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# Impact on Preschool Science Teaching: Post-training Examination of Everyday Science

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**Abstract:** Head Start teachers who attended the Everyday Science for Preschoolers training completed an online survey after 3, 6, 9 and 12 months about experiences with and use of Everyday Science for Preschoolers. Teachers continued to use materials over time and reported using more scientific language, an increased awareness of science, and doing more science activities. Recommendations for professional development include modeling scientific inquiry skills, supporting integration of topics and curriculum areas and providing resources.

Everyday Science for Preschoolers (Everyday Science) is a curriculum that takes a holistic perspective and engages young students in inquiry, enabling learning science through everyday activities. Everyday Science training engages preschool teachers in a sample of hands-on inquiry-based activities, and provides them with a collection of age-appropriate science learning activities in each of twelve science topics.

After training, preschool teachers should be well-positioned to lead young children in inquiry activities on all twelve topics, using instructional strategies that are appropriate to both the age of the children and the particular science topic. In this paper, the authors report on the post-training impact of Everyday Science for Preschoolers on science teaching practices of Head Start teachers.

**Key words**: preschool, early childhood and science.

## 1. Literature Review

### 1.1 Importance of Science Competent Preschool Teachers

The National Science Foundation’s 1998 Forum on Early Childhood Science, Mathematics, and Technology Education concluded with a consensus on the lack of early childhood education professionals’ study of mathematics and science content, which translates to the absence of mathematics and science content within early childhood settings (Nelson, 1999) and failure to “incorporate appropriate science, mathematics, or technology experiences into children’s lives” (Nelson, 1999, p. vi). These conditions still appear to be valid today. According to Early et al. (2010), preschool children spend more of their school day on language arts and literacy, social

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studies and art than science and math, even though science activities could easily by integrated into language arts. Harte and Gilbert (2010) asked preschool and kindergarten teachers to rate their own level of comfort and competence with science and mathematics instruction on a scale of 1 to 5, with 5 indicating a high degree of comfort and competence. Sixty-nine percent of the teachers rated themselves in the 2s on comfort, indicating a low level of comfort and 81% of the teachers rated themselves in the 3s on competence, indicating a moderate level of competence.

These low to moderate ratings on comfort and competence in science and mathematics instruction for preschool and kindergarten teachers have become even more problematic with the recent introduction of the Next Generation Science Standards (NGSS) (NGSS Lead States, 2013). Successful implementation of the NGSS requires a shift in classroom culture and teaching practice for K-12 classroom teachers (Reiser, 2013). According to Reiser (2013), the NGSS requires students being “motivated to figure out rather than learning what they are told” (p. 11) and teachers viewing” instruction as building a coherent storyline, in which questions are grounded on phenomena, leading to investigations, and students develop models through argumentation, and refine those models through new phenomena that challenge existing models” (p. 7). Therefore, the best practice in science teaching is no longer what it was in the past. Teachers, at all grade levels, need expertise in content and inquiry processes as well as integration of content and inquiry to enable their students’ inquiry and learning. Implementation of NGSS also assumes a holistic perspective in teaching where future science instruction builds on prior students’ science experience. This approach means, children’s preschool science experience and their teachers' competence in science instruction play an important role in children’s future science learning.

Teachers play an important role in quality early childhood environments by engaging children in hands on experiences, supporting reflection, engaging in science and integrating science throughout the curriculum (Copple & Bredekamp, 2009). Teachers need to be able to engage children in science, and also be aware of and address children's misconceptions with confidence. Early childhood teachers need the knowledge, skills and resources to support children in science inquiry. Teachers’ ability to scaffold science content and processes for children can lead to development of an initial understanding of the nature of science within young children (Akerson, Buck, Donnelly, Nargund-Joshi & Weiland, 2011).

