

Investigation of Chinese Preschool Teachers' Attitudes and Beliefs toward Science Teaching

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Abstract

The science attitudes and beliefs of preschool teachers in Shaanxi province of China were explored. 185 preschool teachers participated in the survey. The findings revealed that the preschool teachers had the positive attitudes and beliefs toward science teaching. However, there are clearer differences between preschool teachers' science attitudes and beliefs and practical teaching. They may escape teaching science activities in teaching when they meet difficulties in the insufficient teaching time, inadequate knowledge and auxiliary materials. In addition, the factors influencing teachers' science attitudes and beliefs were studied. The gender and education level of preschool teachers had no significant effect on their scientific attitudes and beliefs. It is worthy note that the preschool teachers with bachelor's degree were more willing to carry out some science activities than the preschool teachers with university (3 years). Although there is no significant difference in the attitudes and beliefs of the preschool teachers with different teaching experiences, teaching experiences had a significant difference in the challenge dimension. The preschool teachers with less than 2 years teaching experiences are more confidence in science teaching. Based on the findings, some suggestions are supplied: improving education level, building specific and clear standards, providing more related auxiliary material supports.

Keywords

Attitudes and beliefs; Science; Preschool teacher.

1. Introduction

Children are curious to explore their surroundings by observing, comparing, and predicting communication and so on. They are commonly considered as inherently scientists [1, 2]. In the early years of life, scientific experience promotes children's development in many aspects. The various early science experience not only provides great opportunities of developing children's brain, but also increases interest in science, and helps them to become better observers, gains many skills that enable them to solve problems that they may encounter in daily life [3]. Moreover, science activities in early childhood result in positive attitudes towards science and better understanding of the scientific concepts studied later in school [4] and long-life positive attitudes to science [5,6].

For the importance of science, science teaching has drawn more and more attentions in recent years. Fouad Abd-El-Khalick reveals the distinction between teaching with and about nature of science [7]. Elena Novak invited elementary school teachers (N = 42) to participate in a 3D printing science project[8], explored how collaborative 3D printing inquiry-based learning experiences impact preservice teachers' science teaching self-efficacy beliefs, anxiety toward teaching science. Mary Oliver, et al investigates three approaches to teaching secondary science: the efficacy of inquiry-based instruction [9], adaptive and teacher-directed teaching, and the result shows that there is positive association between the frequency of teacher-directed and adaptive teaching strategies and students' scientific literacy. Diego Romero-Maltrana et al explores a new way to explore the nature of science: Meta-categories, it is a framework which leads teacher to explore sciences dimensions [10].

However, for the preschool science teaching, there are different opinions. Some educators argue that science is too difficult for young children because it involves formal and abstract thoughts [11,12], and some educators agree with introducing the science subject to young children as early as possible [6,13]. Now, it is widely accepted that young children should learn basic science [6,15-16]. It is reported that teaching science to young children is exciting and amazing, and help them to explore the world [3].

As we all know that children involve in science activities through learning by doing, which is hands-on science practices. Shair stressed the importance of hand-on science activities [17]. However, some teachers offer inappropriate curriculum, they are more accustomed to instilling knowledge in children [18]. It focuses on remembering knowledge rather than developing positive scientific attitudes and various research methods in young children. From the reported research, children's long-term attitudes toward science are influenced by the attitudes of teachers, from whom children generally gain their first science experiences [19]. To some extent, teachers' attitudes, and beliefs play an important role in young children's science learning when children inquiry the world [20,21]. Furthermore, beliefs help shape attitudes and are related to behavior [19]. Therefore, the current study aims to investigate the attitudes and beliefs of early childhood teachers toward science teaching.

2. Literature Review

2.1. Teachers' Science Teaching Practices

A large body of literature documents the scientific practice of preschool teachers. Teachers' science attitudes can be reflected by scientific activity frequency. Tu examined 20 preschool classes, finding that the science activities the preschool teachers engaged are only 13.3%, including 4.5% formal sciencing and 8.8% informal sciencing [22]. The similar research was done by Spektor-Levy et al. [6]. 146 preschool teachers were selected as research subjects. The frequency of Math, Science and Technology activities in their class time were counted, finding that 62% of the teachers teaching science weekly, 27% engage in science activities once or twice a month, and 11% once or twice every two months. To some extent, teachers' science teaching frequency varies widely reflects teachers' inadequate teaching preparation and confusion about the teaching process.

