Introduction

In most classrooms today across the United States, science is a part of curriculum that is often pushed by the wayside. It is a rare opportunity to see science being taught in the elementary grades as its own subject with provided time throughout the school week. The lack of science in the classrooms may be the result of one main reason – achievement accountability. According to Judson (2013) and Blank (2013), teachers are neglecting science because state and federal requirements, such as No Child Left Behind, hold subjects like English Language Arts and Mathematics to higher accountability standards. Judson (2013) details that due to this required annual reporting of scores, there is a stronger focus on ELA and math leading to diminishing time spent on less accountable subjects, such as science. Other reasons for this neglect of science are a lack of interest on the part of the student or a lack of knowledge on the part of a teacher.

However, it is important that science is incorporated back into the school day, routinely. For one, there is a growing field of STEM (Science, Technology, Engineering, and Math) positions available that are currently vacant due to a lack of students in these fields. By age 11, students' attitudes and interests towards science begin to show a decline, thereby making it hard to engage students in these subjects as they grow older (Blank, 2013). Therefore, it is necessary to peak interest during elementary school in order to develop student interests in related fields. Although there is a multitude of ways to teach science, one method stands out best for student engagement and developing student ideas and interests: the hands-on approach. According to Satterthwait (2010): "Hands-on activities represent a strategy of teaching in which the students usually work in groups, interact with peers to manipulate various objects, ask questions that focus observations, collect data and attempt to explain natural phenomena" (p. 7). For the sake

of including a universal definition, Satterthwait's definition will apply to all mentions of "hands-on" throughout this discussion.

Current Science in Elementary Schools

One of the main concerns in teaching science is how to appropriately and safely teach to young students. This concern stems from not only a lack of time to teach and learn science, but a belief that not all students will receive the information they need to gain a baseline proficiency in science. Therefore, many educators have taken to a direct instruction approach to teach science, if not neglect it entirely. In a study conducted by Zhai, Jocz, & Tan (2014), twenty-one percent of students depicted doing science as "passively listening to their teacher talk or watching the demonstrations operated by their teacher" (p. 564). Furthermore, these same students articulated that memorizing, copying, and answering teachers' questions are significant in learning science.

Additionally, science is not valued as an appropriate expense of available time by educators or administrators. According to Blank (2013), teachers spend approximately five times as much time teaching English than they do science. This gap has been ever-growing throughout the past thirty years. Judson (2013) furthers this point by acknowledging a one percent decrease in time allotted for science throughout the week over the past decade. As science remains unacknowledged as a necessary subject, students are not provided the adequate time to explore and develop new ideas. Additionally, important skills and attitudes towards science are left behind as early as elementary school, as children do not have time to develop their knowledge and understanding of scientific concepts. That is why it is pertinent that schools and educators find the time for science and create interesting, engaging activities that will help students develop their skills.

Benefits of Hands-On Learning

As previously mentioned, hands-on learning is a very beneficial way to teach science. To begin, not only is it an engaging method, but many hands-on learning activities can be broken up into smaller sections, allowing for activities to require smaller chunks of time over longer periods of time. This can be a way to bypass the excuse that there is not enough time to teach science. Additionally, hands-on learning provides opportunities for students to make connections between what they already know and what they are learning. Hands-on learning also seeks to incorporate cross-curricular skills. Satterthwait (2010) concludes that hands-on learning incorporates three key factors: peer interaction through cooperative learning, object-mediated learning, and embodiment. Through peer interaction, students are developing the social and communication skills that are required standards for English, in addition to the literacy that is incorporated as students are jotting down notes about their hands-on experiment. Object-mediated learning allows for students to manipulate objects and take a "backwards" approach to learning as they discover the real purpose for objects and apply them to different situations. Lastly, embodiment helps students "make sense of [their] perceptions and actions" (Satterthwait, 2010, p. 9). Students are able to use the physicality and knowledge they obtained from hands-on learning and apply them to various situations. With these cross-cutting concepts, less time can be spent on accountable subjects, such as English, as hands-on science is incorporating standards from multiple areas of curriculum.

