughran et al. (2004) and adapted to the Turkish context by Soysal and Radmard (2018), was used. Accordingly, STCT reflects a detailed science teaching content based on the recognition of 'big ideas' for any subject mapped against pedagogical demands. This form consists of eight questions that allow preschool teachers who practice PYP to direct their classroom design *practices, implementation and reflection*. Expert opinion was received from two faculty members who are experts in preschool science teaching and qualitative study in order to ensure the internal validity of the interview questions in the STCT, which was adapted to the preschool education context. After making the corrections from expert opinions, a pilot application was performed with a preschool teacher with 14 years of experience who was not included in participating teachers in order to determine the clarity and comprehensibility of the questions in the interview protocol and whether the study served its purpose. The forms containing the answers obtained from this application were sent to the experts again and the interview protocol was finalized after the feedback received. The characteristics of the questions are detailed in Table 2.

Table 2

STCT characteristics

<u>Question</u>	<u>Characteristics</u>
Q-1	The purpose or orientation of the teacher to teach a particular subject.
Q-2	The orientation of the teacher about why the topic that the children want to learn is important.
Q-3	The orientation of the teacher on advanced and different knowledge bases that children should not learn yet.
Q-4	Teacher's orientation regarding the teaching process regarding difficulties, limitations and disabilities.
Q-5	The orientation of the teacher about child concepts that affect teaching on a particular subject.
Q-6	The orientation of the teacher on teaching approaches, strategies and techniques related to a particular subject.
Q-7	Strategies offered by the teacher to identify children's understanding and confusion about the topic taught.
Q-8	Teacher's orientation towards academic or non-academic teaching approaches and subject area knowledge resources.

A teacher who responds to STCT according to what is given in Table 2 details the basic contents below:

- What children should learn about each big idea;
- Why it is important for children to know these ideas;
- How possible learning difficulties of children and the relevant concepts comply with the teacher's knowledge about the content.

In brief, STCT was designed to reveal teachers' teaching knowledge about a specific science subject matter.

1.2.3 Classroom observations

Classroom observations were conducted to obtain more perceptible and traceable knowledge about the PCKs of preschool teachers included in the study. In this way, it was aimed to better understand teachers' processes of realizing this knowledge and the context they taught (Park & Oliver, 2008). Classroom observations were conducted using the observation protocol developed by Newton, Driver and Osborne (1999). According to this protocol, classroom observations are generally conducted by following three basic frameworks. These frameworks are activities involving students (PA), how they are grouped during the activities (PWG), and teacher-student interaction styles (P&TI). In accordance with the objectives stated here, what teachers and students did during the courses and at which moment (at one-minute time intervals) of the courses they did them were determined.

1.3 Data analysis

The analysis of the data consisted of three steps. In the first step, participants' responses to the PBSS were analyzed through descriptive statistics. In this way, both the pedagogical orientations of all participants and the members of the lower and upper groups were determined. In the second step, inductive content analysis was performed based on the constant comparative method on the responses of the participants in the lower and upper groups to STCT (Patton, 2014). This method, in which the qualitative data collected to better understand any phenomenon are evaluated systematically and objectively according to concepts and themes from an inductive perspective, includes the stages of open coding, creating categories and abstracting (Myring, 2015). Accordingly, first of all, participants' responses to each question in the STCT at the beginning and end of the process were subcategorized, and a coding framework was created. The coding framework was created by complying with the constant comparative method, which includes the stages such as *creating concepts, determining the boundaries of themes, assigning concepts to appropriate themes and summarizing the content of each theme*. Here, it is aimed to *distinguish conceptual similarities, to develop the distinctive power of themes and to explore the patterns* (Strauss & Corbin, 1994). The coding framework was established