As facilitator and consultant, preschool teachers should stimulate students to study science,

arouse their curiosity, encourage children to find and solve problems, help children to develop science concepts and phenomena in their minds [23]. The American National Association for Science Education (NSTA, 2014) recommends that preschool teachers may guide children's natural interests and abilities exploring through well-organized open-ended activities. In the teaching process, preschool teachers should not only understand science of science, but also understand how children learn. And further the appropriate teaching methods are chosen to teach children science [24]. Yoon and Onchwari discussed the process of science teaching practice, including questioning and the 5E's in a scientific context: engaging, exploring, explaining, elaborating, and evaluating [25]. Andres S. Bustamante reported that the adaptive learning approaches (i.e., Vocal engagement, sustained focus, acceptance of novelty and risk, and group learning et al.) are highly useful when children engage in science experiences and study science concepts, such as cause and effect, force and motion, meaning that children science learning can be enhanced by improving children's approaches [26].

In addition, many research groups studied the organizational forms of the preschool science teaching [27-29]. For example, Jana Maria Haus investigated the scientific concepts teaching through scientific games [30]. Soo-Young Hong examined the efficacy of two teaching science approaches, responsive teaching and the combination of responsive teaching and explicit instruction [31]. The results reveal that the teaching approach of the combination of responsive teaching and explicit instruction is better in the science concepts and science vocabulary teaching.

2.2. Preschool Teachers' Attitudes and Beliefs in Teaching Science

Attitude can be defined as a "general positive or negative feeling toward something" [19], Evans et al. defined belief as "knowledge or ideas accepted by an individual as true or as probable" [32]. Attitudes and beliefs have a significant impact on teachers' teaching behavior [33]. Many researches were conducted to explore the primary and secondary teacher's attitudes of science teaching [34-36]. For instance, Harlen and Holroyd revealed that teachers who were not confident in science tended to deal with this lack of confidence by teaching as little science as possible [37]. Merryn McKinnon & Rod Lamberts investigated the self-efficacy of science training, showing that the four-hour continuing education training can effectively improve most of people's confidence in science classes [38].

Recently, there are also some researchers concerning with the attitudes and beliefs of preschool teachers in science teaching. Evelaine Pendergast revealed that preschool teachers are more comfortable with conducting science activities and learn about the benefits of science for early childhood [18]. Feyza T. Erden & Sema Sönmez surveyed 292 preschool teachers [3]. The similar conclusions were obtained that preschool teachers had a positive attitude toward science teaching. Although some researches on science attitudes and beliefs of preschool teachers were studied, the science attitudes and beliefs of preschool teachers, who lives in a unique cultural background and are deeply influenced by the educational ideas from Kairov (former Soviet Union) and John Dewey (America), has rarely been investigated systematically. Therefore, this survey focuses on Chinese preschool teachers, living in Shaanxi province, to investigate their attitudes and beliefs about science teaching.

3. Date and Methods

3.1. Sample

The participants were 185 in-service preschool teachers from Shaanxi province, China. 365 preschool teachers were invited to participate in this survey. The electronic questionnaires were sent to them via WeChat communication software, widely used social software in China. 196 preschool teachers complete the survey, providing a 54% return rate. It will take about 10 minutes to complete this questionnaire. The questionnaire which takes too short time to answer is deemed invalid. Meanwhile, the questionnaires, selecting the same answer continuously or answering questions regularly or clearly incorrect, were eliminated. Therefore, there are a total of 185 available questionnaires. The questionnaire effective response rate is 51%. Table 1 shows the demographic characteristic of the participants.