Varelas, Pieper, Arsenault, Pappas, & Keblawe-Shamah (2014) and Aydede-Yalçin (2016) agree that hands-on learning is an engaging way for students to explore a certain topic or item with all of their senses. It is very easy for students to sit and listen to an educator tell them about how a plant grows or read an article on the topic. However, due to the varying styles in

children's learning abilities, auditory processing may not be the best learning style. With hands-on learning, children are developing and utilizing a variety of skills and methods to learn. Aydede-Yalçin (2016) emphasizes that active learning promotes faster and more permanent learning as it utilizes majority, if not all, of the senses. Hatsidimitris, Connor, Ginges, & Wolfe (2010) agree that hands-on experimentation provides students with different observation methods, which allow students to discover necessary skills or scientific ideas that they might not have otherwise. These observation skills provide opportunities for students to decipher between "lifelong learning skills, scientific knowledge and personal opinion" (Aydede-Yalçin, 2016, p. 111). Varelas, et. al. (2014) and Satterthwait (2010) concede that students are more likely to remember things they are learning through hands-on experiments. The reason for this is that humans tend to remember more clearly things that triggered emotional responses, and hands-on experiences provide opportunities for these responses. Therefore, students are prone to remembering what they learned through hands-on experiences.

Roles in Hands-On Learning

Although it may seem as though hands-on learning is solely students creating their own knowledge, the educator plays a large role in the approach. According to Hoisington, Chalufour, Winokur, & Clark-Chiarelli (2014) and Louca, Zacharia, & Constantinou (2011) the teacher's role is to be a facilitator and a scaffolder. While students may be observing and testing out their own theories, teachers need to nudge students in an appropriate direction and facilitate learning through questions and prompting. Additionally, it is imperative that educators create a positive "physical environment for science inquiry and learning" (Hoisington, Chalufour, Winokur, & Clark-Chiarelli, 2014, p. 73). Appropriate set-up of the classroom and availability of materials create an inviting workspace for hands-on learning.

On the other hand, students should be actively constructing their knowledge and regulating their own learning (Louca, Zacharia, & Constantinou, 2011). They should be using their own topics of interest to facilitate learning and creating connections between what they already know and what they are learning. Hands-on experiences allow for students to see the applicability of the skills and knowledge they are gaining to their real world environments.

Conclusion

In a world where science falls through the cracks due to a lack of accountability and time, hands-on learning is a truly beneficial way to teach science. Firstly, hands-on experiences can be broken into smaller periods over longer expanses of time. Thereby, lack of time becomes less of a problem and excuse. Secondly, hands-on learning in science provides opportunities for children to learn via their own preferred learning style. This automatically incorporates forms of differentiated instruction that would not be incorporated into direct instruction. Thirdly, students construct their own knowledge through 'doing' instead of being transmitted the teacher's knowledge (Aydede-Yalçin, 2016). Teachers do not have to fear that they do not have a deep enough understanding of a topic, as students are building their own understandings and connections. Educators need to serve as a facilitator for these hands-on activities and create an environment that is open to exploration.

References

Aydede-Yalçin, M. N. (2016). The effect of active learning based science camp activities on primary school students' opinions towards scientific knowledge and scientific process skills. *International Electronic Journal of Environmental Education*, *6*(2), 108–125. doi: 10.18497/iejee-green.78816

Blank, R. K. (2013). Science instructional time is declining in elementary schools: What are the implications for student achievement and closing the gap? *Science Education, 97*(6), 830–847. doi: 10.1002/sce.21078

Hatsidimitris, G., Connor, R., Ginges, J., & Wolfe, J. (2010). Glimpses of science: Multimedia-enhanced hands-on activities for primary school students. *Teaching Science*, *56*(3), 39–42.

Hoisington, C., Chalufour, I., Winokur, J., & Clark-Chiarelli, N. (2014). Promoting children's science inquiry and learning through water investigations. *Young Children*, *69*(4), 72–79.

Judson, E. (2013). The relationship between time allocated for science in elementary schools and state accountability policies. *Science Education*, *97*(4), 621–636. doi: 10.1002/sce.21058

Louca, L. T., Zacharia, Z. C., & Constantinou, C. P. (2011). In quest of productive modeling-based learning discourse in elementary school science. *Journal of Research in Science Teaching*, *48*(8), 919–951. doi: 10.1002/tea.20435

Satterthwait, D. (2010). Why are 'hands-on' science activities so effective for student learning? *Teaching Science*, *56*(2), 7–10.

Varelas, M., Pieper, L., Arsenault, A., Pappas, C. C., & Keblawe-Shamah, N. (2014). How science texts and hands-on explorations facilitate meaning making: Learning from Latina/o third graders. *Journal of Research in Science Teaching*, *51*(10), 1246–1274. doi: 10.1002/tea.21173

Zhai, J., Jocz, J. A., & Tan, A.-L. (2014). 'Am I like a scientist?': Primary children's images of doing science in school. *International Journal of Science Education*, *36*(4), 553–576. doi: 10.1080/09500693.2013.791958