by two experts, by discussing how to determine the appropriate concepts and themes for each question. The experts separately evaluated a limited part of the data set. The intercoder reliability percentage was achieved by comparing the analyses performed at different times and places (Miles & Huberman, 1994). This value, which was 91%, indicated that the analyses were proceeding reliably (Lincoln & Guba, 1985). Finally, all analyses were sent to a different expert, opinions were received for external control and the process was completed (Creswell & Plano-Clark, 2017). The third step consisted of the analysis of classroom observations. In the analysis process performed by using the rubric developed by Newton et al. (1999), time charts were made for the instructional application of each participant according to the activities under PA, PWG and P&TI. One more expert also participated in the analyses in order to ensure the reliability of evaluations. The rubric was first introduced to the relevant expert and a framework was created by performing theory-laden negotiations for each activity. For instance, "discussion interaction" under the P&TI category represents discourse sections where teachers and students enter into a wider or deeper discussion about a question or issue. Then, one of the observations recorded on the video was analyzed at different times and places according to the previously determined framework. The inter-coder reliability rate for these analyses was 85%. After the discussions, the analyses performed on the remaining videos were sent to the same expert for external control purposes, and the final opinions were received and the analyses were completed.

2 Results

In this part of the study, the results obtained from quantitative and qualitative data analyses are presented. Firstly, descriptive statistics values given in Table 3 include information on the level of pedagogical beliefs of participating teachers.

Table 3

Descriptive statistics of PBSS scores

	<u><i>N</i></u>	<u><i>Minimum</i></u>	<u><i>Maximum</i></u>	<u><i>$\bar{X}$</i></u>	<u><i>Standard Deviation</i></u>
PBSS Score	39	71.00	109.00	87.6	7.43

Accordingly, participants' mean score of the PBSS was $\bar{X}_{\text{total}}=87.6$. The minimum value for the mean total scores was $\bar{X}_{\text{min}}=71$, the maximum value was $\bar{X}_{\text{max}}=109$. These results revealed that the pedagogical beliefs of the participants were higher than the expected mean value of 78. Therefore, it can be said that PYP practitioner preschool teachers generally had a child-centered pedagogical beliefs. However, there were also teachers with teacher-centered beliefs within the teacher group. Therefore, the lesson plans created by two participants who obtained the highest and lowest scores from the PBSS were first evaluated to

how teachers' science teaching practices changed according to their pedagogical beliefs. Then, the results on classroom observations were presented.

2.1 Theoretical change of instructional content

After the inductive content analysis performed on the responses to STCT, it was observed that teachers in the upper group answered the question regarding the purpose or orientation of the teacher to teach a particular subject with a content and inquiry perspective, however, the teachers in the lower group focused only on content.

“Tupper1: Interpreting the given images and start questioning. Establishing connections with the images. Reaching the concept of 'Water' and 'motion energy' from energy sources. Providing information about which learner profile characteristics we need while interpreting/questioning the images.”

“Tlower1: What do we do to be healthy? The ways of protection from disease. The importance of hand washing (soap usage) When should we wash our hands? We have to eat enough. Toilet hygiene...

When preschool teachers' answers specific to their orientation towards why science content that children want to learn is important were examined, it was observed that both groups had similar objectives.”

“Tupper1: To start the subject by inquiry plays a significant role in determining learning needs. The fact that they return to their past experiences, remember what they have learned and establish connections makes them move towards being a "subject". Furthermore, they become conscious of the use of energy resources. It will be more comfortable for them to establish connections with daily life in the activity performed.”

“Tlower2: In order to continue life in the world, to ensure the continuity of the energy we need, to protect our natural energy resources, to increase energy savings, to become conscious consumers, to raise awareness...”

The answers specific to the second question asked about the purpose and objectives of science content given to children while implementing PYP revealed that all participants answering this question referred to the rationale of citizen and character education. Accordingly, it was observed that the teacher in the upper group using science content for energy subject mentioned the subjects of questioning, awareness raising and preparing for life. However, the teacher in the lower group also mentioned the importance of raising awareness and preparing for life. This result indicated that the goals and objectives of teaching developed independently of pedagogical beliefs. When the answers to the third question related to advanced and different knowledge bases that children should not learn yet were examined, it was determined that the teachers in the upper group mentioned the basic content structure based on the rationale of children's

levels of development. It was revealed that the teachers in the lower group naively mentioned the content structure in this regard.

