

Science Education in the Early Childhood & Special Education Setting:  
An Analysis of Science Education Across Lake Washington, Bellevue & Seattle School Districts

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## Abstract

This survey based research illustrates science education in the early childhood setting, specifically across Lake Washington, Seattle and Bellevue Public School Districts, with a lens on programs serving children with special needs. Taking current best practice into consideration, this research compares the amount of time that teachers currently spend teaching their students science across these settings, with recommendations urging educators to expose their students to the scientific inquiry process early and often. Additionally, the results of this survey align with findings regarding teacher self-efficacy in the area of science, demonstrating that educators who have a science background and/or have received professional development opportunities in the area of science, are likely to teach science more often and lead higher quality lessons. The survey results also demonstrate that the provision of curriculum and training opportunities are indicative of a community that supports science education, and therefore predictive of the amount and quality of science education that students in an early childhood setting receive.

*Key words: Early childhood education, kindergarten, preschool, science curriculum, special education, constructivist approach.*

## Introduction

### *Why Science?*

From the moment a child emerges into the world they are naturally inspired to explore the world around them, through means representative of the very foundation of the scientific process--through observation, cause and effect and experimentation. I remember a day maybe fourteen years ago, when I was rocking my niece to sleep. Under the age of one, her communication skills were restricted to cooing, crying and simple smiles. As I noticed her drifting off to sleep, I reached above the chair we were rocking back and forth in, and with a tug on the light cord the room dimmed. Instead of closing her eyes, she bolted up in my arms and pointed at the light cord with great interest. I tugged on it again, and the light reignited her face. She smiled, and reached up as if to perform the experiment herself. We continued like this for sometime, until she was satisfied. Unable to talk or walk, this ten month old child had managed to form a hypothesis based on observation, engage an adult to test her hypothesis and establish a conclusion about the correlation between the light cord and the illumination of a small room. She had participated in the scientific process.

Science is frequently associated with the memorization of facts or complex chemical equations that are thought to be best left in the hands of professionals. But the reality is that scientific inquiry is a process that even an infant can and does participate in. Children are natural scientists. They seek to understand the world around them through observation and experience,

and are naturally predisposed to question and wonder. They participate in scientific inquiry as a “process of finding out and a system for organizing and reporting discoveries...as a way of thinking and working toward understanding the world,” just as my niece engaged in this process to understand a light switch and the cause and effect surrounding the action of pulling on the light cord (Lind, 1998, p. 3).

Given these natural tendencies, providing a structured science education to children in a preschool and kindergarten setting can be incredibly beneficial. Opportunities to predict and test a hypothesis, with the support of an adult, encourage children to construct meaningful knowledge of their own, rather than the facts being conveyed through the recollection of information from a higher source. Scientific inquiry such as this forces educators to focus on providing experiences that children engage in themselves, giving students the opportunity to perform a task themselves, rather than just acquiring a new fact from a secondary source (Martin et. al., 2005, p. 13). Educators in the early childhood setting often take this important process for granted, forgetting that,

...unless the truth makes sense to a child, the child has no way to use that truth. Unless a child puts pieces of information together so that an idea makes sense, that idea, whether considered true by adults or not, will likely not be true to the child. Inert truths are simply not valuable (Brooks, 2011, p. 18).

When we think of scientific inquiry as a way of learning about the world around us, we are thinking of science not necessarily as a discipline or subject area, but rather as a method for learning. The Constructivist Approach and the Reggio Emilia Approach refer to science in the early childhood setting as a vehicle used to teach children how to identify a question, conduct investigations to answer that question, and finally to record and share what they learn with others

(Stegelin, 2003 & Brooks, 2011). In each of these approaches, a student's interest is highly valued and used to select a topic and direct the course of study. The teacher supports the child by aiding them in identifying the question they want to answer throughout this process and helping them to conduct experiments safely. Teachers engage in the process by being responsive to questions that emerge throughout the investigation and finally by working with the child to determine the best way to share the results of their experiment or the "answers" that they stumbled upon.

While the Constructivist Approach and the Reggio Emilia Approach are often associated with scientific investigations in the classroom, in reality these are both approaches suitable for using across disciplines to answer a wide range of questions. In a sense, approaches such as these encourage teaching a process for answering questions, rather than just supplying knowledge and facts. Instead of relaying key information, educators are equipping children with the tools necessary to learn. That said, a successful early childhood educator "encourages children to wonder, to ask questions, to explore possible answers to these questions, and to construct their own conclusions," making those inert truths that Brooks (2011) referred to, facts that are real to the students (Martin et. al., 2005, p. 13).

### *Current Standards*

Over 50 percent of children between the ages of three and five years old in the U.S. have access to an organized learning experience through a preschool program (Bowman, 1998.) But across these programs, there is little consistency in the area of curriculum, particularly in the area of science education. The same can be said for the inconsistency in curriculum across

kindergarten programs. The American Association for the Advancement of Science (AAAS, 1993) recommends that children across preschool and kindergarten age be exposed to the goals and objectives visible in figure 1. These objectives are also reflected in the Washington State Early Learning and Development Guidelines, which addresses learning from birth through third grade. However there is not standard for curriculum or assessment surrounding these goals in the early childhood setting across Washington state.

Many of these objectives and goals represent an understanding and respect towards the concept of teaching children how to learn, rather than just relaying facts. For example, the balance between “knowledge” and “skills and methods” across each topic emphasizes that students are not just learning facts about the subject matter, but are learning the methods involved in scientific inquiry and experimentation. These objectives revolve around providing children with opportunities to recognize concepts and encourage educators to teach their students methods of scientific inquiry, focusing on recording and sharing observations with a larger body of knowledge as well as with their peers.

**Figure 1.** Framework for what science should include in an early childhood setting, based on the suggestions provided by the American Association for the Advancement of Science.

Physical Science Knowledge	Describe the properties of objects and things
	Explore how things move and change
	Show increase understanding of changes in materials and cause-effect relationships
Physical Science Skills & Methods	Use their senses and tools to gather information, investigate materials, and observe relationships
	Observe and discuss common properties, differences, and comparisons among object and materials
	Participate in simple investigations to test observations, discuss, and draw conclusions and make generalizations

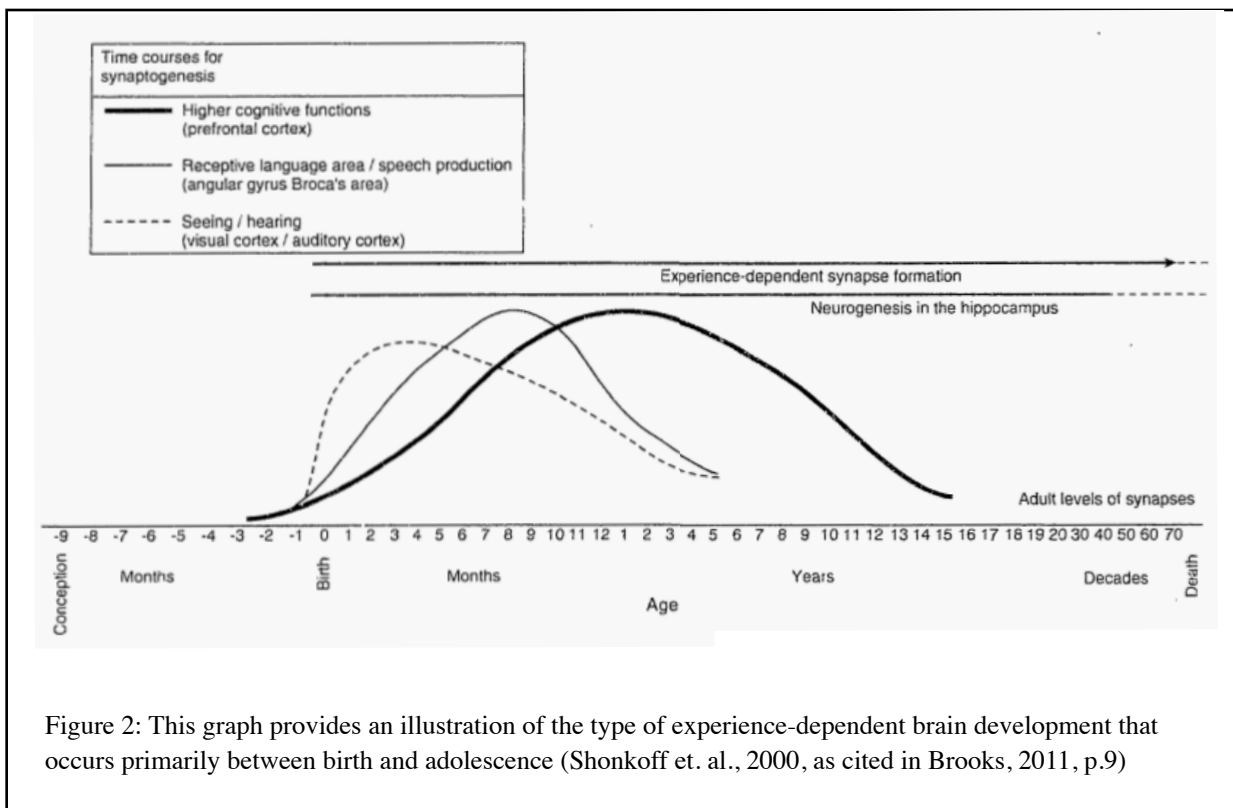
<b>Figure 1.</b> Framework for what science should include in an early childhood setting, based on the suggestions provided by the American Association for the Advancement of Science.	
	Describe and discuss predictions, explanations, and generalizations based on past experiences
Life Science Knowledge	Identify features of plants and animals that help them live in different habitats
	Show an understanding that plants and animals need water and food
	Recognize that people have unique features, but are alike in many ways
Life Science Skills & Methods	Show respect for all living organisms, including themselves
	Begin to systematically compile, classify, and order information collected
	Participate in simple investigations to test observations, discuss, and draw conclusions and make generalizations
	Name, record and share information with others either orally or in written form
Earth Science Knowledge	Recognize that some events in nature have a repeating pattern (e.g., seasons of the year)
	Recognize that the sun warms the land, air, and water, which leads to different weather patterns
	Identify different ways things move, such as back and forth, fast and slow
Earth Science Skills & Methods	Show respect for the environment
	Show interest in investigating phenomena
	Show appreciation for the beauty, balance, and orderliness of the environment
	Readily share information with peers and appreciate the perspective of others
(Recommendations from the AAAS, 1993, as cited in Neuman & Roskos, 2007, p. 123-126)	

Arguably, the objectives outlined in figure 1 are concepts and methods of learning that typically developing children are likely to pick up with experience throughout life. Given that many preschool and kindergarten programs are half day programs rarely longer than three hours per day, science often gets pushed to the back-burner, in favor of spending time teaching emergent literacy and mathematics. In regards to children with special needs in this age

demographic, time spent in class is largely dedicated to working on specific IEP objectives, goals that rarely speak to the development of scientific inquiry. So why is it important to provide young children with and without special needs, with opportunities to develop and practice scientific inquiry in a supportive environment?