Teacher support of young children’s scientific learning may be influenced by a variety of factors including subject knowledge, support of other teachers, reflective practice, attitude towards science and teacher understanding of the nature of science (Edwards & Loveridge, 2011). Greenfield et al. (2009) conducted focus groups with teachers and examined fall and spring readiness scores on the Galileo System for the Electronic Management of Learning of 4-year-old children enrolled in Head Start. Domains measured included approaches to learning, creative arts, early math, language and literacy, motor development, science, physical health and social and emotional development. Greenfield et al. (2009) determined that science readiness scores were lower than all other domains in the spring and gains from fall to spring were lower in science than in other areas. Also, in focus group discussions, teachers reported low self-efficacy regarding teaching science as well as lack of time in the daily routine. With pre-service teachers, Garbett (2003) noticed limited content knowledge based on results on a science knowledge exam and determined that student teachers lacked awareness of what they did not know.

Both the content knowledge and perceived competence of the teacher are important, as demonstrated in the above studies. For both teachers and children to do science and for teachers to support children effectively, teachers need professional development, resources and support. Pre-service early childhood teachers need a methods course that is integrated across content and involves inquiry processes. Pre-service teachers who completed an integrated math and science course using project based approaches and engaged in inquiry during the course increased in both the understanding of content and self-efficacy (Saçkes, Flevares, Gonya & Trundle, 2012).

Bandura (2012) described self-efficacy as "people's beliefs in their capabilities to produce given attainments" (p. 15) and asserted four sources that influence an individual's perceived self-efficacy: a) mastery experience, b) social modeling, c) social persuasion, and d) emotional and physical reactions. Of the four, mastery experiences, which require persistence in a task despite challenges, contributes most to a teacher's self-efficacy level. The teacher efficacy definition focuses on teachers' perceptions of how confident they are of their ability to impact student learning (Klassen, Tze, Betts & Gordon, 2011). Higher teacher efficacy also results in welcoming new teaching strategies and ideas (Stein & Wang, 1988). Tschannen-Moran and Woolfolk Hoy (2007) documented that experienced teachers had a higher self-efficacy belief than new teachers because of their prior mastery experiences. Beginning teachers, however, relied on availability of teaching resources along with other contextual supports, for example, social modeling, persuasion, and emotional reactions (Tschannen-Moran & Woolfolk Hoy, 2007).

## 2. Attributes of Good Early Science Teaching

Developmentally appropriate preschool science involves engagement in experiences that allow for use of scientific skills such as prediction, observation and communication (Copple & Bredekamp, 2009). Even complex notions such as the nature of science can begin to be explored with young children if teachers use explicit strategies over time and are able to scaffold for children during science investigations.

Early science education ought to include opportunities to develop, test and revise hypotheses. Giving children opportunities to make predictions, observe, make changes in predictions, and then reflect on and revisit their own predictions as well as those of others may help deepen understanding of scientific knowledge (Gropen, Clark-Chiarelli, Hoisington & Ehrlich, 2011).

Inquiry based science allows children to explore the content and the process of science. Engaging young children in science exploration in informal ways, including the home setting, may influence the appeal of science as well as spark a greater understanding of science (Czerniak & Mentzer, 2013). Quality early childhood science programs have a focus on inquiry, allowing for reflection and documentation. Early science instruction can help children learn skills not only important to science, but also to other curriculum areas (Czerniak & Mentzer, 2013; Greenfield et al., 2009).

The Everyday Science for Preschoolers curriculum is intended to enable teachers to engage children in inquiry in age-appropriate ways. The curriculum consists of a binder of activities developed with the input of practicing teachers and university faculty. Activities focused on twelve topics relevant to science for young children. These include animals, birds, insects, reptiles, plants, human body, water, weather, colors, life cycles, simple machines and chemical reactions. The curriculum provided the "what" with resources, suggested materials and possible experiences.

The training provided the "how" with opportunities to explore and practice the activities with a group before using them independently. Participants engaged with the scientific language such as hypothesis and prediction as well as strategies for example, charting, asking questions and making comparisons. The purpose of this post-training survey study was to address the general research question of how Head Start teachers used the information and materials from the Everyday Science training. More specifically, the researchers sought to learn the extent to which teachers used scientific processes and implemented NGSS practices, and to what extent were these practices sustained over time. Finally, they examined the 12 science topics included in the Everyday Science curriculum, looking at topics with which teachers rated themselves as having most content knowledge, and in which topics they tried out the materials and activities with their students.

