Science in the Elementary Classroom: Constructivism, Ms. Frizzle, and Me

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Assignment 1

Introduction

Students are scattered throughout the classroom, some in groups, others with the teacher. Everyone is working on projects or research. Everything in the room is about the weather: books, spelling words, math, posters, artifacts, even a radio blaring out weather reports. An upcoming field trip is being announced that will allow the students to experience weather first hand (Cole, 1995). But this is no ordinary elementary classroom. It is the classroom of the quintessential elementary science teacher, Ms. Frizzle with her theme-based outfits, and organized, hands-on, chaotic classroom. Students are guided down a magical path of discovery and learning in a real-world investigation, with a little help from technology: the magic bus. This is the science classroom of a constructivist.

Constructivism

Constructivism, stemming from the works of Piaget, Vygotsky, and Dewey, comes in many shapes and forms, but has two main strands: psychological and sociological (Matthews, 1997). It is a "theory of knowing" (Hsu, and Wang, 2012, p. 65; Seimears et al., 2011, p. 267) where students are not considered empty vessels to be filled (Tippins, Tobin, and Nichols, 1995), but rather builders of their own knowledge. Basic tenets of constructivism that are critical to a student-centered approach are attention to students' prior experience, active engagement with challenging, academic, "real-life" (Yun, 2000, para. 8) situated problems resulting in tangible artifacts, collaboration which provides scaffolding of the learner by knowledgeable peers, instructors, and other experts in the area of inquiry through both face-to-face and online encounters, and reflection on learning.

By engaging in active, real-world, social learning, students encounter new knowledge, which confronts their previous knowledge, creating dissatisfaction (Özdemir & Clark, 2006), providing opportunity for accommodation and assimilation of the new knowledge (Posner et al., 1982). The constructivist teacher acts as a facilitator and guide, scaffolding the learning to ensure that students remain in their "zone of proximal development" (Cole and Wertsch, n.d.). Students' work is "arduous" and "emotionally rewarding", but not so much that frustration inhibits learning (Xin and Feenberg, 2007, p. 425).

Constructivist learning is not a single strategy however. It is a collection of experiential learning strategies such as project, problem, and case based learning (Etuk, Etuk, Etudor-Eyo, and Samuel, 2011). Learning is situated in the students' real world. Heterogeneous groups offer a cognitive apprenticeship, whereby students of differing levels can benefit from one another, along with the guidance of the teacher and other experts through the use of technology. Teachers acting as models and coaches, scaffold student learning, going beyond "traditional school science with its emphasis on key concepts", instead focusing on the "processes of learning and thinking about learning" (Watters & Ginns, 2000, p. 302). The emphasis is on student inquiry, using science process skills. "Students use prior knowledge to achieve "multiple solutions," sharing "social significance" through collaborative classroom interaction (Driver cited in Seimears et al., 2011, p. 269). Technology is harnessed to link the learners, including the teacher, to knowledge and experts outside the classroom, as well as to share the class knowledge with a wider audience (Seimears et al., 2011; Yun, 2000).

Science in the Elementary Classroom: The benefits

Science education has been established as crucial for preparing students for the future (Watters & Ginns, 2000). Constructivist science is not the search for truth or even facts to be learned, but rather a process enabling us to make sense of our experiential world (Semeirs et al., 2011). By offering a constructivist environment in the classroom, the teaching of science becomes more like the science that scientists do: active and social rather than the stuff of lectures, textbooks, and quizzes. At the elementary level, it can lay the foundation for life-long learning and "transform the science classroom" (Matthews, 1997, p. 139).

A constructivist style of learning, allows students to become actively engaged in relevant, real-world topics. Students are encouraged to take responsibility for learning by asking and answering their own questions. This active engagement has been found to enhance a child's natural curiosity, and develop creative skills, fostering a holistic development of the child (Etuk, et al., 2011). Etuk (2011) also found significant difference in science achievement, compared to a transmission style education, possibly because students are actively engaged in the learning, using senses other than just the ear. Substantial difference has also been found in students' and teachers' attitudes toward science (Briscoe & Peters, 1997; Etuk et al., 2011; Tippins et al., 1995). Both teachers and students were found to love science and consider themselves scientists when engaged in the constructivist approach.

The Reality

While constructivism has been recommended as a best practice for teaching and learning, particularly in the science classroom for over a decade (Seimears et al., 2012), in reality, the Ms. Frizzles of elementary education are few and far between. Researchers have found that many elementary school teachers default to the transmission model (the expert teacher filling the minds of empty vessels), with it lectures, textbooks, worksheets, and tests, emulating the way they were taught (Hsu & Wang, 2012; Tippins, et al., 1995; Siemears et al., 2012). Even those pre-service teachers trained in constructivist methods in the past few years, were found to eventually (even after ten years) return to transmission modes when faced with difficulties such as facilities and materials even though they preferred constructivist teaching methods (Feyzioğlu, 2012). Some teachers were categorized as using a transitive instructional style (Feyzioğlu, 2012), with hands-on activities, discussion, and reflection, however their teaching was categorized as "weak constructivist instruction" (Hsu & Wang, 2012, p. 66), and mainly teacher-centered with students having little control of their own learning. Briscoe & Peters (1997) found that the majority of elementary teachers do not like teaching science and thought that their class was boring. In one study, six out of 24 teachers liked teaching science and saw the value in offering hands-on constructivist style learning, but cited a number of constraints such as curriculum, budget, classroom management, facilities, science knowledge, and pedagogical knowledge. In fact Huberman (cited in Briscoe & Peters, 1997) found this to be widespread among teachers in the USA. Watters & Ginns (2000) found that both pre-service and experienced teachers had poor attitudes about both teaching science and their abilities to teach. Finally, Tobin et al. (cited in Appleton and Asoko, 1996) found that most teachers do not possess a constructivist philosophy of learning.