“Tupper2: The cell structure of the seed used during plant germination should be known by the teacher. Because students' inquiries that will require a brief explanation about this subject may need to be answered specific to their level of development. Furthermore, chlorophyll in plants, especially CO₂ they emit around at night and photosynthesis are other knowledge that should be known by the teacher.”

“Tlower2: Hand washing and high body resistance is the main ways of protection from unknown flu viruses that have emerged recently. In this sense, hygiene and adequate nutrition are important for children.”

The fourth question answered by the teachers in the lower and upper groups represented their orientation with regard to difficulties, limitations and barriers related to the teaching process. In this question, teachers talked about child and material-related limitations similarly to each other.

“Tupper1: The fact that the images shown are limited may limit the questioning. It may be difficult to remember their past experiences. They may have no past experiences about the concept of energy and energy resources.”

“Tlower1: Students' indifference in the subject. Thinking that they know what is being told. Interruption of internet access of the digital tools used. Failure of a digital tool to work. Students' difficulty in choosing a center. Lack of material. Students' difficulty in producing ideas.”

According to the answers to the fifth question asked about preschool teachers' understanding of children affecting teaching about a specific science content, it was observed that the teachers in the upper group referred to content experience, while the teachers in the lower group referred to the student interest themes with content experience.

“Tupper2: In general, I prefer a very basic level of lecturing. In general, I consider that they are aware that a plant comes from seed and grows in soil. Mainly demanding clear and precise answers may limit me to some extent.”

“Tlower1: There is a presentation expanding with the question What is a microbe? I can switch from the defense systems of our body to the defense system of animals by using the children's knowledge and experience. I introduce professions based on the idea that we go to the doctor when we become ill.”

Teachers' explanations about the fifth question showed that there was an orientation based on students' knowledge and children's experiences about the content presented. Accordingly, it can be said that PYP practitioner preschool teachers' conceptualizations about students' understanding and misconceptions developed independently of pedagogical beliefs. In the sixth question

representing the teacher's orientation towards teaching approaches, strategies and techniques related to a particular subject, it was determined that all of the participants referred to child-centered strategies, although they were different from each other.

“Tupper2: I usually try to carry out a problem solving process while teaching the subject. I aim for them to produce solutions to the problems they face by asking lots of questions and to recall their prior knowledge. I pay attention to make them establish certain connections with regard to their own lives.”

“Tlower2: I use Web 2.0 tools in accordance with the blended learning and reverse instruction approaches within the scope of digital leader breakthrough. I pay attention to differentiated education.”

Similar results were also found in the seventh question regarding what and how the preschool teachers who participate in the study would measure within the context of science teaching. Accordingly, it was observed that preschool teachers presented child-centered strategies aimed at determining children's understanding and confusion about the subject taught and tended to use alternative data collection tools.

“Tupper1: The illustration activity performed at the end of the activity. The evaluation criteria will be shared with children during the activity. The fact that each child describes his/her drawing helps to determine where they are.”

“Tlower1: A concept map can be created. Apart from it, I expect the children to turn it into a change in behaviors in the long term.”

The last question in the STCT represents preschool teachers' orientation towards academic or non-academic teaching approaches and sources of subject matter knowledge. In this question which is capable of expanding the scope of the other seven questions, it is remarkable that preschool teachers in the lower and upper groups also referred to similar themes.

“Tupper2: I find it right to read and internalize scientific data on the subject while preparing for the lesson. If I am fully equipped with the knowledge I will teach as a teacher, I can make the necessary explanations more accurately and fluently during the student's inquiry and also share the scientific data to meet the student's needs. Furthermore, I also follow the accounts of official institutions and organizations about the subject over the internet.”