## 3. Method

### 3.1 Participants

Participants were teachers in Head Start programs in Kentucky and Indiana who participated in Everyday Science training. Seven hundred fifty-four teachers attended the training. No demographic information was collected at the training, so all of the data is truly anonymous.

### 3.2 Design and Procedure

At the training, Everyday Science activities were explained and demonstrated. Teaching strategies were modeled, specific science vocabulary was highlighted, and resources were explained. After completion of the training, each attendee was given a binder with the curriculum materials to encourage integration into their teaching.

After the training, the agency that conducted the training sent an electronic survey to everyone that had attended the training at intervals of three, six, nine and twelve months after the training. A minimum of two reminder e-mails were sent for each interval. The response rate was 20%, 14%, 10% and 6% at successive time intervals.

The survey design was both descriptive and analytical (Coolican, 2004). It included seven Likert-scale items related to implementation of scientific processes, nine items about classroom strategies, and six items about use of activities/resources from the Everyday Science binder.

Participants were asked to mark which of the 12 Everyday Science topics they had tried at least once, which they tried three or more times, and on which they had most content knowledge.

Open ended questions asked participants where they would go when they needed additional information about scientific topics, what they have done differently in their classroom as a result of the training, and what strategies they have provided to families to extend science learning at home.

## 4. Results

The seven items related to scientific processes are essential for fostering students' scientific learning and investigative curiosity. As shown on Table 1, higher levels of agreement were reported at 12 months than at three months on all survey items about implementation of scientific processes, demonstrating increase in teachers' comfort in using scientific processes with their students.

At three months, those who either agreed or strongly agreed ranged from 52% to 93%. At 12 months, these percentages ranged from 82% to 100%. Although there was no linear trend, higher levels of agreement were reported at 12 months than at 3 months on all items. For example, the activity reported least at 3 months was 52% of participants either agreed or strongly agreed that they used words such as "hypothesis" in their classroom. This increased to 82% at 12 months. The activity reported most often was having children describe what they are seeing, with 93% marking agree or strongly agree at 3 months, and 100% at 12 months.

Student's inquiry disposition and science learning are enhanced when teachers incorporate strategies that reflect Appendix F — Science and Engineering Practices in the NGSS (Next Generation Science Standards, For States, By States, n.d.). The nine items on classroom strategies (see Table 2) incorporate NGSS practices.

**Table 1 Percentage of Respondents Marking Agreement Using Likert Scale 5 (Strongly Agree) to 1 (Strongly Disagree)**

| | 5 | 4 | 3 | 2 | 1 | N |
|---|---|---|---|---|---|---|
| I provide specific or detailed descriptions to children in my teaching so I can model focused observation and investigation | | | | | | |
| 3 months | 31.8 | 56.3 | 10.6 | 0.7 | 0.7 | 151 |
| 6 months | 35.2 | 53.3 | 8.6 | 1.9 | 1.9 | 105 |
| 9 months | 30.3 | 55.3 | 14.5 | 0 | 0 | 76 |
| 12 months | 30.3 | 66.7 | 3.0 | 0 | 0 | 33 |
| I provide a variety of materials and tools like magnifying glasses, containers and note pads to children so they can collect, describe, and/or record information | | | | | | |
| 3 months | 41.3 | 45.6 | 11.9 | 1.3 | 0 | 160 |
| 6 months | 51.5 | 41.7 | 6.8 | 0 | 0 | 103 |
| 9 months | 51.3 | 36.8 | 11.8 | 0 | 0 | 76 |
| 12 months | 58.8 | 35.3 | 5.9 | 0 | 0 | 34 |
| In my classroom, we often try out or test our hypotheses then record what happened. | | | | | | |
| 3 months | 19.2 | 48.3 | 25.8 | 6.6 | 0 | 151 |
| 6 months | 22.1 | 51.9 | 18.3 | 4.8 | 2.9 | 104 |
| 9 months | 28.0 | 42.7 | 29.3 | 0 | 0 | 75 |
| 12 months | 34.4 | 53.1 | 12.5 | 0 | 0 | 32 |
| I often use scientific words like "hypothesis" and "investigate" in my classroom because I understand the value of teaching science to build basic literacy skills. | | | | | | |
| 3 months | 16.7 | 35.3 | 33.3 | 14.7 | 0 | 150 |
| 6 months | 17.6 | 41.2 | 34.3 | 3.9 | 2.9 | 102 |
| 9 months | 25.0 | 27.6 | 38.2 | 2.6 | 0 | 76 |
| 12 months | 36.4 | 45.5 | 18.2 | 0 | 0 | 33 |
| I use the resources provided in the Everyday Science for Preschoolers binder to plan developmentally appropriate science activities. | | | | | | |
| 3 months | 29.8 | 48.3 | 19.2 | 2.6 | 0 | 151 |
| 6 months | 24.5 | 58.8 | 14.7 | 1 | 1 | 102 |
| 9 months | 30.7 | 49.3 | 17.3 | 2.7 | 0 | 75 |
| 12 months | 39.4 | 45.5 | 9.1 | 6.1 | 0 | 33 |

