

Changing Instructional Practice with a Science Center workshop: The Journey of Six Elementary Science Teachers

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Abstract

The purpose of this qualitative case study research was to ascertain the significance of the professional development workshops organized by a science center in a Midwestern city of the United States. The research investigated the effect the workshop had on the instructional practice of the participating elementary science teachers. This study was guided by the following research question: How do the professional development programs at a science center help teachers change the way they teach and consider science in their classroom? The six elementary school teachers in this study were identified as a result of their participation in the science center workshop. Teachers' self-efficacy regarding the teaching of science was sought through a Likert-style survey and triangulated with classroom observations and interviews of individual teachers.

The findings of this study revealed two overarching themes: one, that the workshops were beneficial to some and two, that it did not improve instructional practice of others. The paper will identify the reasons given by the teachers why they thought the workshop was relevant and beneficial or not. Though this study utilized a small sample of teachers, those involved in this study felt they acquired knowledge that would be either beneficial to them or to their students and they particularly enjoyed the inquiry-based activities that were conducted at the science center workshop. This study contributes to research that informs school administrators of the need for continued teacher professional development.

Keywords: Professional development, Science center, instructional Practice

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Introduction

Achieving scientific literacy for all has continued to be a challenge for science education scholars as the scientific community strive to reform our science standards. According to the reform standards, “scientific literacy has become a necessity for everyone” (NSTA, 1989, p.1.). Scientific literacy as suggested by the National Research council (2000, 2013) and the American Association for the advancement of science (1994) is the ability to understand and have knowledge of science concepts and processes. Bybee (2000) noted that though the national goal is to achieve scientific literacy, “this remains a challenge” (p. 45). Fulfilling this goal, Bybee continued, would require collaboration between formal and informal institutions. These informal institutions include Science Centers, Museums, Community Outreach programs and Cultural institutions which educate the public outside the regular school setting (Anderson, Lucas, & Ginns, 2003; Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003; Falk & Dierking, 2000; Hein, 2000, Kisiel, 2013; Roberts & Bybee, 2014).

The literature reveals that science centers and museums are assuming a dynamic role in the science education of children especially as public school budgets continue to decrease (Falk, 2001; Falk & Dierking, 2001; Kisel, 2013; Price & Hein, 1991). Researchers have suggested (Bitgood, Serrell, & Thompson, 1994, Schwan, Grajal, & Lewalter, 2014) that the traditional classroom is taking advantage of museums as informal learning environments. There is an increase in the number of schools turning to science centers, museums and zoos for the education of students (Price & Hein, 1991). These studies (Cox-Petersen, Marsh, Kisiel, & Melber, 2003; Dierking et al., 2003; Kisiel, 2013; Falk, 2001; Falk & Dierking, 2001) suggest science centers and museums provide experiences and resources that encourage hands-on learning and enhance creativity among elementary school children. It has also been suggested in the literature that these informal institutions provide students and science teachers alike, engagement in authentic science content learning and practices (Gano & Kinzler, 2011).

Statement of the Problem

Since the inception, of A Nation at Risk Report (1983) and the No Child Left Behind (2001) act the teaching of science still needs improvement. The attainment of science literacy a goal science teachers are still trying to achieve, is more than memorizing formulas and charts; it needs to help students understand the environment around them. A 2012 survey of science and mathematics education revealed that a large percentage of elementary school teachers did not major or minor in science during their college days. (Banilower, Smith, Weiss, Malzahn, K. Campbell, & Weis, 2013). How then can they be expected to teach science effectively to students? The problem, according to research, can be solved through extensive professional development (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2010; Weiss, Banilower, McMahan, & Smith, 2001). There is still the question of how research can improve the teaching and learning of science in the nation’s elementary schools.

Despite the acknowledgement that science literacy is of utmost importance, students are still not being provided with science experiences that are authentic or meaningful to them. It has also been documented that teachers lack the subject knowledge and

sometimes the resources to direct students to attain meaningful scientific inquiry (Kisiel, 2014). Lack of these resources have in turn led to avoidance of science topics not covered in science textbooks they were provided.

If teaching of science is to be improved, teachers need to fully utilize informal science learning resources available in their communities. Though many studies have documented the problems associated with the teaching of science (Abd-EL- Khalick, 2013; Abd-El-Khalick, Bell & Lederman, 1998, Hodson, 2014), very few have identified the potential resources science centers and science museums can provide. Empirical literature is also limited in terms of identifying how well aligned these professional development programs are with the needs of teachers. This study therefore focused on how this center can actively be involved with teachers to provide the inquiry-based experiences needed by students.

This study examined the professional development workshop offered by a science center. This is in recognition of the gap in available literature on the active role of science centers in the teaching of science. It also focused on the reflections of teachers who attended this workshop and whether attending this professional development workshop made any difference in the way they taught science in the classroom. The specific research question that guided this study was: How does the professional development program at this science center help teachers change the way they teach and consider science in their classroom?