“Tlower2: I attended digital leaders' education. I received a certificate. Eco schools' energy book. Sample blended learning classroom practices. Podlet, Edpuzzle, Google Drive, Active table, Wooclap, flipglip, blog posts...”

As can be seen from the sample explanations, the teachers in the upper group referred to the teacher competence theme by stating that they prepared for the lesson to increase their own subject matter knowledge, and the teachers in the lower group referred to the teacher competence theme by emphasizing that they participated in certificate programs. On the other hand, it was also found that preschool teachers tended to use secondary resources.

2.2 Practical change of instructional content

The observation results obtained by the analysis of courses based on science teachings conducted by PYP practitioner preschool teachers in their own classrooms are presented through Figure 1. Accordingly, teachers' classroom instructional practices were explained by time charts according to the activities within the framework of PA, P&TI and PWG. Furthermore, the observation notes about science teaching conducted all teachers in their own classrooms were also shared.

Figure 1 presents a general profile of the classroom instructional practices of teachers with two years of PYP experiences in preschool education in the lower and upper groups. Accordingly, it is observed that teachers included children in the question-answer and deliberative interaction processes in small groups and large groups independently of their levels of pedagogical beliefs. Another important result is that teachers followed in-depth questioning activity independently of their levels of pedagogical beliefs (Chen, Hand, & Norton-Meier, 2017). On the other hand, it is observed that teachers generally tended to include children in Group Discussion, which is a discourse-based dialogic form of interaction. For instance, the teacher in the upper group, who conducted science teaching about the development of living things, started teaching by posing a question to the children and conducted the deliberative interaction processes with the probe questions he asked to different children.

Figure 1. Classroom observations.

When the differences between the activities, in which the preschool teachers in the lower and upper groups included children, were examined, the participants in the lower groups mainly performed group works with the children. Another remarkable result in Figure 1 is that children were included in question-answer activities through sample pictures, videos and research findings, independently of a predetermined methodology. In this type of dual activity called “Unstructured activity” and “Question-answer interaction”, teachers included their students in question-answer activities through a question accompanied by an image or video. Therefore, it was revealed that there was no noticeable difference in terms of the main types of activities in which children were included by preschool teachers who practiced PYP in the lower and upper groups during science education.

When classroom instructional practices of preschool teachers in the lower and upper groups according to their pedagogical beliefs were considered in terms of the discursive interactions between students and teachers, the same similarities attracted the attention. It is observed that teachers mostly focused on question-answer and deliberative interactions. For instance, the teacher in the lower group, who performed science teaching about the functioning of the world, started the course with a question-answer interaction, employed the deliberative

interaction processes and ultimately made children to perform individual experiment activity that allows children to use the knowledge they have gained. Furthermore, it was determined that all teachers interacted with children and provided individual feedback.

Finally, when the results in Figure 1 are considered in terms of the social environment for the main activity children are engaged in, it is observed that the preschool teachers in the upper group included children only in individual and all classroom activities; however, the teachers in the lower group used all types of activities at different moments of teaching. It can be said that preschool teachers with more professional experience tended to enrich the social environment independently of their pedagogical beliefs. In brief, it can be said that the teaching practices of preschool teachers with equal experience in PYP developed independently of pedagogical beliefs.