Table 1: Descriptive statistics

| Variable | Subgroups | N | % |
|---------------------|----------------------|-----|------|
| Gender | Male | 19 | 10.3 |
| | Female | 166 | 89.7 |
| Age range | 20-24 | 9 | 4.9 |
| | 25-29 | 109 | 58.9 |
| | 30-34 | 27 | 14.6 |
| | 35-39 | 23 | 12.4 |
| | 40-44 | 10 | 5.4 |
| | 45-49 | 3 | 1.6 |
| | 50+ | 4 | 2.2 |
| Educational Level | University (3 years) | 58 | 31.3 |
| | Bachelor's degree | 118 | 63.8 |
| | Master's degree | 9 | 4.9 |
| Years of experience | <1 | 6 | 3.2 |
| | 1-2 | 23 | 12.4 |
| | 3-5 | 72 | 38.9 |
| | 6-8 | 31 | 16.8 |
| | 9-10 | 8 | 4.3 |
| | 10+ | 45 | 24.3 |

From the table, it can be found that the ratios of the male and female preschool teachers are 10.3% and 89.7%, respectively. 63.8% preschool teachers are under the age of 30. 68.7% preschool teachers have a bachelor's degree or above. Over one-half of the participating preschool teachers (54.6%) have 5 years of work experience or less. Around 24.3 % participating preschool teachers have ten or more years of teaching experience.

3.2. Measure

The Preschool Teacher Attitudes and Beliefs Toward Science (P-TABS; Maier et al.2013) was employed in this survey. The questionnaire consists of 31 questions including three aspects: (1) teacher comfort: teachers' comfort of planning and demonstrating different science activities;

(2) child benefit: teachers' attitudes and beliefs toward the benefits of science education for children; and (3) challenges: teachers' discomfort and concern about their abilities and the time required to implementing science activities. The scale shows satisfactory reliability in this survey, Cronbach's $\alpha = .805$. The survey uses a five-point Likert scale. Each statement ranges from strongly agree to agree, neutral, disagree and strongly disagree. 7 negatively worded items were valued reversed.

3.3. Procedures

This investigation follows ethical principles. First, the corresponding author's director approved the study. Second, the research purposes were clearly informed to the participants. Third, the completion of the questionnaire was entirely voluntary. If not, they will not be punished. Finally, it was necessary to note that the survey was conducted anonymously. SPSS version 26.0 was employed to perform exploratory data analysis and compute descriptive statistics. The strength of the relationships between some statements was determined by the bivariate correlation analyses.

4. Results

4.1. Descriptive

4.1.1. Teacher Comfort

Table 2 gives the mean scores and standard deviations of preschool teacher comfort items. It can be found that the mean scores range from 3.86 points to 4.20 points. Of the participated preschool teachers, 89% "strongly agreed" or "agreed" that they enjoy doing science activities with preschool children. 88% feel comfortable doing science activities in preschool classroom. 91% "strongly agreed" or "agreed" that they design science activities specifically in weekly teaching activities. In terms of accessing scientific resources, most preschool teachers (84%) get their ideas by reading relevant teaching reference books. The preschool teachers who put forward the science activities according to what children say or do are around 83%. Around 84% preschool teachers discuss their ideas and issues of science teaching with other colleagues. In addition, with the general application of the networks, some teachers (79%) design their science activities with the help of internet resources. On teaching methodology, 94% "strongly agreed" or "agreed" that they used all kinds of classroom materials for science activities. Approximately 90% teachers "strongly agreed" or "agreed" that they would demonstrate experiments in class. For science teaching content, 78% "strongly agreed" or "agreed" feeling comfortable physical and energy science as compared to life science (85%) and earth science (80%).

| Factor | M | SD |
|--|------|-----|
| I feel comfortable planning and demonstrating classroom activities related to physical and energy science topics (e.g., force of gravity; gas, liquids, solids). | 3.95 | .82 |
| I discuss ideas and issues of science teaching with other teachers. | 3.98 | .72 |
| I use all kinds of classroom materials (e.g., blocks, toys, boxes) for | 4.20 | .57 |

| | | |
|--|------|-----|
| science activities. | | |
| I use resource books to get ideas about science activities for young children. | 3.93 | .78 |
| I feel comfortable doing science activities in my early childhood classroom. | 4.07 | .69 |
| I feel comfortable planning and demonstrating classroom activities related to life science topics(e.g.living things, plants, animals). | 4.05 | .71 |
| I use the internet to get ideas about science activities for young children. | 3.86 | .83 |
| I get ideas for hands-on activities from what my preschoolers do, say, and ask. | 3.89 | .71 |
| I include some books about science during story time. | 4.08 | .57 |
| I enjoy doing science activities with my preschool children. | 4.11 | .65 |
| I demonstrate experimental procedures (e.g., comparing objects to see if they will sink or float) in my classroom. | 4.09 | .74 |
| I make an effort to include some science activities throughout the week | 4.17 | .64 |
| I feel comfortable planning and demonstrating classroom activities related to earth science topics(e.g.,sun, moon, stars, weather) | 3.88 | .84 |
| I collect materials and objects to use in my science teaching. | 4.06 | .68 |

