EFFECT OF DIGITALLY-INSPIRED INSTRUCTION ON SEVENTH GRADE SCIENCE ACHIEVEMENT

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ABSTRACT

Results of a collaborative, quasi-experimental, research and development project partnering university professors with a seventh grade science teacher are reported. The study proposed to test the academic effectiveness of innovative digitally-inspired instruction using commonly available digital tools on 33 North Texas public school students enrolled in seventh grade science. Technology was introduced into science lessons not as the goal of instruction, but as tools to develop effective and engaging 21st Century learning. State mandated student learning objectives were tested pre- and post-intervention using district benchmark tests to determine effects of digitally-inspired instruction on achievement. Mean achievement pass rates increased from 18% - 42% for all learning objectives measured. Instructional unit lesson design and associated digital tools are also described.

KEYWORDS

Science Achievement, Digital tools, BYOT

1. INTRODUCTION

Contemporary K-12 students adept at multitasking in fast-paced, multidimensional digital environments often disengage from traditional two-dimensional instruction when technology merely substitutes for paper/pencil tasks (i.e. type an essay) or occasionally augments 20th Century instruction (i.e. view a YouTube video; Puentedura, 2008). To re-engage 21st Century learners, digital instruction models that evolve from current technology are needed (Taylor, 2005). Educators inspired to experiment with engaging new instructional models need support from school administration and university researchers to develop and test the effectiveness of instruction not previously experienced or observed (Hayes, 2010; November, 2010).

2. REVIEW OF LITERATURE

Literature supports the need for improvement in science instruction in the US and in Texas (National Center for Education Statistics, 2012; TIMSS, 2007). Science, technology, engineering, and math (STEM) research recommends development of contemporary, research-based teaching strategies and materials to support active, in-depth, global learning (Dickman, Schwabe, Schmidt, & Henken, 2009; Lopatto, 2007; National Research Council, 2005; 2007; 2009; Wood, 2009). Furthermore, STEM curriculum should challenge students with open-ended assignments that are both personally meaningful and engaging (Barak & Asad, 2012).

To evolve from passive content-consumers to active information-processors requires instructional engagement. Engaged learners work collaboratively, transforming understanding through creative problem solving (Jones, Valdez, Nowakowski, & Rasmussen, 1994). Wasserstein (1995) noted authentic engagement occurs when educators furnish students with enough skills and tools to become self-motivated. Schlechty (2001) stresses students learn best in applied learning tasks, emphasizing engagement is an active and interactive process, and not synonymous with time on task. Engaged students learn more, retain more, and enjoy the learning activities more than unengaged students (Dowson & McInerney, 2001; Hancock & Betts, 2002; Lumsden, 1994; Voke, 2002).

Instructional goals that create opportunities for authentic engagement, where students meet expectations and intended instructional outcomes responsive to learner interests and values, produce the most effective learning (Schlechty, 2002).

Although technologies have tremendous potential to transform learning experiences, empirical evidence does not support instructional effectiveness when technology merely augments content delivery (Cuban, 2002; Cuban, Kirkpatrick, & Peck, 2001; Judson, 2006; McClure, Jukes, & MacLean, 2012; Palak & Walls, 2009; Windschitl & Sahl, 2002). Conversely, use of digital tools coordinated with effective research-supported instructional practices can promote collaborative learning environments focused on student engagement and in-depth conceptual investigation (Freidman, Beauchamp, Blain, Lirette-Pitre, & Fournier 2011; Kahveci, 2010; Keser, Uzunboylu, & Ozdamli, 2011; Smeureanu & Isaila, 2011).

It is evident more research is needed to understand how to design technology-infused, learner-centered instruction. The purpose of this study was to determine the effect of implementing transformational digitally-inspired instruction on public school science students' science achievement.

3. METHOD

Applying a quasi-experimental research and development model, university researchers partnered with public school teachers to develop and test lessons that incorporated digitally-inspired instruction using devices common in a student's environment (smart boards, computers, tablets, smart phones, etc.). The sample consisted of 33 students enrolled in one teacher's seventh grade science classes at a North Texas middle school. In addition, 19 fifth grade, and 29 fourth grade students from three classes in other schools participated in the last lesson of the unit and served as an authentic audience for the culminating project.