Brooks addresses this concern by discussing early brain development in children, specifically development that takes place before the age of seven (2011). Anatomical features of the brain develop and change based on experiences that children have, and likewise this brain development affects behavior and experience. In other words, the more an individual experiences something or engages in it, the more proficient they will become in that activity and process. This ability, for the brain to develop and reorganize itself in response to experiences, is referred to as neuroplasticity. Neuroplasticity allows the brain to grow structures “necessary to send and receive messages, strengthen[s] or prune[s] those structures as experience dictates, and insulates the structures so that the messages are sent efficiently and quickly,” (Brooks, 2011, p. 8). In regards to the scientific process as a method for learning and internalizing new information in a meaningful way, the more a child has a chance to engage in that process, the more proficient they will become in the process.

It is important that opportunities to engage in the scientific process occur early and frequently. Findings within the field of neuroscience support this effort to provide experiences in the early childhood setting, confirming the correlation between competence in the area of science inquiry later in life and experiences with science early in life (Bowman, 1998). Studies conducted by Shonkoff et. al. (2000) supports this correlation between early exposure and later skill. This study examined the type of brain development that occurs early in life as a result of



exposure and experience, and found that while receptive language, speech production, and visual/auditory cortex development resulting from experience primarily takes place before the age of one, neural activity for high cognitive functions is at its peak during the preschool and kindergarten years. Figure 2 demonstrates the results of this study, indicating that between the ages of about ten months until about the age of seven years, children encounter the greatest experience-dependent synapse formation in the area of higher cognitive functions. This peak indicates that children are likely to benefit the most from having those repeat experiences, between the ages of about 10 months to seven years of age, with higher cognitive functions. Such “high cognitive function” includes the reasoning and process involved with identifying a question and answering it through scientific inquiry.

What this research indicates is that, while science education occurs throughout life, it is particularly important to provide preschoolers and kindergarteners with opportunities to engage

in scientific investigations given the amount of experience-based brain development which occurs early on. Given the process involved in conducting a scientific investigation, science activities are an ideal vehicle for providing young children with opportunities to develop higher cognitive function.

In light of this research in the area of neuroscience, the question becomes not whether or not science should be integrated into the early childhood setting, but *how* it should be integrated into this setting. Martin et. al. explains that teachers tend to teach science in the manner that they were taught, which generally results in a didactic lesson, invoking the need to memorize facts and concepts through a less than ideal means (Martin et. al., 2005). Martin et. al. goes on to hypothesize that many teachers, especially in the early childhood setting “perceive the job of the science teacher to be the skillful impartation of scientific facts and concepts to children, perhaps bolstered by an activity or two designed to demonstrate the truths of the material they are presenting,” (Martin et. al., 2005, p. 13) and adds that children are frequently discouraged from “making meaningful connections to their existing knowledge” (Ulerick, 1989, as cited in Martin et. al., 2005, p. 13). Penner adds to this concern, explaining that “science education in school typically focuses on accumulating facts,” amidst activities that are “often restricted to prepackaged experiments that are little more than demonstrations of the state of current scientific knowledge,” with the goal to produce predictable results (2001, p. 1). But as Brooks suggests, unless children have a chance to experience and internalize new knowledge for themselves, particularly in the area of scientific inquiry, they are unlikely to really grasp the facts (2011). Early on, children need to have the opportunity to trudge into the unknown, and pull on that light switch to answer their own questions, if they are to learn the process of discovery.

*Best Practice*

Given the broad science objectives suggested by the American Association for the Advancement of Science (AAAS, 1993) and given the importance of putting the child in charge of the learning process, there are some specific teaching methods recommended for teaching science to children in an early childhood setting. Current research suggests that science is best taught in the early childhood setting by enlisting an approach that actively engages learners and allows them to direct the learning by respecting and heeding to student interest, while leaving them in the driver seat. In this case, the teacher plays a more passive support role, rather than providing the kids with the answers, acting as a guide as children find the answers for themselves. This “less is more” attitude is intended to provide the children with the chance to internalize and discover independently, thereby providing an opportunity not only for them to make the discovery of a truth themselves, but also the occasion to engage in the discovery process (Brooks, 2011 & Lind, 1998). While sometimes the conclusions and discoveries that children walk away with are incorrect, it is the process of “doing” science that is important, especially in the early childhood special education setting (Brooks, 2011 & Bowman, 1998).

While early childhood curriculum in the area of science is limited, there are several approaches that are frequently employed in the early childhood setting, that have demonstrated success in this self-discovery process. These include the Project Approach, the Constructivist Approach and the Reggio Emilia Approach. Even though there are some big differences between each of these approaches, it is their similarities that are more pertinent when talking about science education. Each method features a strong student-centric technique that values student interest and opinion, particularly in lieu of selecting a unit or classroom theme. Each approach

listed above also puts the student in the active role of both identifying an age appropriate research question but also in answering that question. Each method puts the teacher in the role of a passive support system, guiding students along the way and aiding them in expanding their questions and identifying new questions throughout the discovery process, over a long period of time, meaning that a single investigation could take several weeks to come to a natural end. Finally, each of these approaches involves sharing what is learned through some means (Brooks, 2011; Helm et. al., 2010; Stegelin, 2003). In the case of children with special needs, this element of sharing what was learned may involve teacher dictation or documentation, but the general idea is that the students are somehow sharing their process and conclusions with their surrounding community.

These best practice approaches work to include individuals with varying abilities with ease. Each approach naturally lends itself to targeting a variety of learning, and focuses on providing students with an opportunity to explore and share what they have learned through employing different strengths. These curricula leave room for explicit instruction in regards to teaching strategies to learn, all of which are key modifications identified by Grumbine et. al. in their article entitled “Teaching Science to Students with Learning Disabilities,” (2006). Another study found that when other subjects, such as reading or mathematics were embedded into a hands on science activity through one of these approaches, students actually scored better when tested on these skills than if the subject matter had been taught in a traditional way (Adamson, 2011). Through collaboration between a general education teacher and a special education teacher, appropriate modifications, such as overarching themes to units and flexibility in how students report what they learn, can be put into place, and lend scientific material accessible to every student (Steele, 2007).

*Self-Efficacy & Professional Development*

Even with these approaches in mind, many teachers “believe they do not know enough science to be able to teach it,” and tend to teach their students in the same fact-based manner that they were taught if they address science in the classroom at all, (Martin et. al., 2005, pg. 14).

Research has demonstrated that teacher self-efficacy in the area of science is a strong indicator of the quality of science education that takes place in the classroom. Teachers that feel uneasy about teaching science or about their personal knowledge in this subject matter are less effective teachers, and likewise the attitude of a school district as a whole towards science, can effect what science looks like in the classroom (Lumpe, 2000; Czerniak et. al., 1990). Other studies looked at teacher preparation and professional training opportunities in regards to the amount of time teachers spend teaching science in their classroom, and found that educators with little science background tend to teach science less in their classrooms (Enochs et. al., 1990).

What many of these research projects, looking at teacher self-efficacy in the area of science, have found is that professional training opportunities go a long way to fill in the gap in confidence and knowledge, and prepare teachers with the tools needed to access the approached mentioned above. Several studies have provided training opportunities to early childhood educators, focusing on teaching them how to educate their students through hands-on investigations at science museums and enabling the teachers to develop science curriculum aligned with museum exhibits, that fulfilled state and national science education standards (Duran et. al., 2009; Akerson et. al., 2010; Goulart et. al., 2009). These studies have supported the claim that the quality of science education and teacher self-efficacy improves with exposure to professional training opportunities.

Based on observed trends regarding teacher self-efficacy, training programs and observations across general education and special education in the early childhood setting, it is likely that current science education does not adhere to best practice. But the question still stands--what does science look like across early childhood programs, specifically those that serve individuals with special needs, across Lake Washington, Bellevue and Seattle Public School Districts? Are teachers employing best practice approaches such as the Project Approach or the Constructivist approach, or are their issues with teacher self-efficacy in the area of science that are coming into play? With the opportunities educators have to work with young minds, in the midst of such a key time of brain development, concern over science education in the early childhood setting is a question we can't afford not to ask.

## Methods

An electronic survey, available through <http://catalyst.uw.edu/webq/survey/tbcoffin/162923>, served as the primary data collection method for this research in order to obtain a description of what science education currently looks like across Lake Washington Public School District, Bellevue Public School District and Seattle Public School Districts, specifically in the early childhood setting. Participants were contacted via email, containing a description of the research as well as a link to the survey.

### *Participants*

Participants who were invited to complete the survey portion of the research included teachers working throughout Lake Washington, Bellevue and Seattle Public School Districts serving children between the ages of three and seven, or, based on grade placement, in a preschool or kindergarten program. Given the interest in contacting educators that worked with children with special needs and typically developing children, many of the educators contacted worked across multiple grades, doing resource room support and pull out with children, including those in preschool, kindergarten and head start programs. These educators included individuals teaching in general education programs, multi-age programs, blended programs, inclusive programs, as well as resource room setting. Head teachers, as well as paraeducators, classroom aides and assistant teachers were included. This study was conducted in Washington State, in Seattle and the surrounding area in an effort to include all public schools that are a part of the districts listed above. Participants were selected based on program and district affiliation and no other qualifying characteristics.

### *Survey*

Respondents were asked to answer eleven questions, four of which were optional, with the remaining questions requiring a response in order to complete the survey. Each participant received the same questions. Survey questions were designed to identify the respondent through zip code and program placement only, with any other identifying characteristics being left anonymous. Survey questions were based on current research supporting best practice for science education in early childhood settings, focusing on questions intended to reveal information about teacher self-efficacy in the area of science, the amount and quality of science education in the classroom across public programs, and questions intended to provide evidence of teacher preparation programs or professional training opportunities in the area of science education.

A link to the survey was sent out to educators via email, and respondents were given one month to complete the survey, if they opted to participate. All respondents received the same series of questions, and were given the opportunity to review their responses before submitting. A sample of the survey can be viewed in figure 3, on the following pages.

# Science Education In The Early Childhood Setting

**Question 1.**

What is your school's zip code?

Required.

**Question 2.**

What grade level do you teach?

Required.

- Head-start
- Preschool
- Kindergarten
- Other:

**Question 3.**

How would you describe your class? Please select the one that most resembles your classroom.

Required.

- General education classroom
- Blended classroom
- Inclusive classroom
- Resource room
- Self-contained program
- Other:

**Question 4.**

What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school degree or equivalent (e.g., GED)
- Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree
- Other:

**Question 5.**

If you attended college, how many science courses did you take?

- None
- 1-2 science courses
- 3-4 science courses
- 5 or more science courses

**Question 6.**

Have you received any professional development training in the area of science, to support or aide in integrating science into your classroom? (staff training, clock hours, FOSS kit training, etc.)

Required.

- None
- 1-2 training opportunities
- 3-4 training opportunities
- 5 or more training opportunities

**Figure 3-Sample of survey questions:** This figure provides a sample of the survey questions that all participants received. The survey consisted of eleven multiple choice and short answer questions.

**Question 7.**

How comfortable do you feel teaching science to your students?