Table 2: Means and standard deviations of teacher comfort items

4.1.2. Child Benefit

Table 3 presents the mean scores and standard deviations of child benefit items. 92.9% “strongly agreed” or “agreed” that science activities can foster children’s science interest. 95% “strongly agreed” or “agreed” that children are curious about scientific concepts and phenomena. Based on the understanding, 83% of the preschool teachers “strongly agreed” or “agreed” that more science activities should be introduced into the early childhood classroom. 89% “strongly agreed” or “agreed” that science-related activities improve children’s learning approaches and experimenting hands-on with materials and objects is the best way to learn science. It can be accepted by most preschool teachers that science-related activities is benefit to improving children’s math skills (92%)、 language skills(83%) and social skills(83%). Some preschool teachers had the opposite opinions that science-related activities are too difficult for children to learn (73%) and it may be a better time for children learning science when they can read freely (62%).

Table 3: Means and standard deviations of teacher child benefit

| Factor | M | SD |
|--|------|-----|
| Preschool science activities help foster children’s interest in science in later grades. | 4.3 | .74 |
| More science should be taught in the early childhood classroom. | 4.03 | .84 |
| Experimenting hands-on with materials and objects is how young children learn best. | 4.22 | .71 |
| | 4.14 | .67 |
| Science-related activities help improve preschoolers’ approaches to learning. | 4.16 | .60 |

| | | |
|---|------|------|
| Science-related activities help improve preschoolers' math skills. | | |
| Science-related activities help improve preschoolers' language skills | 4.00 | .73 |
| Young children cannot learn science until they are able to read. | 2.27 | 1.03 |
| Science-related activities are too difficult for young children. | 2.47 | .98 |
| Science-related activities help improve preschoolers' social skills. | 3.97 | .69 |
| Young children are curious about scientific concepts and phenomena. | 4.24 | .62 |

4.1.3. Teacher Challenges

Table 4 represents the mean scores and standard deviations of preschool teacher challenge items. 89% “strongly agreed” or “agreed” that more time are needed to prepare science teaching. Only 36% “strongly agreed” or “agreed” that there isn’t enough time to carry out science teaching. 43% “strongly agreed” or “agreed” that they don’t have enough scientific knowledge to teach science. The preschool teachers who treat planning and demonstrating hands-on science activities as a difficult task is around 14%. 68% “strongly agreed” or “agreed” that they feel some difficult in teaching the scientific methods. 31% of preschool teachers are afraid that children will ask science questions they can’t answer. In addition, about 33% of preschool teachers said they did not have enough materials to do science activities.

Table 4: Means and standard deviations of teacher challenges items

| Factor | M | SD |
|--|------|------|
| Given other demands, there is not enough time in a day to teach science. | 3.12 | 1.13 |
| Preparation for science teaching takes more time than other subject areas. | 4.18 | .69 |
| I do not have enough scientific knowledge to teach science to young children. | 2.81 | 1.02 |
| I feel uncomfortable talking with young children about the scientific method (e.g., making hypotheses, predicting, experimenting). | 2.28 | .99 |
| I am afraid that children may ask me a question about scientific principles or phenomena that I cannot answer. | 3.20 | 1.06 |
| Planning and demonstrating hands-on science activities is a difficult task | 3.60 | .90 |
| I do not have enough materials to do science activities. | 3.13 | 1.04 |

4.2. Preschool Teachers' Gender and Education Level on Science Attitudes and Beliefs

Independent sample T test was used to estimate whether there was the significant effect of gender on science attitudes and beliefs. From the test results, the gender of the preschool teachers had no significant effect on Teacher comfort ($t(183) = .596, p > 0.05$), Child benefit ($t(183) = -1.061, p > 0.05$), Teacher challenges ($t(183) = -.121, p > 0.05$), and Total ($t(183) = -.122, p > 0.05$). For understanding whether educational level of preschool teachers influenced teachers' science attitudes and beliefs, one-way analysis of variance was carried out. According to the analyzed results, the teachers' educational level had no significant effect on Teacher comfort [$F(2,182) = .151, p > 0.05$], Child benefit [$F(2,182) = .512, p > 0.05$], Teacher challenges [$F(2,182) = .158, p > 0.05$], and Total [$F(2,182) = .098, p > 0.05$]. From the above analyzation, it can be found that there was no significant effect of preschool teachers' gender or educational level on their science attitudes and beliefs.