**Table 2 Percentage of Responses to Item: "Indicate Which of the Following Classroom Strategies You Have Used (Please Check All That Apply)" at Each Time Interval**

| Survey Item | 3 mo. | 6 mo. | 9 mo. | 12 mo. |
|---|---|---|---|---|
| | (*n* = 140) | (*n* = 100) | (*n* = 74) | (*n* = 41) |
| Charting and graphing differences | 82.9 | 87.0 | 89.2 | 90.2 |
| Asking questions to encourage comparison (how is ___ different from | 89.3 | 87.0 | 89.2 | 87.8 |
| Asking questions to encourage exploration (how does ___ feel?) | 90.0 | 84.2 | 90.5 | 85.4 |
| Extending questions and comments to check children's scientific understanding | 60.7 | 63.0 | 62.2 | 68.3 |
| Looking for patterns and relationships | 81.4 | 78.0 | 71.6 | 85.4 |
| Introducing new vocabulary words and using them in context of the topic we are studying/researching | 77.9 | 78.8 | 79.7 | 80.5 |
| Journaling or other ways of documenting | 38.6 | 47.0 | 47.3 | 51.2 |
| Viewing quality video clips related to | 32.9 | 33.0 | 35.1 | 48.8 |
| I do not use any of these strategies | 2.9 | 1.0 | 2.7 | 2.4 |

At the 3-month interval, the strategy most used was "Asking questions to encourage exploration" whereas "Charting and graphing differences" was most used at the 12-months interval. On five of the eight strategies, a higher percentage of participants at the 12-month interval reported using that strategy, as compared with the 3-month interval. The strategy with the greatest increase in implementation, journaling, increased at each interval. The three strategies most used at all intervals were charting/graphing, asking comparison questions, and asking exploration questions, with more than 80% reporting using these strategies across all time intervals. These three most used teaching strategies address many of the eight practices of NGSS by helping children to ask questions, investigate, and interpret data. At three months, 60% of teachers who responded checked on children's scientific understanding, and at 12 months, the percent was 68. Without teachers assessing their students' knowledge and skill level of scientific inquiry or investigation, preschool students cannot increase in their understanding of scientific knowledge and processes.

Responses to survey items about the impact of using activities and resources from the Everyday Science binder indicate teachers were reading more about science, brainstorming potential materials/tools, and bringing more science concepts into the classroom across all time intervals as result of integrating Everyday Science activities and resources, as shown on Table 3. Use of guest speakers was reported least frequently. Although there was no clear linear trend, percentages were higher at 12 months than at three months for all activities.