Required.

- I am uncomfortable teaching science, and try to avoid science related units or themes in the classroom.
- I am a little uncomfortable teaching science, but am willing to present the material.
- I am comfortable teaching science, but don't actively try to incorporate science into the classroom.
- I am comfortable teaching science, and incorporate it into the classroom on a regular basis.
- I am comfortable teaching science, and try to work it into my classroom at every opportunity.

**Question 8.**

Do you have a science curriculum that you use in your classroom? If yes, what curriculum do you use?

Required.

Please list the science curriculum or resources you use in your classroom here, with as much identifying information as you can supply.

**Question 9.**

Do you have a designated "science" time in your classroom schedule?

Required.

- Yes
- No
- Other:

**Question 10.**

How often do you teach science in your classroom?

- Less than 1 hour per week
- 1-2 hours per week
- 2-4 hours per week
- More than 4 hours per week

**Question 11.**

Is there anything else, in regards to science education in your classroom or in the early childhood setting, that you'd like to share?

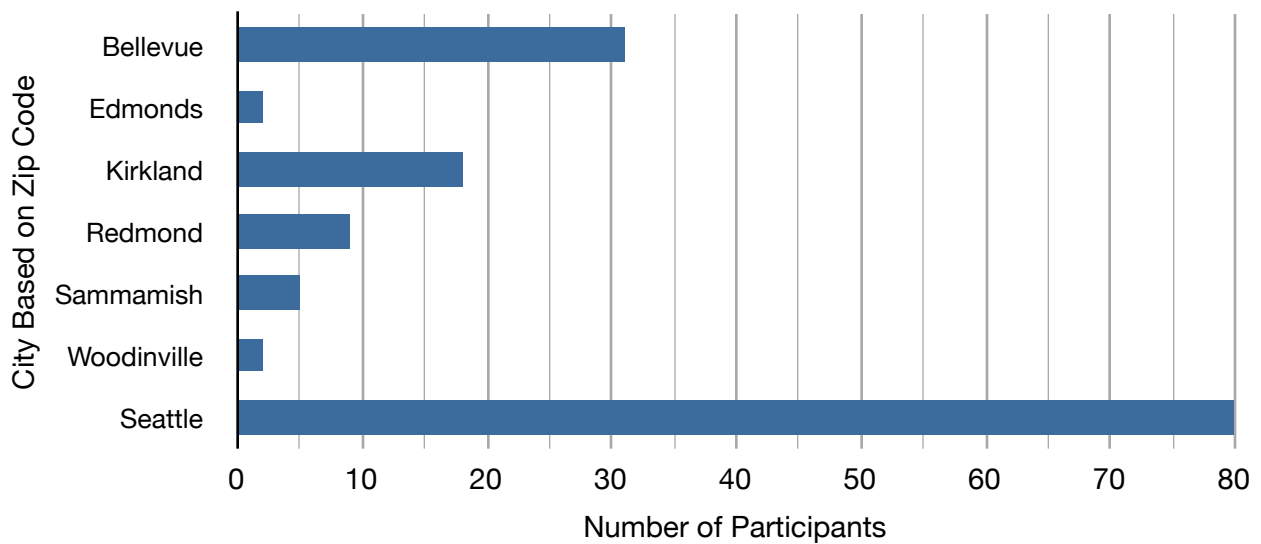
Submit responses

**Figure 3-Sample of survey questions:** This figure provides a sample of the survey questions that all participants received. The survey consisted of eleven multiple choice and short answer questions.

## Results

### *Participant Background & Educational Setting*

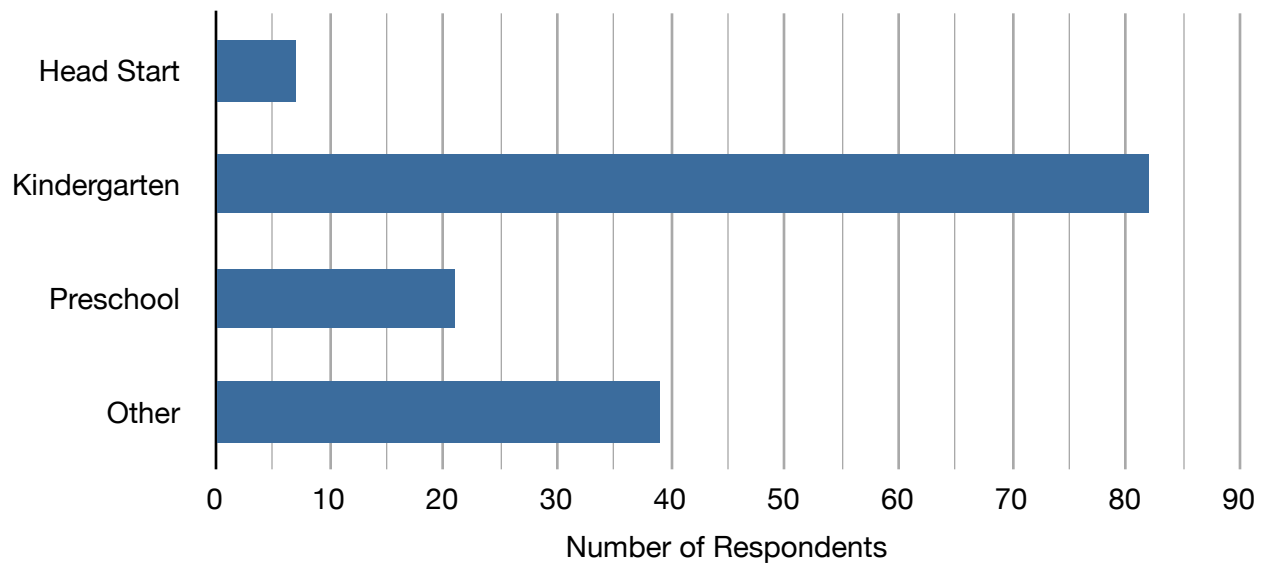
After the month in which surveys could be completed, the final count was 149 completed surveys. Survey responses to the first question regarding zip code revealed that most of the respondents were educators from the Seattle Public School District, with 80 participants from this school district. The remaining respondents hailed from Bellevue Public School District, with the second highest response and finally, Lake Washington Public School District was the least represented of the three, correlating with the relative size of each school district. Figure 4 reveals a graphic break down of location of respondents, based on school zip code.



**Figure 4-Participants Based on Zip Code:** This figure provides an illustration of the number of participants from each city, based on school zip code provided.

Figure 5 demonstrates that the majority of the respondents reported working in a kindergarten program, with 82 participating teachers working solely with kindergarteners. Preschool programs were represented across the responses of 21 participants, and head start was the least represented program, with only seven participants. The remaining participants selected

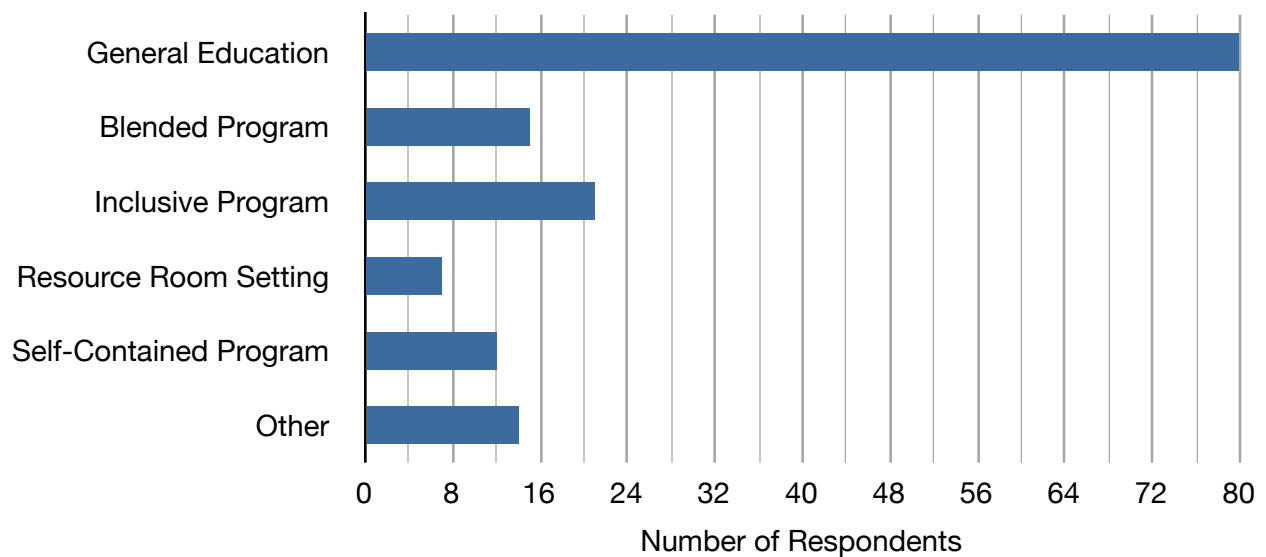
the option of “other” on the survey. Many of these individuals described themselves as working with multiple age groups, including kindergarten, head start or preschool, doing so in the capacity of a multi-age program, through an elementary resource room that served kids K-5 or K-8, or working as a paraeducator or classroom support staff who worked across elementary ages, including kindergarten and younger.



**Figure 5-Program Placement:** This figure illustrates the number of participants based on their respective school program, such as kindergarten, preschool, head start or “other” which was largely represented with participants that serves more than one age group, including kindergarten, preschool or head start.

Most teachers and educators who responded to the survey worked in what they described as a general education setting, with a total of 80 respondents serving typically developing children. Inclusive programs were the next highest represented program, with 21 respondents describing their education setting as an inclusive classroom serving special education students and typically developing students. There were also 15 blended programs represented through the responses. Of the remaining responses, 12 teachers described their classroom as a self-contained setting, seven described their setting as a resource room, and 14 selected the category of “other.”