Based on state mandated learning objectives, a four-week instructional unit was developed and implemented. Learning objectives included the main function of the systems of the human organism, levels of organization in plants and animals, difference between the structure and function in plant and animal cell, functions of the cell and cell theory of all organisms. Students were pre- and post-tested on benchmark questions from the standardized Texas seventh grade assessment based on learning objectives for seventh grade science to determine the effect of unit instruction on achievement. The classroom teacher coordinated the collection of student academic achievement data following the district procedures for benchmark testing. Pre- and post-test scores were submitted to university researchers for analysis using online data collection forms (Google Docs) at the conclusion of the instructional unit.

The four-week unit implemented, entitled "The Organ Trail," included the following activities and associated digital tools. In weeks 1 and 2, Searching multiple digital information resources, students completed webquests to answer guiding questions related to the purpose and importance of one organ of the human body (as assigned by the teacher). Next, in the role of employees working in teams, groups of 2-3 students collaborated to create a letter addressed to the Human Body Corporation using evidence to justify why their assigned organ should not be fired from the Human Body. To compose the letter, students used Meetingwords (http://www.meetingwords.com) which works like a wiki but each contributor is color-coded and there is a built in, back channel for teacher monitoring. After completing the letter, students used the Baiboard (http://www.baiboard.com) application to create a collaborative poster to graphically support the arguments in their group letter.

In weeks 3 and 4: Learning activities culminated in two frog dissection exercises. In the role of surgeons, students completed a self-paced digital frog dissection program using the Digital Frog 2.5 APP (http://www.digitalfrog.com) and a Frog Dissection APP purchased within the Edmodo platform (like the iPad APP, but not limited to one purchase). In addition to completing the associated digital workbook activities, the teacher embedded questions requiring students to describe what they learned about their own organs by studying the frog's organs. After completing the digital frog dissection activities, students dissected real frogs. Three elementary science classes (two fourth and one fifth grade) from different schools viewed the dissections using SKYPE projector mode with one webcam. Skyping was included to replicate the experience of global collaboration. Sharing iPads, pairs of elementary observers used a Todaysmeet (http://todaysmeeet.com) back channel session to ask questions. One seventh grade student mediated the Todaysmeet feedback and relayed fourth and fifth grade student questions to seventh grade dissectors who responded directly.

4. RESULTS

Students (N=33) were pre- and post-tested using benchmark questions from Texas learning objectives for seventh grade science to determine the effect of unit instruction on achievement. The benchmark passing goal for each learning objective was set at a score of 70%. Findings indicated an increase in the percentage of students who reached the 70% achievement level from the pretest to the post test on all objectives tested. Nine questions regarding the main function of the systems of the human organism saw the number of students who met the 70% pass rate increase 18% from pretest (64% passed) to posttest (82% passed). On four questions pertaining to levels of organization in plants and animals, the number of students meeting the 70% pass rate increased 33% from pretest (67% passed) to posttest (100% passed). Differences between the structure and function in plant and animal cells, addressed in six questions, increased student pass rates 42% from pretest (52 % passed) to posttest (94% passed). Three questions pertaining to the functions of the cell saw a 34% increase in students who passed from pretest (58% passed) to posttest (82% passed). Finally, on two questions related to cell theory of all organisms pass rates for students increased 21% from pretest (64% passed) to posttest (85% passed).

5. CONCLUSION

Improved academic achievement can result when technology is strategically used to meet instructional goals**.** Through interaction and exploration in creative and innovative ways, technology empowers students to communicate and socialize beyond the classroom. As evidenced by the results of this study, a digitally expanded classroom can accommodate community-driven, interdisciplinary, and virtual collaboration. Digital tools provide an unprecedented opportunity for schools to reexamine traditional approaches and current practices, and redesign parameters of effective instruction (The Horizon Report, 2012). Supporting educator effectiveness by expanding innovative learning models that utilize online and blended learning, high-access, technology-enriched learning environments, and personalized learning models will likely increase student learning (State Educational Technology Directors Association, 2011).Furthermore, technology used to redesign or create original tasks (rather than replicate tradition instruction) results in richer, more engaged and integrated learning at higher levels of thinking (Puentedura, 1980).

Teaching digital learners demands different instructional strategies. Educators today must engage digital learners and create instructional opportunities by utilizing technology to empower learners. Schools must move from *automating* processes (attendance, report cards, email) to *informating* processes that empower students to solve problems, access information and create relationships outside the classroom using the tools of technology (November, 2010).

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