**Table 3 Percentage of Responses to Item: "Using the Activities and Resources Provided in the Everyday Science for Preschoolers Binder in The Classroom with My Children Has Caused Me to Do the following (Please Check all that Apply)" at Each Time Interval**

| Survey Item | 3 mo. | 6 mo. | 9 mo. | 12.mo. |
|---|---|---|---|---|
| | (*n* = 138) | (*n* = 100) | (*n* = 72) | (*n* = 41) |
| Research more about topic(s) we are studying, for example going to the KET website | 59.4 | 57.0 | 55.6 | 61.0 |
| Bring guest speakers who are expert on the scientific topics we are studying | 14.4 | 19.0 | 52.8 | 19.5 |
| Read more about the topic so I have more content knowledge to share with my children | 68.8 | 71.0 | 72.2 | 80.5 |
| Brainstorm about potential materials and tools that can be used for children's exploration and investigation. | 63.8 | 66.0 | 63.9 | 68.3 |
| Bring more science concepts into my classroom throughout the day | 67.4 | 64.0 | 81.9 | 76.5 |
| None of the above | 8.7 | 7.0 | 4.2 | 7.3 |

Table 4 illustrates the results of which Everyday Science topic teachers implemented with their students. The science topics addressed in the Everyday Science binder included typical topics (animals and weather) as well as less commonly practiced areas (e.g., simple machines and chemical reactions). All of the Head Start teachers who responded to the surveys indicated they had implemented all of the topics from the binder with their children at 3, 6, 9 and 12 months interval, indicating their willingness to try new or less comfortable topics as shown on Table 4.

Across all intervals, the topics most often reported as tried at least once were animals, weather and color. At 12 months, 78% had also tried lessons about insects, an increase from the 46% reported at three months. Reptiles and simple machines were tried by fewest, but those reporting trying reptiles increased from 17% at 3 months to 32% at 12 months, whereas there was no such increase for simple machines.

As more time passed after the training, more of the activities from the Everyday Science binder were implemented, as shown on Table 5.

**Table 4 Percentage of Responses to Item: "Please Indicate Which Topics from the Everyday Science For Preschoolers Binder You Tried with Your Children (Please Check All That Apply)."**

| Survey Response | 3 mo. (*n* = 125) | 6 mo. (*n* = 95) | 9 mo. (*n* = 66) | 12 mo. (*n* = 37) |
|---|---|---|---|---|
| Animals | 66.4 | 57.9 | 69.7 | 83.8 |
| Birds | 29.6 | 29.5 | 40.1 | 51.4 |
| Insects | 45.6 | 55.7 | 57.6 | 78.4 |
| Reptiles | 16.8 | 11.6 | 36.4 | 32.4 |
| Plants | 41.6 | 46.3 | 60.6 | 73.0 |
| Human body | 38.4 | 34.7 | 40.9 | 62.2 |
| Water | 46.4 | 42.1 | 40.9 | 56.8 |
| Weather | 69.6 | 70.5 | 83.3 | 73.0 |
| Colors | 57.6 | 57.9 | 69.7 | 83.8 |
| Life cycles | 24.0 | 29.5 | 47.0 | 54.1 |
| Simple machines | 27.7 | 12.6 | 13.6 | 10.8 |
| Chemical reactions | 20.0 | 16.8 | 19.7 | 29.7 |

**Table 5 Percentage of Responses to Item: "of the Topics Covered in the Everyday Science for Preschoolers Binder, from Which One did You Try at least Three Activities Provided in The Binder (Please Check All That Apply)"**

| | 3 mo. (*n* = 113) | 6 mo. (*n* = 91) | 9 mo. (*n* = 63) | 12 mo. (*n* = 34) |
|---|---|---|---|---|
| Animals | 37.2 | 36.2 | 39.7 | 44.1 |
| Birds | 19.5 | 18.7 | 22.2 | 20.6 |
| Insects | 25.7 | 31.9 | 20.6 | 35.3 |
| Reptiles | 8.0 | 8.8 | 12.7 | 11.8 |
| Plants | 27.4 | 26.4 | 41.3 | 52.9 |
| Human body | 20.3 | 23.1 | 20.6 | 35.3 |
| Water | 25.7 | 18.7 | 20.6 | 44.1 |
| Weather | 41.6 | 48.4 | 57.1 | 61.8 |
| Colors | 41.6 | 35.2 | 47.6 | 55.9 |
| Life cycles | 12.4 | 15.4 | 25.4 | 23.5 |
| Simple machines | 10.6 | 8.8 | 17.5 | 8.8 |
| Chemical reactions | 8.0 | 5.5 | 12.7 | 23.5 |

At three months, 42% reported having tried at least three activities on the topics of weather and colors. At 12 months, 62% had tried at least three activities on weather and 56% on color. Animal activities were next highest, mirroring the most tried topic response from Table 4. Percentages at 12 months being higher than those at 3 months for all topics, except simple machines, which fell from 11% at three months to 9% at12 months, demonstrates teachers' willingness to stretch their comfort level and perhaps increase in their efficacy belief for science teaching.