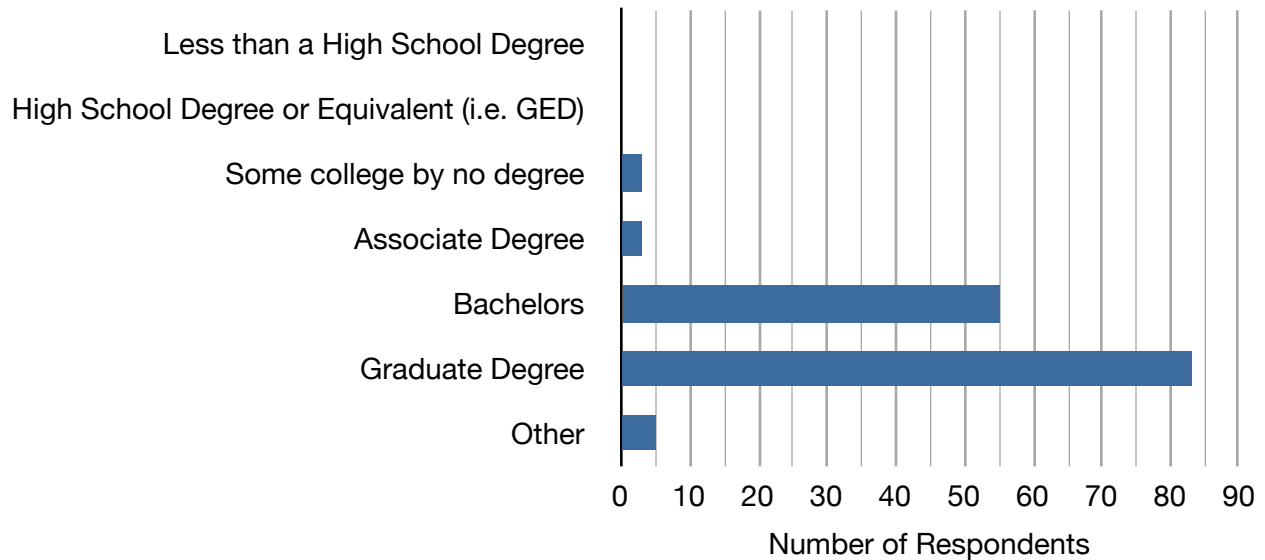
Most of the participants who referred to their placement as “other” worked across several settings as support staff, such as a paraprofessional or a special education teacher who served a variety of children across multiple programs. Those who select also included individuals working in DATA programs or other Autism extended day programs. This data indicates that while 80 participants in this survey serve the general education population, at least 62 of those who responded to the survey work with children with special needs, either as a resource room support staff, special education teacher, or some other capacity. This data is illustrated in figure 6.



**Figure 6-Population Served Through Based on Program:** This figure illustrates the program type, indicating population served in regards to typically developing children and children receiving services for special needs. In this sense, general education includes programs that work primarily with typically developing kids, where as blended and inclusive programs, resource room settings and self-contained programs are more likely to work with kids with special needs.

Most of the participants in the survey reported having a graduate degree, with 83 indicating having a Masters degree or higher. Out of the remaining participants, 55 had received a Bachelors degree, six had attended some college or received an Associates degree, and five marked other under education. Additional details provided indicated that those who marked “other” had either earned a Washington State Teaching Certificate through a teaching preparation

program or other teacher education program, or were a NBCT (National Board Certified Teacher). This data is illustrated in figure 7 on the following page.



**Figure 7-Education Level of Respondents:** This figure illustrates the level of education of respondents. Results ranged from some college but no degree to graduate degrees and specialized certifications. These results indicated that all participants in the survey had participated in some form of continuing education.

### *Science in the Classroom*

Figure 8, which can be found on the following page, illustrates the relationship between number of professional development opportunities or trainings about science education that were provided to educators in relation to the amount of time (in hours) educators spend teaching science in their respective classrooms. These results illustrate that of the educators who noted spending less than one hour per week teaching science, 41.3% of these educators had no training opportunities in the area of science, 36.9% of these educators had between one and two training opportunities, 17.3% of them had between three and four training opportunities and 4.3% of those reporting less than one hour of science per week, had participated in five or more science trainings.

Within the educators that noted spending between one and two hours per week teaching science, 19.6% of these educators had no training opportunities in the area of science, 15.1% of these educators had received one or two training opportunities, 22.7% of them had between three and four training opportunities and 42.4% of those reporting one to two hours of science per week, had participated in five or more science trainings. For teachers that reported spending between two and four hours per week teaching science, 10.3% of these educators had no training opportunities in the area of science, 13.7% of these educators had between one and two training opportunities, 24.1% of them had three or four training opportunities and 51.7% of those reporting teaching science for two to four hours per week had participated in five or more science

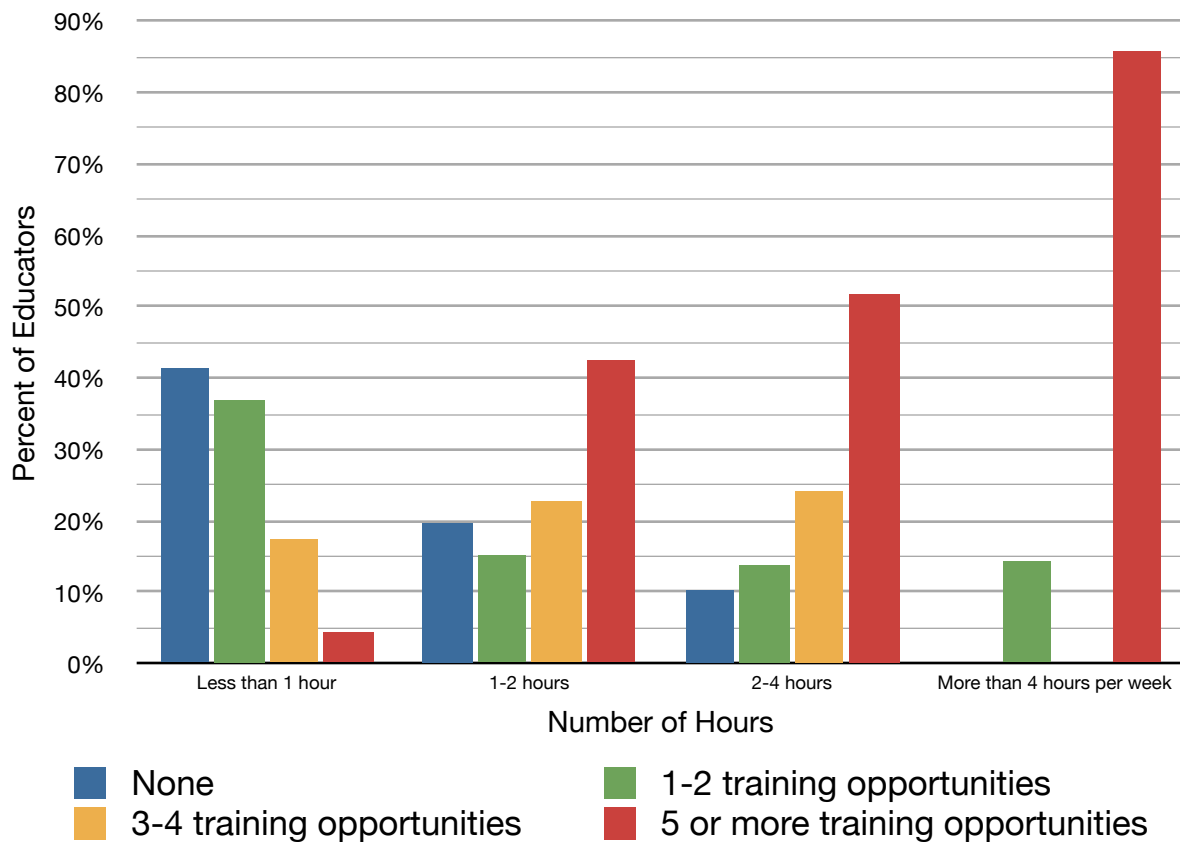


Figure 8: This figure compares the number of hours spent teaching science per week compared to training opportunities available to educators responding to this question. The percentage provided compares training opportunities across number of hours taught. For example, of all the participants who reported spending less than one hour teaching science per week, approximately 40% of these individuals received no professional development opportunities in the area of science.

trainings. As for the educators who reported spending more than four hours per week engaging in science lessons and activities, 0% of these individuals received no trainings, 14.2% had participated in one to two training opportunities, 0% participated in three to four training opportunities, and 85.7% of teachers who taught science four or more hours per week participated in five or more training opportunities in the area of science.

Figure 9 compares the relationship between science courses taken at the college or university level (as a graduate student or as an undergraduate student) and the number of hours spent teaching science per week in the educators' respective classroom. Out of the educators that reported spending less than one hour a week on science activities in the classroom, 8.6% of these individuals took no science courses in college, 36.9% enrolled in between one and two science courses, 30.4% took three or four science courses at the college level, and 23.9% took five or

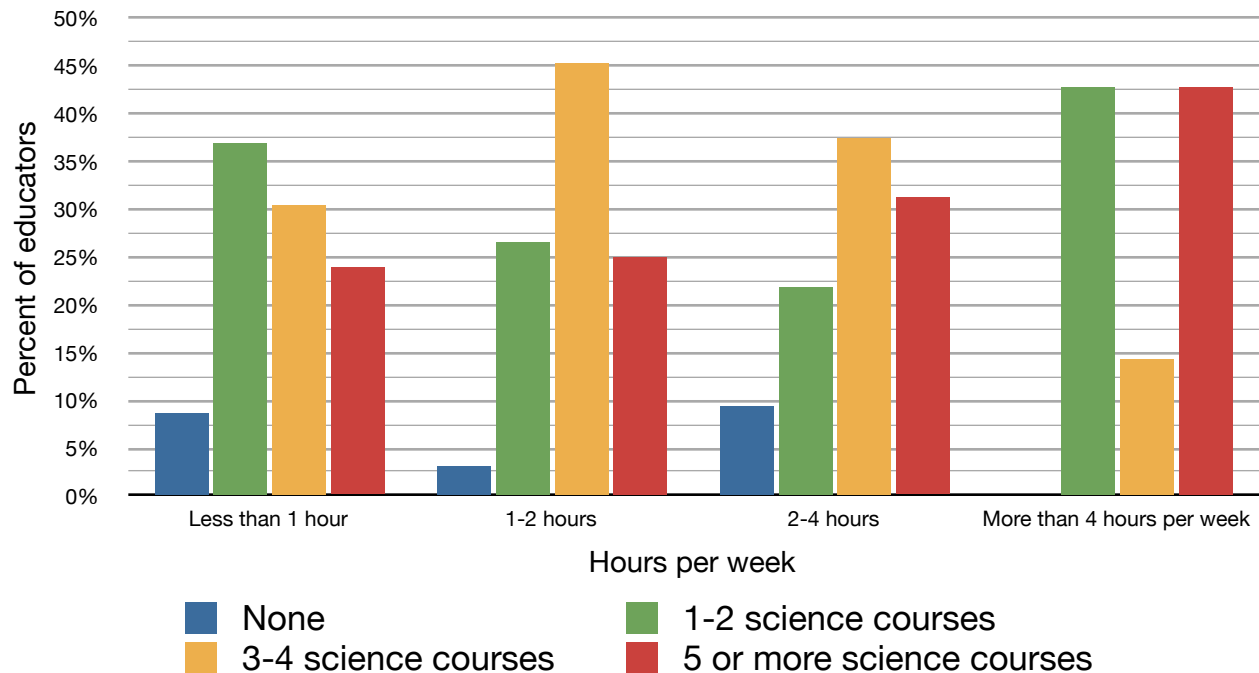


Figure 9: This figure compares the number of hours spent teaching science per week compared to the number of college or university level science courses that educators enrolled in at one point. The percentage provided compares college level science courses across number of hours science is taught in their respective classrooms. For example, of all the participants who reported spending less than one hour teaching science per week, approximately 36.9% of these individuals enrolled in one or two science courses as a graduate or undergraduate student.

more science courses. For educators that noted spending one or two hours a week on science activities, 3.1% of these individuals took no science courses in college, 26.5% enrolled in between one and two science courses, 45.3% took three or four science courses at the college level, and 25.0% took five or more science courses. Of the educators that reported spending between two and four hours per week on science in the classroom, 9.3% of these individuals took no science courses in college, 21.8% enrolled in between one and two science courses, 37.5% took three or four science courses at the college level, and 31.2% took five or more science courses. Finally, of the teachers who reported spending more than four hours per week on science in their classroom, 0% of these individuals reported not enrolling in college level science courses, 42.8% of them reported taking one or two science courses, 14.2% of them took three or four science courses in college, and 42.8% of them said that took five or more science courses in college.