3 Discussion

In this study, PYP practitioner preschool teachers' theoretical orientation towards science teaching and how their practical applications changed according to their pedagogical beliefs were investigated. According to the results obtained after quantitative and qualitative data analyses, it was revealed that PYP practitioner preschool teachers who participated in this study had child-centered pedagogical beliefs. This result meets preschool science teaching standards (NAEYC, 2009; Harlen, 2013). Accordingly, it is important that science education is performed not only for informational purposes for scientific concepts, but also with play-based and child-centered pedagogical strategies (Gustavsson & Pramling, 2014). Therefore, all teachers should design and implement qualified science teaching activities independently of their pedagogical beliefs (Maier, Greenfield, & Bulotsky-Shearer, 2013; Oppermann, Brunner, & Anders, 2019). According to the results in this study, the quality of PYP practitioner preschool teachers' theoretical orientations and practical applications for science teaching was independent of their pedagogical beliefs. However, preschool teachers with high pedagogical beliefs put more emphasis on inquiry in their theoretical conceptualizations about science teaching. The role of inquiry is at the forefront in PYP which is an international program (Walker, 2004; IBO, 2012). Here, teachers should design activities that will encourage children's active participation in research and inquiry processes. This approach is consistent with NSTA's (2014) position advocating the integration of inquiry-based content and practices into preschool science teaching. In the literature, many researchers have argued that child-child and teacher-child interaction should be at the highest level and that teachers should ask thought-provoking questions, so that meaningful learning occurs (e.g. Castle, 2012; Toyama, 2016; Wood & Hedges, 2016). Researchers also agree that preschool teachers with child-centered pedagogical orientation will have the possibility that they can do it more easily

(Fleer, 2009; Khader, 2012). Therefore, the results of this study are compatible with the consensus in the literature.

As it was mentioned before, there is very limited empirical information on preschool teachers' pedagogical orientation and practices within the context of both PYP and science teaching. However, the main point that the literature agrees is preschool teachers' use of child-centered and play-based instructional strategies during science teaching (Tu & Hsiao, 2008; Fleer, Gomes, & March, 2014). The purpose of the PYP is to ensure that children use what they learn in the classroom in order to create some kind of action that will improve their local or global community (IBO, 2012; Morrissey et al. 2014). The fact that PYP practitioner preschool teachers who participated in this study encouraged students to establish connections with daily life through the activities they performed supports the specified position. PYP practitioner preschool teachers who participated in this study referred to child-centered strategies and alternative measurement and evaluation processes, independently of their pedagogical beliefs. This result also meets the current standards for preschool science teaching. Furthermore, it was observed that the teachers in the lower and upper groups reflected these theoretical orientations to their classroom practices and performed individualized activities to support the functioning, learning and thinking of children in the areas of cognitive, social, physical and emotional development. It was observed that teachers explained this situation independently of their pedagogical beliefs by referring to the concept of teacher efficacy. The available literature has revealed that there is a mutual relationship between teachers' pedagogical practices and self-efficacy (Gerde, Pierce, Lee, & Van Egeren, 2018; Opperman et al., 2019). PYP practitioner preschool teachers who participated in this study were aware that they had to develop their competencies in order to perform a qualified science teaching, which confirms Sheridan et al.'s (2009) claim. Accordingly, one of the most important predictors of qualified science education is pedagogical awareness. It is assumed that teachers with high pedagogical awareness think with learning-oriented and child-centered aspects and tend to design and implement qualified teaching. In this study, PYP practitioner preschool teachers performed science teaching activities based on question-answer and deliberative interactions representing child-centered orientation, independently of their pedagogical beliefs. In brief, the results obtained in this study provide sample ideas about how preschool science teaching should be. Furthermore, the results also revealed the contributions of the PYP context to qualified science teaching.

Conclusion and recommendations

This study is important in terms of describing the quality of a preschool science teaching in the context of PYP and how teachers' pedagogical beliefs serve it. Based on the results obtained in the study, it was revealed that PYP practitioner preschool teachers were generally based on child-centered teaching and tended

to use inquiry-based pedagogical strategies. Based the discussion of these results on the basis of the available literature although it is limited, the following recommendations can be made:

1. In-service training programs in which inquiry-based pedagogical strategies are discussed for a qualified science education in preschool education can be designed.
2. Studies with higher participation can be conducted for the evaluation of PYP in terms of preschool science teaching standards.
3. Studies in which PYP can be evaluated from multi-perspectives through the eyes of children at different developmental levels within the context of preschool science teaching can be conducted.
4. Studies that will enable the comparison of PYP with different programs within the context of preschool science teaching can be conducted.

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