4.3. Preschool Teachers' Teaching Experience on Attitudes and Beliefs in Science Teaching

As seen from Table 5, the teaching experiences of the preschool teachers had no significant effect on Teacher comfort [$F(5,179) = 1.526, p > 0.05$] and Child benefit [$F(5,179) = 2.193, p > 0.05$]. However, it can be found that teacher challenges revealed a significant relation to teachers' working experience [$F(5,179) = 3.147, p < 0.05$]. Note that the score of preschool teachers with 6-8 years working experience is apparently higher than that of preschool teachers with less than 2 years in science teaching challenge. In addition, when the preschool teacher works for 9-10 years, there appears a distinctly low value, which may be related with the teacher burnout at this stage of work [39].

Table 5: Difference between work experience on attitudes and beliefs in science teaching

| | Less than 1 year (N=6) | | 1-2 years (N=23) | | 3-5 years (N=72) | | 6-8 years (N=31) | | 9-10 years (N=8) | | >10years (N=45) | | F | p |
|-----------------------|------------------------|-------|------------------|--------|------------------|--------|------------------|--------|------------------|--------|-----------------|--------|--------|-------|
| | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | | |
| Teacher comfort | 55.17 | 2.229 | 58.39 | 6.479 | 55.31 | 6.601 | 56.00 | 6.933 | 54.13 | 7.140 | 57.69 | 5.555 | 1.526 | 0.184 |
| Child benefit | 38.83 | 2.229 | 40.57 | 4.934 | 40.64 | 3.482 | 38.87 | 5.965 | 37.50 | 5.372 | 41.49 | 4.187 | 2.193 | 0.057 |
| Challenge | 20.83 | 1.941 | 20.09 | 3.554 | 22.25 | 3.372 | 22.84 | 4.172 | 19.50 | 2.777 | 22.78 | 3.515 | 3.147* | 0.010 |
| Attitudes and beliefs | 114.83 | 6.113 | 119.04 | 11.578 | 118.19 | 10.277 | 117.71 | 14.353 | 111.13 | 11.679 | 121.96 | 10.043 | 1.736 | 0.128 |

5. Discussion

Almost all preschool teachers who participated in the survey made clear that they tried to involve some science activities during the weekly teaching activities and had rather positive attitudes and beliefs in teaching science. These findings are consistent with the results reported by Feyza T.Erden [3] and Evelaine Pendergast [18]. However, a relatively high proportion of preschool teachers reflected that they often encountered difficulties in teaching schedule, scientific knowledge reserve and teaching methodology, which made them less willing to carry out science teaching. Through focusing group interviews, the similar results were found by Greenfield [40]. In China, children's development is divided into five areas: health, language, society, science and art. Among them, the field of science includes two aspects: scientific inquiry and mathematical cognition. In teaching, for pandering to the expectations of children's parents, preschool teachers paid more attentions to mathematical cognition such as numbers, quantities and graphics. Contrarily, scientific inquiry activities were somewhat ignored. Scientific inquiry teaching requires preschool teachers to have sufficient time and auxiliary materials. On the other hand, limited to the running conditions of the preschool, there is the higher student-teacher ratio and relatively lower teaching capital investment in the preschool. For the higher student-teacher ratio, there is no enough time for preschool teachers to prepare scientific inquiry activities. Except this, for the lower teaching

capital investment, there are not enough auxiliary materials for preschool teachers to design scientific inquiry activities. Maybe, these are the possible reasons that preschool teachers who had rather positive attitudes and beliefs in teaching science are not too inclined to carry out scientific activities. The effect of the education level on the attitudes and beliefs in science teaching was considered. The findings indicated that there is no significant effect on preschool teachers' science teaching attitudes and beliefs. This is consistent with some existing studies [41].