Figure 10 investigates the relationship between the number of training opportunities that educators participated in compared to their comfort level teaching science. This question was based on five defined levels of comfort with science education material. The questions were designed to reveal both comfort level with the material and desire to incorporate the material into the classroom, and include the following:

- **1**=I am uncomfortable teaching science, and try to avoid engaging in science units or themes in the classroom
- **2**=I am uncomfortable teaching science, but I am willing to present the material
- **3**=I am comfortable teaching science, but I don't actively try to incorporate science into the classroom
- **4**=I am comfortable teaching science and incorporate it into the classroom on a regular basis
- **5**=I am comfortable teaching science and try to work it into my classroom at every opportunity

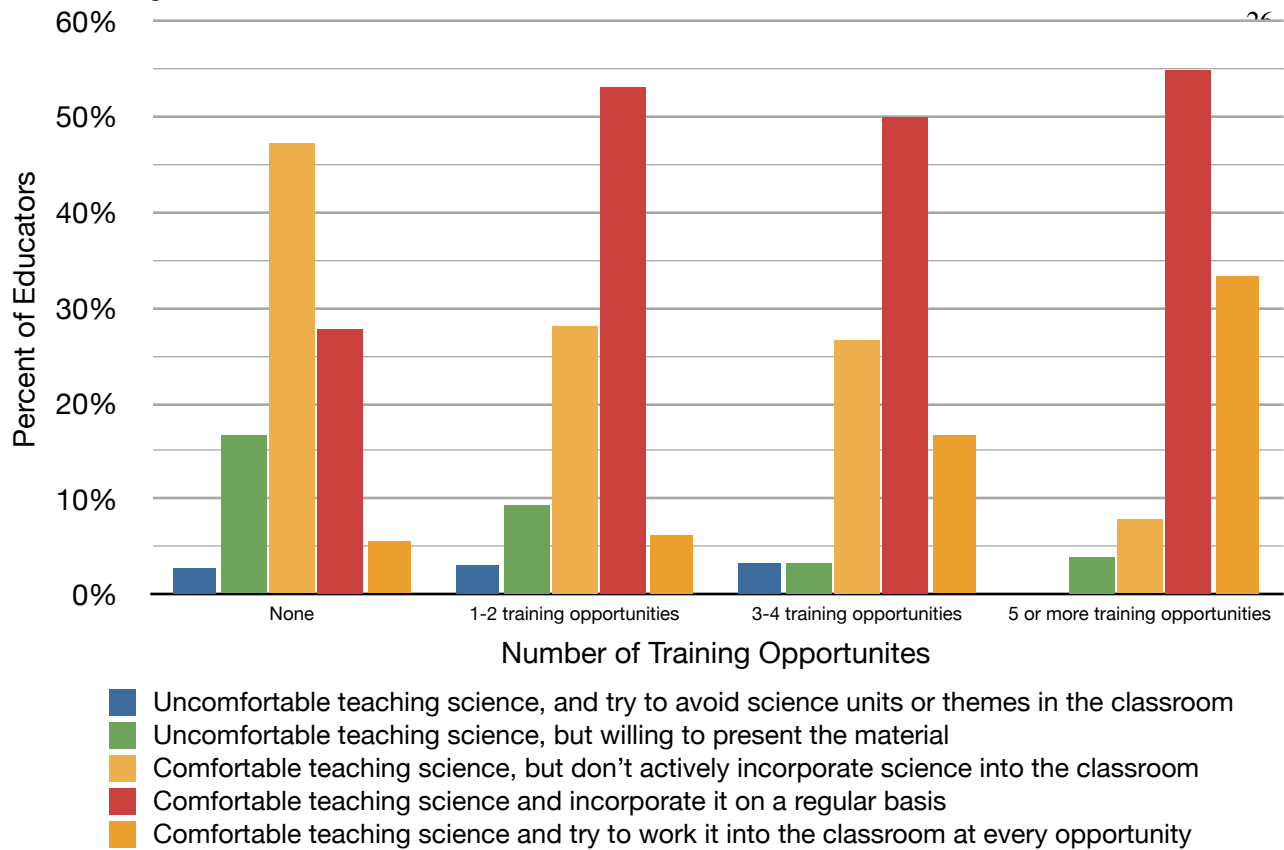


Figure 10: This figure compares the number of training or professional development opportunities, in the area of science, provided to individual respondents and how comfortable they are with teaching science in their classrooms. The comfort level was based on a rating scale that is described in the key above. For example, of the educators that noted participating in five or more training opportunities, 33.3% of these individuals reported being that they felt comfortable teaching science, and tried to work it into their classroom at every opportunity.

In this case, a 1 or a 2 indicates that the educator is uncomfortable teaching science material to their students, whereas a 3, 4 and 5 indicate that the educator is comfortable teaching science, with each number indicated the degree to which the educator is comfortable and uncomfortable with the material. Out of the educators that stated they had not participated in any training opportunities related to teaching science in their classroom, 2.7% of them said they were uncomfortable teaching science and tried to avoid science related themes, 16.6% reported being uncomfortable teaching science but willing to present the material, 47.7% reported being comfortable teaching science but did not actively incorporate it into the classroom, 27.7% stated that they were comfortable teaching science and incorporated it into the classroom on a regular

basis, and 5.5% stated that they were comfortable managing science material in the classroom and tried to work it into the classroom as often as possible.

Within the pool of educators who reported participating in one or two science education training opportunities, 3.1% of them said they were uncomfortable teaching science and tried to avoid it in their classroom, 9.3% stated that they were uncomfortable teaching science but willing to do science activities, 28.1% reported being comfortable teaching science but not active in incorporating it into the classroom, 53.1% stated that they felt comfortable teaching science and incorporated it into the classroom on a regular basis, and 6.2% stated that they were comfortable managing science material into the classroom and tried to work it into the classroom as often as possible. Out of the teachers who reported participating in three to four training opportunities, 3.3% of them said they were uncomfortable teaching science and tried to avoid it in their classroom, 3.3% stated that they were uncomfortable teaching science but willing to do science activities, 26.6% reported being comfortable teaching science but not active in incorporating it into the classroom, 50.0% stated that they felt comfortable teaching science and incorporated it into the classroom on a regular basis, and 16.67% stated that they were comfortable managing science material into the classroom and tried to work it into the classroom as often as possible.

Finally, out of the teachers that stated they participated in five or more science education related training opportunities, 0.0% of these individuals reported avoiding science activities in the classroom, 3.9% stated that they were uncomfortable teaching science but willing to present the material, 7.84% of the respondent reported being comfortable in teaching the material, but not active in including science in their classrooms, 54.9% noted that they felt comfortable teaching science and incorporated it into their classrooms on a regular basis, and finally 33.3% of

the respondents reported being comfortable with science education and stated that they tried to incorporate it into their classroom routine at every opportunity.

Figure 11 compares number of college or university level science courses taken as an undergraduate or graduate student with the individuals comfort level teaching science related material in their classroom. This figure illustrates that 25.0% of the individuals who did not take any college or university level science courses, felt uncomfortable teaching science in their classroom and tried to avoid it, while 75.0% of them were uncomfortable teaching science, but willing to present the material in their classroom. No educators who reported taking zero college

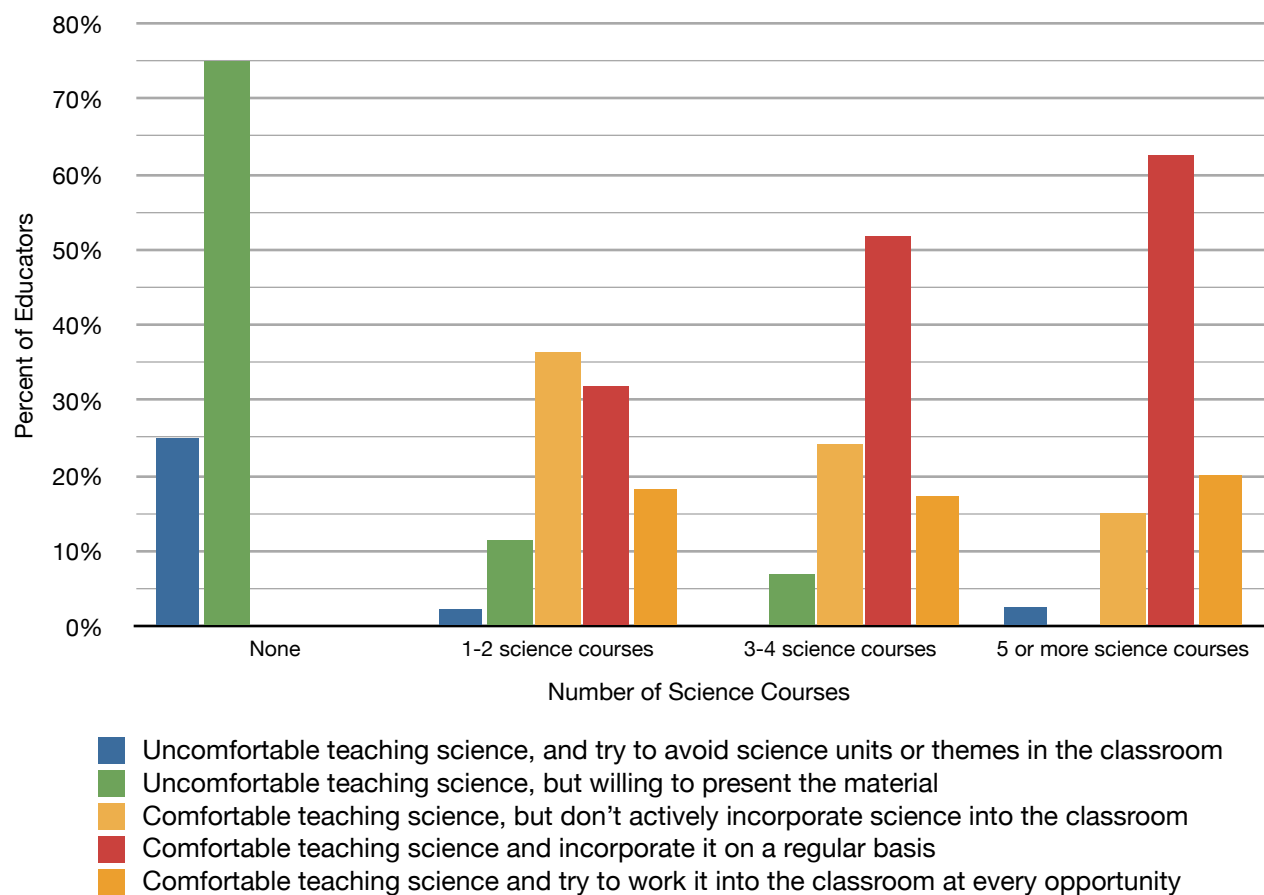


Figure 11: This figure compares the number of science courses individual educators took at a college level with how comfortable they are with teaching science in their classrooms. The comfort level was based on a rating scale that is described in the key above. For example, out of the educators that reported taking three to four courses in science, 51.7% of these individuals reported being that they felt comfortable teaching science, and tried to work it into their classroom on a regular basis.

courses on science described themselves as being comfortable teaching science material to their students. Of the teachers who reported taking one or two science courses in college, 2.2% of them said they were uncomfortable teaching science and tried to avoid it, 11.3% stated that they were uncomfortable teaching the material but willing to present it in their classroom, 36.3% stated that they were comfortable teaching science but did not actively try to incorporate it into the classroom, 31.8% reported being comfortable with it and incorporating it into their classroom on a regular basis, and finally, 17.2% of educators who had taken one or two science courses in college said that they were comfortable teaching science and tried to work it into their classroom at every opportunity.