Barriers

Although constructivism is recommended, and the benefits are clear, there seem to be significant obstacles that inhibit the implementation in the elementary science classroom. Hsu & Wang (201) cited a teacher's personal history as a barrier. Teachers are influenced by their own experiences as learners. Most are themselves products of a traditional school education and many consider the "chalk and talk" (Etuk et al., 2011, p. 3) method to be a more "efficient [and] effective" (Seimears et al., 2012, p. 266) means of communicating knowledge, despite growing proof that this is not the case. Teachers are often focused on imparting correct facts rather than cultivating inquiry.

Teachers' beliefs are a second major hurdle to implementing constructivist strategies. Studies show that it is not just a matter of changing practice. In fact, according to Tobin (cited in Appleton & Asoko, 1998) a teacher's belief about content and methods for learning is the most pervasive barrier and needs restructuring in order for change to occur (Briscoe & Peters, 1997).

According to Seimears et al. (2012), "teaching for meaningful learning takes time" (p. 269). Students need time to reflect on and revise their thinking in relation to new knowledge, a "gradual and time-consuming" (Özdemir & Clark, 2006, p. 354) process. However, the broad, mandated science curriculums in most schools are not conducive to the time needed. Additionally, the requirement of demonstrating understanding of the curriculum through testing, and its connection to funding (such as the US NCLB policy) is likely to push teachers back to a transmission style (Briscoe & Peters, 1997; Seimears et al., 2012).

Another major barrier, particularly at the elementary level, is centered on the teacher's tolerance for ambiguity and chaos (Tippins et al., 1995). Teachers have been found to return to transmission type teaching because they find difficulty with classroom management (Feyzioğlu, 2012). Some are not able to tolerate the noise generated by group activities, preferring individually defined activities instead (Briscoe & Peters, 1997).

Content knowledge (Briscoe & Peters, 1997; Tippins et al., 1995) at the elementary level is another concern. Teachers, who are not experts in science, find it risky to offer open-ended activities, opting rather to keep things in the realm of what they know for certain. This has been found to lead to low self-efficacy (Appleton & Asoko, 1998; Watters and Ginns, 2000).

Recommendations

It is clear that constructivism offers best-practice teaching strategies for elementary science education. It is also equally clear that what has been done so far is not sufficient to enact sustained constructivist teaching practices in the elementary classroom. What then is to be done in order to increase the likelihood of teachers adopting this practice? According to Tobin (cited in Appleton & Asoko, 1998) because a teacher's belief is the most pervasive influence in initiating change, teachers first need to understand constructivism and its practices (Seimears et al., 2012). True, lasting change is unlikely to happen as a consequence of top-down mandates or in-service workshops (Appleton & Asoka, 1996; Etuk et al., 2011;

Watters & Ginns, 2000). Recommendations for pre-service teachers include extensive training not only in theory and practice, but also in preparation for the inevitability of barriers (Etuk et al., 2011; Feyzioğlu, 2012). In addition, it is critical to develop positive attitudes in pre-service teachers towards science (Watters & Ginns p. 301).

Information and change are not enough to sustain longitudinal change however. Practicing teachers require support, feedback, and reflection. In other words, it is recommended that teachers themselves participate in a constructivist inquiry, reflecting on their own teaching and the learning of their students in the area of science (Briscoe & Peters, 1997; Hsu & Wang, 2012). Successful change in teaching practice is "incremental" (Appleton & Asoka, 1998, p. 178; Feyzioğlu, 2012) and has found to only be the result of a community of practice, which offers long-term collaboration with other same-grade teachers (Tippins et al., 1995). This community can provide a climate conducive to change: a safe place for brainstorming, the freedom to discuss failures and successes, the freedom and support to explore alternative assessments, and the support for the difficult task of turning the curriculum into problems for students to explore (Briscoe & Peters, 1997; Hsu &Wang, 2012; Tippins et al., 1995).

…And Me

While I have on occasion thought of myself as the Ms. Frizzle of my school, I would in fact fit into the transitive style of teaching. I love science and see great value in a constructivist-learning environment. Whenever possible, I provide hands-on learning activities and engaging problems for my students. However, as has been noted, the transitive style teacher is a "weak constructivist." I am hampered by many of the barriers cited above and I have not yet truly allowed my students to have full control over their learning. In order to become a strong constructivist teacher, I need to situate myself in a community of practice in my own environment, working together with other teachers at my grade level to support and encourage each other in this process.

Conclusion

Students need opportunities to develop habits for critical thinking and life-long learning. A constructivist elementary science classroom is an ideal environment for this to happen. By demonstrating an excitement about learning and a "personal commitment to life-long learning" (Watters & Ginns, 2000, p. 301), teachers will be able to provide meaningful learning opportunities for their students, equipping them not for any upcoming tests, but for a lifetime of learning. The constructivist science class is an adventure, and "You never know what will happen on a trip with Ms. Frizzle (Cole, 1987, p. 7).

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