Considering that the master degree preschool teachers are only 9 out of 185 in this survey, there was not enough variation in the educational level to obtain a meaningful effect of educational level on teachers' attitude. However, by analyzing the results of the questions that survey participants try to include some science activities throughout the week, the average scores of the preschool teachers with University (3 years) and bachelor's degree are 4.08 and 4.21, respectively. To some extent, it can be found that the preschool teachers with bachelor's degree are more willing to carry out some activities, which may be related with the education experience. The duration of the University (3 years) and bachelor's degree is 3 and 4 years in China, respectively. The duration of the bachelor's degree is longer than that of the associate degree, indicating that the preschool teachers with the bachelor's degree have more opportunities to learn scientific theory and practice. Based on a more scientific knowledge background, the preschool teachers are more inclined to use the multiple methods organizing science teaching. Higher mean scores (3.94, the score of the preschool teachers with University (3 years) is 3.81) for the preschool teachers with bachelor's degree in the questions that they often got ideas for hands-on activities from what my preschoolers do, say, and ask can prove the point.

The survey revealed that teaching experience had no significant effect on preschool teachers' attitudes and beliefs toward science teaching in terms of "Teacher comfort", "Child benefit" and the total score for science attitudes and beliefs ($P > 0.05$). However, there was a significant difference in the work experience of challenge ($P < 0.05$). In the challenge dimension, the mean score of the preschool teachers with 6-8 years teaching experience is significantly higher than that of the preschool teachers with less than 1 year or 1-2 years teaching experience, indicating that the preschool teachers with less than 1 year or 1-2 years teaching experience have more confidence in science teaching. For the preschool teachers with less than 1 year or 1-2 years teaching experience, there are the less time away from universities, which makes them have a relatively new educational concept. Most of the preschool teachers with less than 2 years teaching experience are single. They have enough time and energy to put into teaching. Compared to the preschool teachers with less than 2 years teaching experience in the rise of the occupation, the preschool teachers with 6-8 years teaching experience are in the career stable period. Due to the long-term repetitive work, they have lost their freshness in their work, resulting in a significant drop in work enthusiasm and interest. They are more inclined to complete the work according to routines, rather than focus on the variety and effectiveness of children's activities. So, for the preschool teachers with less than 2 years teaching experience, they have more time and energy, advanced educational concept and work enthusiasm, which make them more comfortable in science teaching.

6. Conclusions

In this survey, the science attitudes and beliefs of preschool teachers in Shaanxi province of China were examined. Although the preschool teachers had the positive attitudes and beliefs toward science teaching, they tend to escape teaching science activities in teaching when they meet difficulties in the insufficient teaching time, inadequate knowledge and auxiliary materials. The results lead to the differences between teaching ideas and teaching behavior. The factors influencing teachers' science attitudes and beliefs were analyzed. The gender and education level of preschool teachers had no significant effect on their scientific attitudes and beliefs. However, an interesting finding found that the preschool teachers with bachelor's degree were more willing to carry out some science activities than the preschool teachers with university (3 years). Except for the gender and education level, there is no significant difference in the attitudes and beliefs of the preschool teachers with different teaching experiences while there is a significant difference in the challenge dimension. The preschool teachers with less than 2 years teaching experiences are more confidence in science teaching. The preschool teachers with 6-8 years teaching experiences are in burnout and more inclined to complete their tasks according to routines.

In summary, there are clear differences between preschool teachers' science attitudes and beliefs and practical teaching. To change the current situations of preschool science education, some measures would be necessary to promote preschool teachers carrying out science activities in line with their attitudes and beliefs. According to the findings, the following three suggestions were put forward:

The educational level of the preschool teachers should be improved. Accompanied with the increase of the educational level, the preschool teachers will acquire more science delivery methods and deeper understanding of the theoretical issues related to early childhood science education.

The specific and clear standards for early childhood science education should be built. Science class hours and content should be explicitly presented. And further, appropriate evaluation methods should be given. The standards can help the preschool teachers to solve the difficulties in science teaching and increase science teaching.

More materials should be supplied for science activities. Enough materials are beneficial to improve the effectiveness of science activities teaching.

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