Out of those educators who reported taking three or four science courses in college, 0.0% reported avoiding the material in their classroom out of discomfort, 6.8% reported being uncomfortable teaching science material but willing to present it to their students, 24.1% of the respondents said that they felt comfortable teaching science but did not actively try to incorporate science into their classroom, 51.7% of those who took three or four science courses said they were comfortable teaching science and tried to incorporate it into their classrooms on a regular basis, and 17.2% stated that they were comfortable teaching science and that they tried to present the material to their students at every opportunity.

Lastly, figure 11 illustrates that 2.5% of the respondents who reported taking five or more science courses throughout college stated that they were uncomfortable teaching science and tried to avoid science themes with their students, 0% reported being uncomfortable teaching science but willing to present the material, 15.0% of educators noting five or more science courses reported that they are comfortable teaching science but that they don't actively try to incorporate science into the classroom, and 62.5% stated that they were comfortable teaching

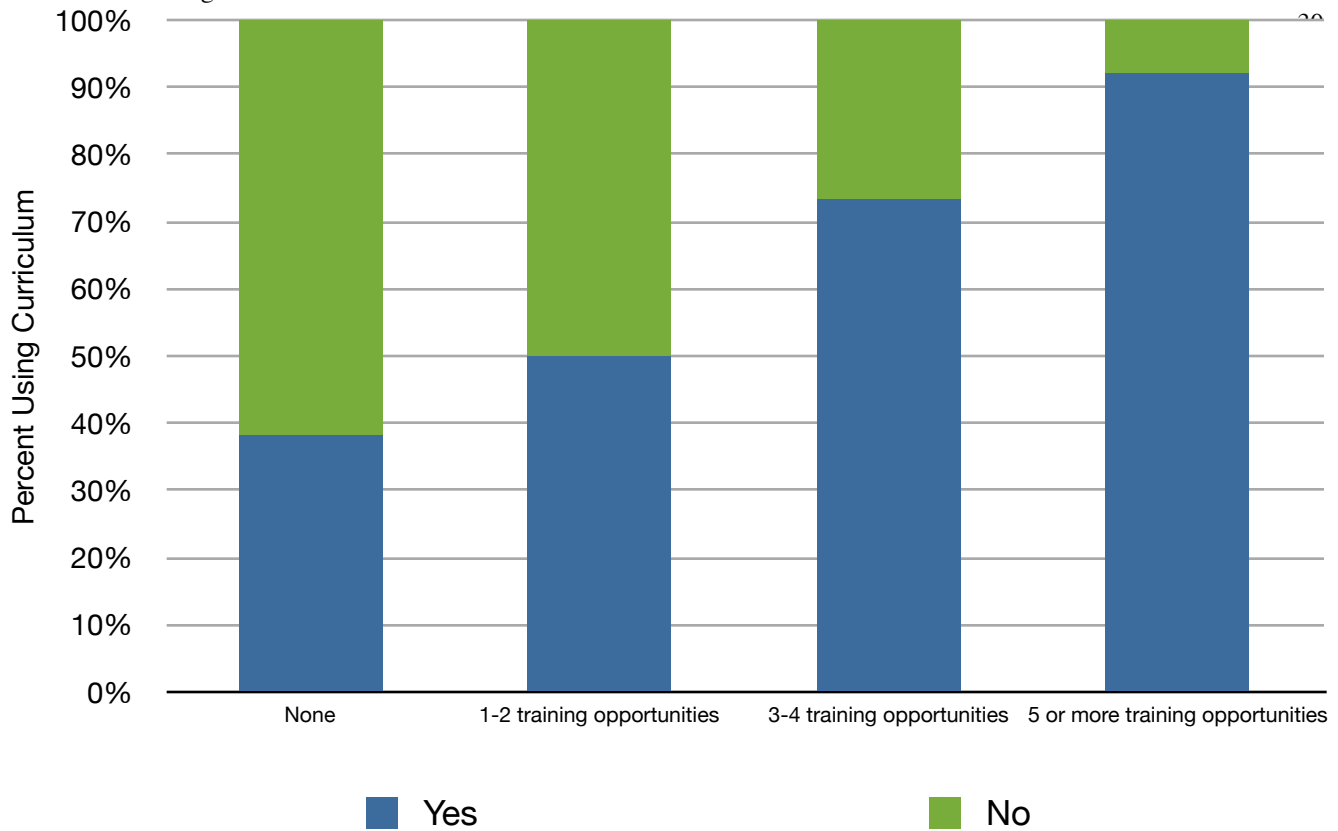


Figure 12: This figure compares the use of a science curriculum with the number of training opportunities provided, where the green bar or “no” indicates that there is no curriculum utilized in the classroom and the blue bar or “yes” indicates that a science curriculum is utilized in the specific classroom setting. For example, out of the individuals that reported engaging in one to two training opportunities, 50.0% reported using a curriculum, and 50.0% reported not using a curriculum to teach science in their classroom.

science lessons, and tried to incorporate it into their classroom regularly. Finally, 20.0% of teachers that took five or more science courses said that they were comfortable teaching and leading science activities and tried to work these types of opportunities into their classroom frequently.

Figure 12 demonstrates the relationship between training opportunities provided and whether or not a formal science curriculum is utilized in the classroom setting, based on individual educators experience. The goal of reviewing this relationship was to see if there was a correlation between a formal science curriculum and whether or not teachers had access to

training opportunities. Out of classroom settings where educators did not have access to any training opportunities, 38.2% of these classrooms reported using a formal science curriculum while 61.7% of these classrooms reported not using a set science curriculum for science units and themes. In programs that had access to one or two science education training opportunities, 50.0% said they used a science curriculum, while the remaining 50.0% said they did not use a curriculum. For settings that reported engaging in three to four training opportunities, 73.3% said they used a science curriculum in their classrooms, while 26.6% reported they did not use a curriculum. Finally, 92.1% of educators that reporting participating in five or more training opportunities stated that they used a curriculum in their program, while only 7.8% of those who received this many professional development opportunities said they did not have a curriculum.

Based on participant response, the science curriculum that surfaced most frequently were FOSS kits (Full Option Science Systems) produced by Delta Education. Other responses varied from workbooks to internet resources. Out of all the responses, 69% of teachers reported using

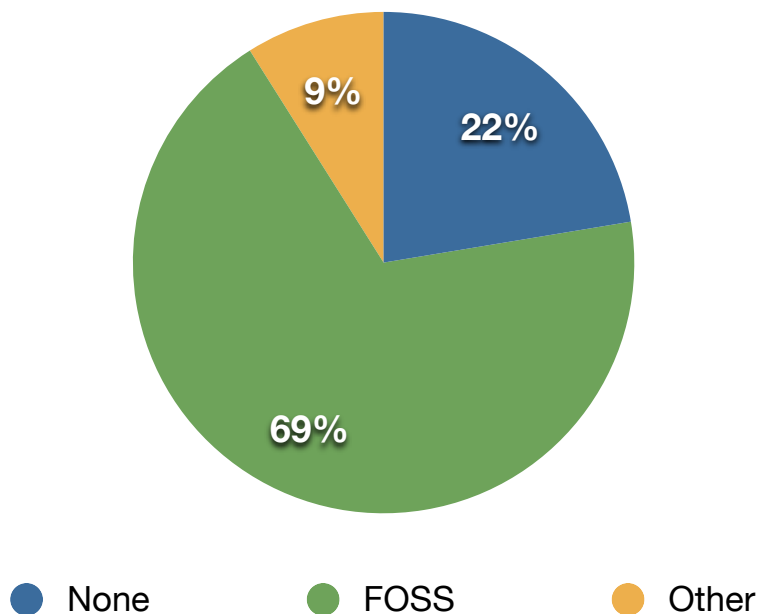


Figure 13: This figure provides a visual representation of the percent of educators reporting using a FOSS kit for their classroom science curriculum, educators that did not use a curriculum, and those who used another curriculum or online resource.

FOSS kits in their classrooms, 22% reported not using any curriculum in their classroom, and 9% indicated that they used a different curriculum or set of resources in their classroom when teaching their students science. This data is represented in figure 13.

Figure 14 illustrates the relationship between hours per week dedicated to science, and the number of educators who have a designated science time in their classrooms. These variables were compared in order to assess whether or not the presence of a designated science time indicates more time spent engaging in science activities and lessons in the classroom. The results indicate that of the educators who reported teaching science for less than one hour per week, 65.1% of these individuals did not have a designated time for science in their classroom and 34.4% of them did have a designated science time for their students over the course of a week. Out of the educators who said they spent between one to two hours on science, 28.5% of these individuals