For the survey item: "Please indicate which topic from the Everyday Science for Preschoolers binder you feel you have the most content knowledge after using it in your classroom," the topics on which participants most consistently reported having the most content knowledge were colors and weather as illustrated in Table 6.

**Table 6 Percentage of Responses to the Item: "Please Indicate Which Topic from the Everyday Science for Preschoolers Binder You Feel You Have the Most Content Knowledge after Using It in Your Classroom."**

| | 3 mo. ($n$ = 116) | 6 mo. ($n$ = 91) | 9 mo. ($n$ = 63) | 12 mo. ($n$ = 34) |
|---|---|---|---|---|
| Animals | 30.2 | 24.2 | 27.0 | 29.4 |
| Birds | 11.2 | 14.3 | 34.9 | 20.6 |
| Insects | 19.8 | 25.3 | 30.2 | 29.4 |
| Reptiles | 7.8 | 6.6 | 14.3 | 14.7 |
| Plants | 23.3 | 20.9 | 30.2 | 29.4 |
| Human body | 20.7 | 18.7 | 14.3 | 20.6 |
| Water | 23.3 | 11.0 | 14.3 | 26.5 |
| Weather | 34.5 | 39.6 | 34.9 | 35.3 |
| Colors | 35.3 | 24.2 | 38.1 | 52.9 |
| Life cycles | 19.8 | 18.7 | 20.6 | 14.7 |
| Simple machines | 8.6 | 8.8 | 7.9 | 8.8 |
| Chemical reactions | 7.8 | 6.6 | 6.3 | 14.7 |

The only topic marked by more than 50% was colors, at the 12-month interval. The percentage having content knowledge increased from the 3-month point to the12-month point for birds, insects, reptiles, plants, water, colors, and chemical reactions. Topics marked as areas of knowledge by fewest participants were simple machines, chemical reactions, and reptiles. From Table 5 on which topics participants used three or more activities, simple machines and reptiles were two of the least popular topics, which can potentially explain why participants may feel less knowledgeable in content. An anomaly was chemical reactions. The chemical reactions activities did gain popularity in Table 5 (from 8% at 3-months interval to 23% at 12-months interval) but only 15% of teachers felt they had the content knowledge after usage. However, increase in popularity did translate to increase in content knowledge as 8% at three months compared to 15% at 12 months stated they felt knowledgeable of content for chemical reactions. Animals and plants were marked by 20–30% of participants, across all time intervals. At the 12 month interval, the rank order of topics on which participants had most knowledge was positively correlated with the rank order of topics on which participants had tried at least three activities, Spearman's $r = .91$, $p < .01$. This strong, positive correlation supports the idea that providers' level of comfort with the content knowledge is strongly related to their classroom implementation.

Responses to open-ended questions were similar across the time intervals. For additional information about scientific concepts, most went to the internet. Books, resources from Kentucky Educational Television and peers were also reported as knowledge sources. As a result of the training, participants used more science activities, more science vocabulary, and paid more attention to making science materials available in the classroom. Most reported sending home newsletters with hands-on activities or experiments, nature walk and exploration activities, color activities, and journaling.

## 5. Conclusion

Everyday Science for Preschoolers training, despite its limitations, did have an impact on the teaching of science in Head Start programs at three–, six–, nine– and 12–month intervals. Limitations of this study on post-training impact of Everyday Science for Preschoolers include the low response rate at the start as well as the attrition rate. It is possible that at 12 months only those teachers actually implementing Everyday Science responded. In addition participant demographics were not collected. Examination of these in relation to the findings could have enhanced the study. For example, are newly trained teachers better at incorporating science instruction into the curriculum? Those who did respond reported increased implementation of science in the classroom. While these results cannot be generalized they could inform possible supports in professional development.