Significance of Study

Educators today are asking if the skills children acquire in American schools would prepare them to compete globally with other world economies. Results of this study will inform educators as to how the workshop offered by science centers can help shape the way science is taught in elementary schools. The information can also be used by school administrators to collaborate with these out-of-school institutions to improve science teachers' instructional practice. It will also assist science centers, museums and other out of school institutions in recognizing their importance in the education of American children. Research also shows that adequate knowledge of science is a teacher's main tool in helping students learn science (Duschl et al., 2007). The authors argue that "currently K-8 teachers have a limited knowledge of science" (p. 296), a notion also supported by the 2012 survey by Banilower, Smith, Weiss, Malzahn, K. Campbell, & Weis (2013). Sustainable professional development is needed to overcome inadequate science content or science teaching self-efficacy of K-8 teachers currently in service.

Science centers have the potential to augment in-service training and provide resources for teachers. Since science is not one of the core subjects tested in the early grades, experience has shown that most school districts' curricula have narrowed to focusing on reading and mathematics in order to pass state standardized tests (Penna, 2007). This practice has placed limits on the kinds of experiences students and teachers have in school. Penna (2007) suggested that it is important for schools to look outside the school environment for resources that can help teachers improve the science learning experiences that students have, experiences much needed for them to learn about their natural environment. Science centers can therefore provide real-world experiences that will aid teachers in understanding the true nature of science.

Calls for reform require teachers to change their practice. However, as some researchers note (Cohen and Ball, 1990, Davis, 2003) change is difficult, “And changing one’s teaching is not like changing one’s socks” (Cohen & Ball, 1990 p. 334). Changing the way one teaches requires a professional development that cannot be done in just one summer workshop, it has to be an on-going process. We must remember that, teachers who participate in in-service have many years of constructing their own way of teaching that involve their own personal beliefs and experiences. Teacher belief is not something that can be changed in one training.

The objective of any professional development program as suggested by Gall and Vojtek (1994) should be to improve teachers’ professional skills and most importantly to encourage authentic learning. They also went on to state that any good professional development should take into consideration the need for teachers to enhance their teaching and make a difference in the lives of their students. According to Sparks (1988), this can be achieved through a program that is structured, encourages small-group sharing and problem solving sessions (as cited in Gall & Vojtek, 1994). A view also supported by Stewart (2014).

The answers to the research question in this study are intended to assist museums recognize programs most relevant to teachers and the ever-changing curriculum. It also highlights community resources available to teachers in the school districts in this Midwestern state. The answers will aid teachers to form partnerships with available science centers and museums, to develop their curriculum and provide other out-of-school opportunities for students to effectively gain scientific knowledge and to interact with the environment.

Answers to the research question also provide science centers the opportunity to examine the programs they offer if they are more engaging teachers.

Participants

The study started with ten teachers but due to attrition and time constraint only six teachers attending a Midwestern city science center professional development workshop completed the study. To examine how science center workshop, affect the field of science education, teachers were selected based on their interest in participating in the workshop and their ability to help this researcher best understand the phenomenon (Creswell, 2015). To keep the study balanced, teachers were purposely selected to represent different grade levels (1-6) and levels of teaching experience. These grades were selected because at these elementary levels teachers were teaching in a self-contained classroom, which made classroom observation more comprehensive. It also allowed for different perspectives about participants’ teaching practices to be garnered (Creswell, 2015).

To guarantee rich data collection, participants selected were from several school districts in some Midwestern cities to allow for different instructional practices and experiences. Related literature reveals that a small sample size of 8 is common in qualitative case studies (Creswell, 2015; Miles & Huberman, 1994). This small sample size allowed the researcher to give a detailed description of each case. The small sample size was also due to the time constraint of school districts’ academic calendar (Penna, 2007). The ultimate goal of this study was to use self-reporting techniques to gather information on how teachers feel about their ability to teach

science and how the professional development workshop helped them to make instructional changes. It was also to further the research knowledge of science centers' professional development for teachers and in turn enhance science teaching.

Methodology/Research Design

In this study, a collective case study was employed. A collective case study according to the literature is an instrumental study consisting of multiple cases focusing on a specific issue to understand each case (Creswell, 2015; Stake, 1995, 2003). The aim was to examine how science teachers' participation in a science center's professional development program changed their instructional practices. The importance of selecting each case was based on what Stake (2003) described as "balanced, variety and the opportunity to learn" (p. 135). There were other reasons for selecting a qualitative research design. Data collection occurred in a natural setting, where participants' perspectives were interpreted directly (Bogden & Biklen, 2003; Miles & Huberman, 1994; Stake, 1995). A case study according to Yin (1994) "is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 13). Since qualitative research is more concerned with daily processes that shape a phenomenon (Bogden & Biklen, 2003; Gillham, 2000) a case study design allowed the researcher to view from the teachers' perspectives how what they do daily shapes their instruction. Also since several cases were examined to provide insight into the knowledge base in literature of how museum programs can change the way teachers teach science, a collective case study was more appropriate (Stake, 2000). To triangulate data, ethnographic tools such as observation and interviews were used in conjunction with a teacher efficacy survey to provide a holistic picture of participants' self-reflection and their teaching practices in the area of science.