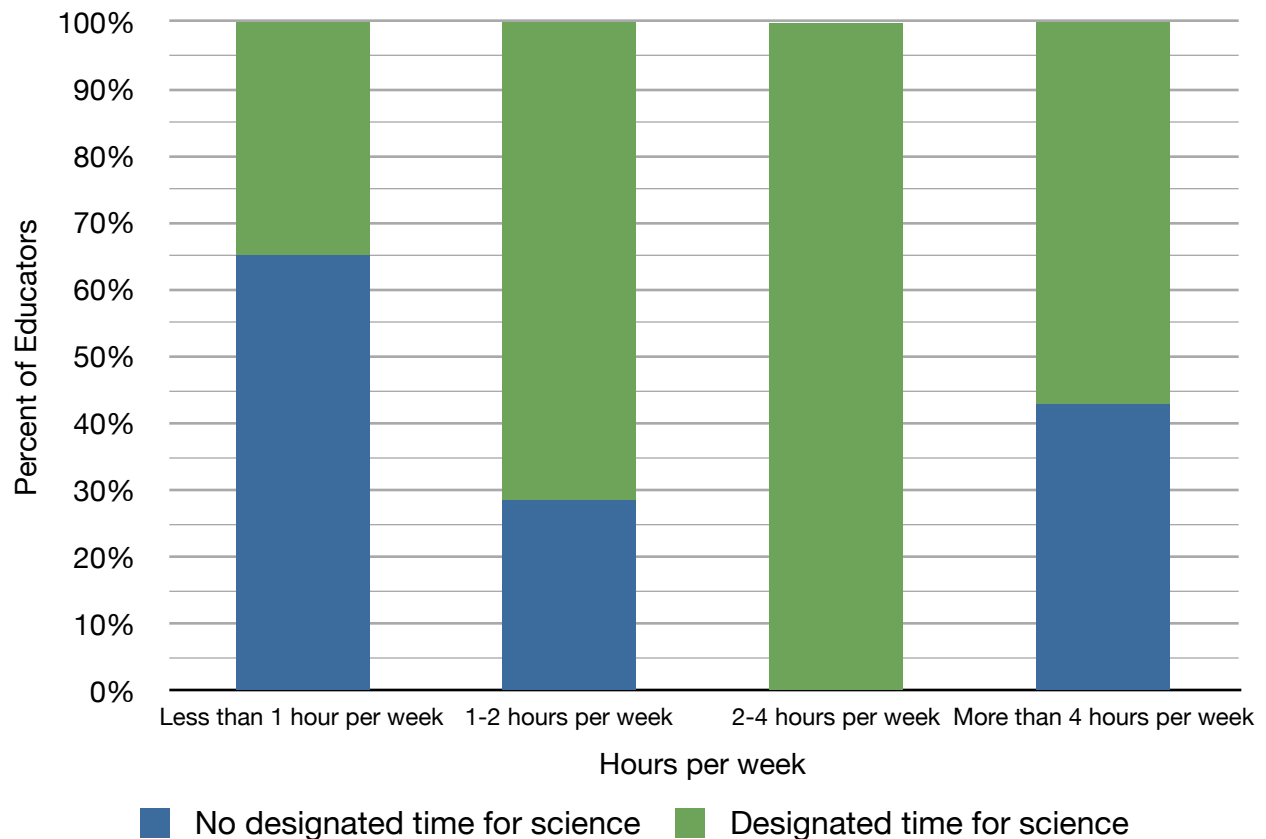


Figure 14: This figure illustrates the relationship between the hours a week dedicated to science and whether or not there was a consistent designated time set aside in that classroom for scientific inquiry to take place.

said they did not have a designated science time in their classroom and 71.4% of them reported have a designated time for science each week. As for teachers spending between two and four hours engaging in science during the week, 100% of these educators said they had a designated time for science. Finally, out of the educators who reported spending more than four hours on science per week, 42.8% of them said they did not have a designated science time and 57.1% of them noted that they did have a designated time for science.

Figure 15 compares the hours per week dedicated to science with access to a science curriculum. These variables were compared to see if the presence of a formal science curriculum was predictive of the amount of time spent engaging in science related material. This data indicates that of the educators who reported teaching science for less than one hour per week, 58.9% of these individuals did not use a science curriculum in their classroom and 41.0% of them did. Out of the educators who said they spent between one to two hours on science, 17.2% of these individuals said they did not use curriculum and 82.7% of them reported using

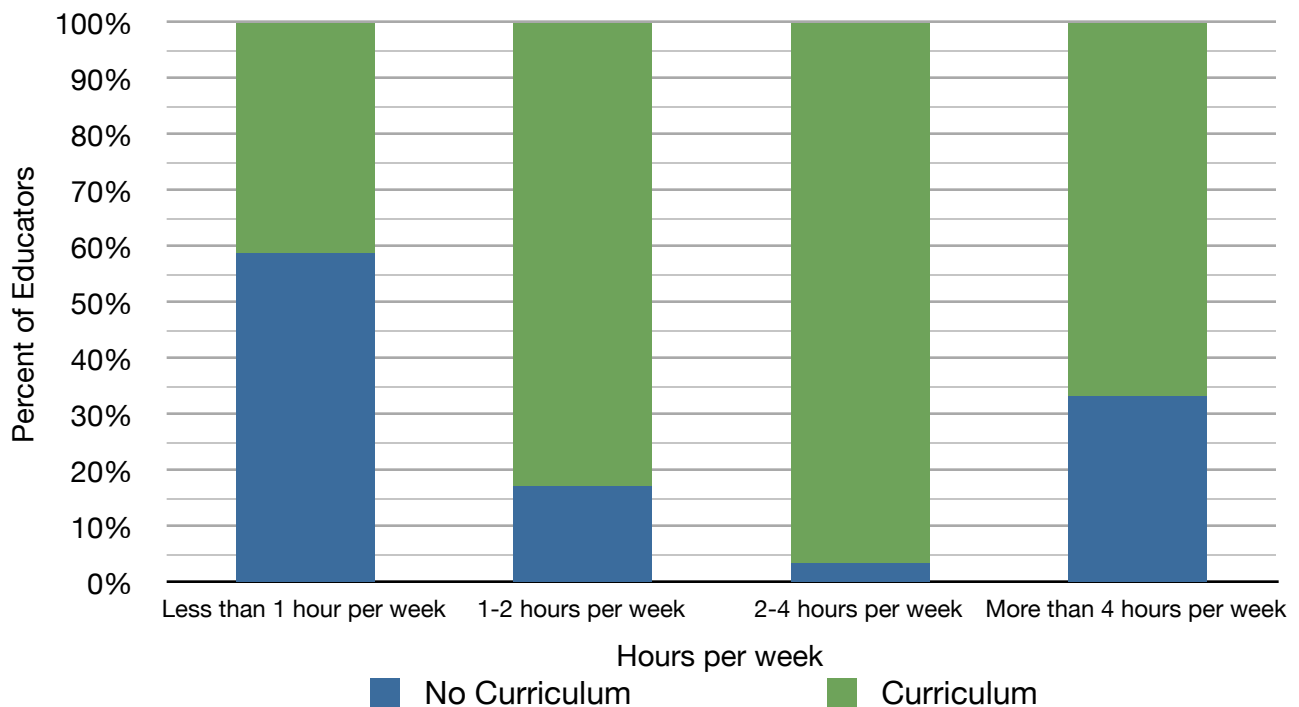


Figure 15: This figure illustrates the relationship between the hours a week dedicated to science and whether or not there was a science curriculum used in the classroom setting.

curriculum for science. As for teachers spending between two and four hours engaging in science during the week, 3.5% reported not using a curriculum, while 96.4% of these teachers did.

Finally, out of the educators who reported spending more than four hours on science per week, 33.3% of them said they did not have a designated science curriculum and 66.6% of them noted that they did have a specific curriculum that they used in the classroom setting.

## Discussion

### *Demographics*

Data regarding the characteristics of the respondents, such as zip code, program and classroom setting, indicates that the most represented group of educators are teacher who work in a general education kindergarten setting, based out of the Seattle Public School District. While other programs and schools were included in the pool of survey participants, Seattle school district teachers were by the far the largest demographic who responded to the survey. This could in part be due to how the participants were contacted. A potential problem that might have effected the number of respondents able to participant may have been in part due to the method in which email addresses were collected for the survey. Email addresses were collected via the respective school district websites, and as such website maintenance could be an issue if some of the email addresses were out of date or no longer valid. This may have played a part in the underrepresentation of certain groups, and explain the high number of Seattle based participants versus other zip codes. When considering the high number of Seattle Public School participants, versus Bellevue or Lake Washing School Districts, it is also important to take into consideration the size of the applicant pool for each respective district. Seattle Public School District is by far the largest of the three public school districts included in this survey, both in terms of number of schools, but also in terms of number of staff members working in the early childhood setting.

Given that the survey was delivered through the internet, internet accessibility was a potential hurdle that may have made is difficult for some educators to complete the survey. At this time, many head start or ECEAP programs across the school districts contacted lack this easy access to internet, and as a result this method of delivery could in part explain the underrepresentation of ECEAP and Head Start programs. In order to paint a more compete

picture of what science education looks like in head start programs over the selected districts, a paper copy of the survey should be sent to these specific programs.

The large number of kindergarten programs represented maybe explained by the make up of each school district. There are currently a greater number of kindergarten programs offered throughout the districts polled when compared to preschool and head start programs. In order to get a better picture of what science education looks like in the preschool setting, private preschools would also have to be contacted with this survey.

### *Science in the Classroom*

Research has suggested that exposure to science related material, especially before the age of seven, may be highly beneficial for providing students with the opportunity to develop higher cognitive functions through experience-based learning (Brooks, 2011; Michaels et. al., 2008; Shonkoff et. al., 2000). While rich and dynamic education environments in general can supply important experiences that help to shape brain development, science in particular is well equipped to teach children how to ask and answer questions, a key process in regards to learning how to learn. The more opportunities children have to engage in the scientific process or investigation over the course of a week within the classroom, the more opportunities they have to develop these skills. These early experiences are predictive of scholastic success later in life (Brooks, 2011).

Much of the data gathered through this survey, reflects the amount of science kids are receiving, in relationship to the presence of curriculum, the amount of time designated to science in the classroom, and educator confidence and knowledge in the area of science indicated by college courses and professional development opportunities. The argument being that if students

are receiving multiple opportunities over the course of the week to engage in science related topics and activities and are receiving instruction from trained confident educators, then they are getting key experiences that will aid in the development of higher cognitive function (Brooks, 2011).

In figure 8, a trend is observed in regards to the relationship between the number of professional development opportunities provided to educators and the number of hours these respective educators spend teaching science per week. This trend indicates a correlation between training opportunities in the area of science and the amount of time students are exposed to science in their classroom. The largest percentage of educators that reported teaching science less than one hour per week, indicated that they had not received any training opportunities in science, where as educators who received more training, reported teaching more science. In other words, teachers that receive professional training in science are more likely to teach science in their classrooms.

This correlation is potentially explained through the availability of resources. Given that more science in the classroom is statistically connected to training opportunities and the presence of a science curriculum, one can assume that the resources that accompany a formal curriculum may make science lessons and activities easier to plan and more accessible to teachers in the early childhood setting. This also suggests that districts that are willing to dedicate resources to purchasing a formal curriculum appear to be more likely to fund professional development sessions. This correlation is discussed in greater detail later on.

There was no strong trend observed in figure 9 which illustrates the relationship between the number of hours spent teaching science per week with the number of college level science courses the teacher enrolled in. It is important to refer to figure 7 at this point, which suggests

that all educators who responded to the survey had attended at least some college, indicating that all participants likely had the option to take a college level science course at one time or another. Despite this consistency, there appears to not be a strong correlation between the amount of time spent teaching science over the course of a week and a teachers personal education background in science.

In the past, researchers have demonstrated a correlation between teacher self-efficacy in the area of science and professional development opportunities, finding that teachers who engaged in science education trainings felt more confident teaching it (Lumpe, 2000; Levitt, 2002; Enochs; 1990; Czerniak et. al., 1990; Duran et. al., 2009). The argument is that teachers who are confident teaching science are more likely to provide effective science instruction to their students and teach it more often. The questions surrounding teacher preparation for the purposes of this survey looked specifically at professional development opportunities provided by respective school districts to early childhood educators. Given that training programs have been demonstrated to increase confidence and comfort, the survey sought to reveal whether or not early childhood educators were being provided specifically with science training opportunities, and whether or not trainings or college courses in the area of science were predictive of the amount of time teachers taught science in their classroom or their comfort level with the material.