Research (e.g., Garbett, 2003; Greenfield et al., 2009) and the National Science Foundation (Nelson, 1999) has indicated that science instruction has been lacking within the early childhood setting and also has demonstrated the need for professional development so preschool teachers can acquire the knowledge, skills, support and resources in order to support children in science inquiry. However for preschool teachers to feel competent to do more science at a deeper, integrated level, which would facilitate successful implementation of NGSS at K-12 level, the preschool teachers will need to apply the principles of constructivism, assimilation and accommodation (Piaget, 1952, 1977), of acquiring a novel task, which in this case would be the integration of Everyday Science activities, resources, and teaching strategies. True understanding results when teachers make sense of the new information themselves and construct how they will integrate science in their teaching based on their existing science competency, comfort, and motivation level. How teachers feel about science influences their actions. The social nature of self–efficacy can facilitate teachers' appraisal of their competence, comfort, motivation, and acquisition of science knowledge; which results in continuous engagement of science and behavior change within the classroom.

The results of this study mirror self-efficacy and constructivist principles in that teachers increased both in implementation of science (number of activities on a topic as well as variety of topics) and integration of explicit science strategies (such as journaling, asking exploration questions) with children over time after the *Everyday Science* training. The Head Start teachers also indicated they were reading more about science themselves and brainstorming about potential resources for science concepts as they used the *Everyday Science* binder more. Thus, Head Start program teachers used the information and materials from the science training to elevate their content knowledge/mastery in science as well as become more intentional with science practices/strategies over time. As teachers engaged in more science, they became, more willing to try out information in the *Everyday Science* binder. The only exception was with the topic of Simple Machines. This topic is not a common topic early childhood educators address in their classrooms; and as a result, Simple Machines may have been a topic that was too novel for them.

### 5.1 Research to Practice: Recommendations for Early Science Professional Development

Teachers who may feel less secure about fostering their students' inquiry based science learning, if they are provided with training and materials, may engage students and succeed in offering developmentally appropriate science experiences. This change in behavior, then, may in turn influence attitudinal change and increase self-efficacy related to teaching science, which may lead to doing more science. Based on our study findings on post-training impact of *Everyday Science for Preschoolers*, below is a brief discussion of professional development aspects for early childhood educators that could enhance both competence and confidence levels regarding science.

**(1) Process matters.** Be sure to model scientific inquiry skills such as observing, classifying, predicting, hypothesizing, experimenting and communicating (Copple & Bredekamp, 2009) while engaging in authentic investigation during the training. The more the early childhood educators have the opportunity to try out different science practices in addition to being able to observe, the higher the possibility of making the scientific inquiry skills as their own practice with their students after the training. The more teachers do during and after the training, the more confident and competent they will become in integrating different science practices.

**(2) Integration matters.** Be sure to provide information on variety of topics. According to The National Association for Young Children Developmentally Appropriate Practice guidelines, the preschool science curriculum ought to include concepts and experiences from life science, physical science and earth science (Copple & Bredekamp, 2009). According to Sharapan (2012), Science, Technology, Engineering, Art and Math (STEAM) is ultimately about discovering and exploring the world around us. Therefore, focus on a range of topics and especially non-typical topics during the training. More exposure to different topic content and strategies during the training will help the teachers engage in intentional examination of what science topics and practices are missing in their teaching. For example, Moomaw and Davis (2010), in an inclusive classroom setting, used pendulums and inclines and noticed children demonstrating higher level thinking strategies and increasing verbal exchanges.

**(3) Resources for individual teachers matter.** Provide resources that were used during the training to each teacher so that s/he can refer back while implementing what was learned in professional development in the classroom. It is vital that teachers build onto their current expertise/mastery so they can address children's misconceptions. An essential feature of the resources for teachers from the training ought to be additional online resources. As teachers engage in more science, they will seek out more to increase their science knowledge, skills, and strategies. Having a starting point for finding additional resources is critical for teachers' self-improvement/education and continual science learning.

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