Again, as this research focused on classroom practices, there was the need to reveal their self-efficacy beliefs to science teaching. A self-reporting of these beliefs informed the research of how these beliefs influence the way the participants teach science. The science teaching (STEBI-A) self-efficacy instrument developed in 1988 (Riggs) was adapted by Ramey-Gassert (1993). All 20 goals are presented and ranked according to a five-point rating scale (5=Strongly Agree, 4=Agree, 3=Uncertain, 2=Disagree, 1=Strongly Disagree).

Limitations

This study was based on teachers' beliefs or self-efficacy of how science can be taught in order to improve students' scientific experiences. It was also based on the assumption that professional development programs organized in informal settings such as science centers are relevant to the teaching of science in elementary schools. It is also assumed that teachers may not honestly provide answers to survey questions about the teaching of science and about their professional needs. On the other hand, science centers may identify professional development needs that may not be in the best interest of teachers. Another major limitation to this study that should be noted is that change takes time and this research had a 3-4-month time constraint.

Discussions/ Findings

The qualitative case study results offer narratives of six teachers perception of the professional development experiences and programs provided by the science center. Each participant described what was beneficial and what was not so beneficial to their instructional practices. Findings and results from observations, interviews and survey of teachers who participated in a science center professional development workshop revealed two themes. The following themes merged 1) workshop was beneficial and 2) it did not improve instructional practice. Themes were further explored to reveal the contributing factors or subthemes. As for theme one, teachers felt the following factors were gained from the workshop, scientific knowledge, opportunity to experience the unit, awareness of science center resources, teacher confidence, opportunity to collaborate with other teachers, teaching tips and the alignment of curriculum to the state content expectations. Theme 2 revealed factors that contributed to some teachers not feeling the workshops improved their instructional practice, and they include, strong science background, time constraint, loss of a full day of teaching and no follow-up activity.

Through the results of self-efficacy survey and the individual interview data teachers in this study clearly made their perceptions about the professional development and their beliefs in their ability to teach science and improve student learning known. Their efficacy beliefs may be due to the workshop provided by the science center or the number of years in the teaching profession. Overall, teachers involved in this study felt they received experiences that would be either beneficial to them or to their students and they particularly enjoyed the inquiry-based activities that were conducted in the science center. There were, however, areas they felt also needed some improvements to make it a more rewarding experience for them and their students.

Recommendations for Further Research

There are several ways this research can be extended. In this study, a very small sample of teachers who attended the workshop participated, which does not constitute the general view of all the teachers who attend such workshops. As the research on the importance of science centers continue to grow, a longitudinal research is needed to establish whether the workshops organized by these centers actually, have an impact on science teachers' instructional practices. This study shed some light on teachers' perspectives on science center workshops and their benefits to elementary school science teachers.

Further examination of the degree of impact through qualitative and quantitative methodology could provide a clearer picture of the science center workshop experience. In this study, recruitment of participants was done during the workshop which was organized in the middle school year. The time constraint contributed to the low number of participants in this study. It is therefore recommended that for future research teachers should be recruited earlier in the school year as it will give more opportunity for more classroom observations before and after the workshops. There is the belief that this might provide a more detailed account of any instructional improvements teachers make and if the improvements can be attributed to the workshop attendance.

As a result of time constraints, this study only focused on the post-workshop experience of the participating teachers. To further extend this study, it is also recommended that a pre- and post-observation of classrooms be done to compare the instructional abilities of teachers before and after the workshop. This activity could provide a more explicit representation of the degree of change in their instruction after attending the workshops.

Conclusion

This study utilized a case study approach to explore the potential value of informal science institutions such as museum and science centers. It examined the effect of the professional development programs this center provide had on the science teachers who attended. This was achieved through the insight of six participating teachers obtained through workshop, classroom observations, interviews and self-efficacy survey instrument.

This study adds to the literature about science education because it brings to light how the integration of science center resources can enhance the instructional practices of elementary science teachers. Other researchers have noted limited effective professional development opportunities for teachers especially for science teachers who already feel inadequate to teach science because of their limited science background (Melber & Cox-Petersen, 2005). This study attempted to shed light on how informal science centers such as science centers can provide the additional information science teachers need to improve their instruction.

Majority of the teachers involved in this study reported that the workshop had a positive impact on their teaching practices. The extent to which the workshop experience improved their instructional practices is not known due to the small sample of participants and the duration of the study. It should be noted however that using a new sample is common in education research. However, more research is needed to determine how these informal science centers help teachers improve their instructional practices and positively impact student learning in science. The benefit of this study was also to draw attention of teachers to the use of workshops organized by science centers to fulfill their professional development needs.

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