Figure 10 illustrates that teachers who reported engaging in one or more science related trainings were generally more comfortable teaching science, with 78% of respondents receiving one more more trainings expressing comfort in teaching science or a rating of three or above (rating system described earlier on page 25). As research suggests, if the quantity and quality of science lessons in the classroom is based on how comfortable teachers are working with the

material, than the number of training opportunities is predictive of the quality and quantity of classroom science education (Lumpe, 2000; Levitt, 2002; Enochs; 1990; Czerniak et. al., 1990; Duran et. al., 2009).

The number of college or university level science courses educators reported taking was also examined as a potential predictive variable of teacher self-efficacy in the area of science. Based on the results of this comparison, visible in figure 11, 100% of the teachers who had taken zero science courses in college, reported being uncomfortable teaching science in their classroom, with a comfort rating of a 1 or a 2. Most teachers who reported a comfort level of 4 or above with teaching science noted taking three or more science courses at the college or university level. These findings suggest that the amount of experience a teacher has in college level science courses is more predictive of self-efficacy than training and professional development opportunities are. In other words, science education or a science background increases teacher confidence, and as this confidence and comfort level increases, research suggests that the quality of the in class instruction available to students also improves (Lumpe, 2000; Levitt, 2002; Enochs; 1990; Czerniak et. al., 1990).

Figure 12 compares which teachers had access to training opportunities based on the presence or absence of a science curriculum. This comparison was made to see if the presence of a formal science curriculum is predictive of whether or not schools offer training to the educators using the curriculum. The trends observed through this illustration demonstrates that as the presence of a curriculum is generally paired with more training opportunities. This might be in part be related to the high number of programs represented that are currently using FOSS kits (figure 13). Each FOSS kit is traditionally paired with a teacher in-service component. This correlation between curriculum and a high number of training opportunities could also be related

to resource allocation and reflect how much science is valued within an institution or more specifically within an early childhood program. The National Committee on Science Education Standards and Assessment (1996) speaks to the allocation of resources, indicating that institutions that allocate necessary resources to science programs within the school, are more apt to provide a supportive environment for science to take place, encouraging educators to teach science in their classrooms both by providing the means to do so, but also demonstrating that this subject matter is valuable. In other words, institutions that invest in a designated science curriculum appear to be more likely to foster a supportive environment for quality science education to take place in, through resources, by valuing science education, and providing educators with training opportunities.

Similarly, programs that had an established or designated time for science, tended to spend more time doing science. These findings are illustrated in figure 14. Out of the respondents, 91.1% of those who reported spending two hours or more per week with science material in their classroom, indicated that they had a designated time for science, whereas 43.3% of those spending *less* than two hours engaging in science, failed to have a designated time for science over the course of a week. This suggests that having a designated time for science is an effective way to insure that science has a consistent presence in the classroom.

### *Additional Thoughts*

Aside from the questions about demographics, there were few questions that dealt directly with educating children with special needs. This in part due to a lack of research that has been done on teaching science to children with special needs in an early childhood setting, but also because the goal was to ascertain what science education currently looks like in the overall

early childhood setting. Some questions and concerns, however, were raised in the final questions of the survey. In addition to the required and more structured components of the survey, participants were also invited to add anything else they would like, in a final optional, open-ended short answer question. Throughout the comments included, there were some interesting points raised that are worth taking into consideration for the purposes of this research, especially in regards to science education for students with special needs.

Teachers reporting from programs that served children with special needs indicated that very few of their students received supports for science related material. Without any IEP goals directly related to science in the early childhood setting, the majority of teachers serving this population reported that they supported their students during science mainly on the writing or reporting process involved with in science, rather than supporting them through developing concepts of scientific ways of thinking, despite the research supporting science education in reference to brain development (Brooks, 2011).

Special education teachers and support staff who did report doing science with their students on IEPs, specifically in preschool environments, mentioned lacking an appropriate science curriculum that was accessible to their students. Many teachers working with special education populations reported that standard science curricula are not appropriate for students on IEPs, and without an appropriately modified science curriculum it was difficult to present the material due to the prep time required to produce their own modifications and adaptations.

A consistent theme across these additional comments proved to be a great interest in working with a curriculum that is appropriate for the early childhood setting, but especially in terms of something that was appropriate for children with special needs or varying abilities. One teacher, serving students who she described as “medically fragile” in a self contained program,

referenced this lack of appropriate curriculum as being very limiting. What curriculum there is in Seattle, Lake Washington and Bellevue Public School Districts, namely the FOSS science kits, many teachers expressed concern over losing these resources with impending funding cuts across all school districts.

Time was a consistent theme of concern across all settings, given that many of the programs polled through this survey reported being a half-day program. Many teachers cited the pressures of focusing on reading and math, and other pre-academic areas, and how these trends pushed other activities out of the classroom with so little precious time in the day to work with their students. While teachers discussed trying to supplement this deficit by providing opportunities to talk about science related topics across free choice or other less structured play times, it is important to point out that science has been demonstrated to be an effective interdisciplinary subject, within which other domains can be embedded in. One study in particular focused on teaching math concepts through hands-on science activities in elementary settings, and found that students who engaged in the hands-on science activities as a vehicle for learning these concepts actually scored significantly better on standardized tests than their peers who learned the concepts through a more traditional manner (Adamson et. al., 2011).

Worse than this lack of curriculum or time to dedicate to science, was a trend that many teachers noted regarding special education pullout services, such as time spent with a SLP or PT/OT or other specialty that required a student exit their classroom setting to receive these services. The concern was that much of this pullout time occurred during science. One teacher said that pullout during science is “viewed as better than taking them [students] out of reading or math instruction, but I have concerns that it leaves long-term gaps for our most vulnerable students.” Given the potential benefits in engaging in the scientific inquiry process, as well as the unique

writing instruction that generally is paired with recording observations and findings, this issue is a real concern.

Another teacher spoke to some concerns in regards to how technology may be adversely affecting the way that science is taught to children in an early childhood setting, in the following passage,

I don't know what the "new" curriculum models are, but I sure do miss the days of hands on, learning in a natural environment, and EXPERIENCES. I notice that kids in the class I work in are expected to sit at circle for 30-60 minutes while the teacher drones on and on and on and on and on, talking and showing videos on the smart board. Technology is nice, but what about THE EXPERIENCES??? Heaven forbid we should ever paint or play with anything messy!(It truly breaks my heart, but as I do not have a degree, my 20 years in a SpEd pre-school setting counts for nothing and I am expected to keep my opinions to myself.

Throughout all of these comments, despite the critique of current science and concern over losing it, there was an optimistic theme, in which teachers in the early childhood setting consistently identified their students as natural scientists, excited and implored to learn about the world around them, regardless of ability or challenge. One teacher summed it up quite nicely, by writing the following:

Children this age are so eager to learn new and exciting things about their world, and to share what they know. They also have many misconceptions about the world and nature and it is a joy to share science facts with people who believe in the Tooth Fairy! My students see any and every possibility in their world. It is a great responsibility to bring a structured science lesson into their lives and they're learning at this developmental stage is fragile and quite precious.

## Conclusion

### *Additional Research*

While this survey based research project provided a great deal of information in terms of what science education currently looks like in the early childhood setting, it also unveiled additional questions that require addressing, particularly in regards to teacher self-efficacy and the question pertaining to college courses in science. I would be interested to learn if teachers who reported taking college courses majored in a scientific field, took these science courses as electives, or if they were a required course needed to graduate. I believe that this question would reveal a great deal, not just about college level exposure to science, but also about personal aptitude for the subject matter, which may be more telling than the presence of a science background reflected in the number of courses taken. I would postulate that those who took science courses as electives or as part of a major reported being more comfortable with science material and that they also taught it more frequently. Additionally, it would be interesting to learn if teachers were required to enroll in professional development opportunities that they participated in, or if it was on a volunteer basis.

Based on the personal reports indicating that most pull out services, particularly PT/OT and SLP services, occur during science as well as the limits to which kids received support during science, I think it would be pertinent to pole related service staff working with kids with special needs, to get a better idea of whether or not this is true across all early childhood programs, and if so why. I would also be interested to learn how FOSS kits and other science

curricula used in the early childhood setting are currently being modified and adapted for children with special needs.

### *Overall Thoughts*

Based on the results of this study, it appears that programs that harbor more science experiences for children in the early childhood setting tend to be programs that have a designated time for science, use a specific science curriculum, and provide professional development opportunities in the area of science for their teachers. In meeting this criteria, schools are not only providing the means and matter to engage students in age and ability appropriate experiences, but they are also setting the expectation that science is a valued and important part of their institution. As far as teacher self-efficacy in the area of science, a research supported variable believed to be predictive of the quality and quantity of science education in any classroom, college level science courses and professional development opportunities both seem to play a strong role in what science looks like in the classroom. Teachers who have had a background in science through taking college level science courses demonstrate greater comfort in teaching their students the material, however teachers who have participated in science training sessions indicate that they teach science more frequently.

This research points to many deficits in our current science education in early childhood settings, particularly programs that serve students with special needs. Teachers from self-contained programs or other programs working solely with students with special needs, indicated a lack of time and resources to address science concepts with their students. This can be explained in part by lack of teacher preparation, but also by lack of institutional support, indicated by few trainings and lack of appropriate curriculum.

Research has demonstrated that students benefit greatly from a rich educational environment, particularly before the age of seven (Brooks, 2011). Given that science is an key subject in aiding in the development of higher cognitive function and science activities fosters an environment in which students are invited to *learn* how to *learn*, it is our job as educators to ensure that any student, regardless of abilities or challenges, has the opportunity to tug on a light switch, form a hypothesis and come to a conclusion they can share. Through curricula that takes an interdisciplinary approach to teaching science along with other key subjects; through institutions that support scientific thought through the provision resources and means; and through teachers who are trained to be competent and confident in science activities, science instruction can become a worthwhile and useful pursuit that teaches children how to learn about the world around them.

### *Future Undertakings*

Based on the research provided through this survey, I have assembled a brief teacher training program as well as a science curriculum entitled “Machines & Movement” that is designed to be appropriate for preschoolers and kindergarteners in an inclusive setting. The training, first implemented at the Infant and Early Childhood Conference on May 4, 2012, provides an outline of what is currently thought to be “best practice” but then provides practical suggestions for teachers interested in infusing their half-day programs with appropriate and open ended science explorations that encourage kids to direct the learning and ask the questions. The curriculum is intended to be a guided program that encompasses these best practice methods, with the intention of being used in a half-day preschool or kindergarten program. It is based off of a number of successful preschool science curricula, including Science Start! Curriculum and

work from the Pacific Science Center. The activities include modifications and adaptations that make this curriculum accessible to a wide early childhood audience. In the future, I would like to create a similar program for each of the science domains suggested for the early childhood setting.

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