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Literature Review: How To Effectively Use SRS in the Elementary Classroom

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Introduction

Digital natives are children who were born after 1980 and raised in a digital world (Palfrey & Gasser, 2008). Palfrey and Gasser (2008) suggest that these digital natives are very different from "digital immigrants" in that they communicate and relate differently to each other and the world around them. Digital immigrants adapted to the Internet whereas digital natives are born into a world of digital communication technologies and are accustomed to technological devices, such as computers, Internet, cell phones, ipods, MP3 players, and electronic gaming devices, as an integral part of their daily lives. The dilemma for digital natives is that they are avid digital multitaskers, yet they are in schools that do not use technology to keep them engaged, motivated, and successfully learning. Over the past four decades, educators have recognized the value of using technology in the classroom and since then have made many attempts to provide 21st century learning opportunities for their students (Fouts, 2000). To increase student and teacher interaction, as well as engagement and motivation, this instructional design project will incorporate a technology called Student Response Systems (SRS). The purpose of this study is to explore whether teachers can effectively create a lesson plan using the Interactive SRS Lesson Plan Template. This is a not an intervention study for the children and therefore, student academic knowledge is not the focus of the project. Although, if implemented by the teacher in the classroom, some students may improve their comprehension skills as a result.

SRS are an interactive technology that allows for ongoing formative assessments by enabling the teacher to pose questions and receive student answers immediately, which can then be displayed electronically for students to self-assess (Johnson & McLeod, 2004). Although touted to be a new technology, Judson and Sawada claim that SRS "cannot be considered

emerging technology" (2002, p. 176), since some college instructors were able to receive electronic feedback from students even in the 1960s. However, SRS are becoming increasingly adopted in K-12 and higher educational environments, as cost and equipment are becoming more feasible. For instance, Classroom Performance Systems (CPS), one type of SRS, currently has more than three million response pads across the United States in thousands of elementary schools as well as more than 800 universities and ten foreign countries (Edens, 2009). In some cases, SRS can be referred to as CPS (Edens, 2009); classroom response system (CRS) (Beatty, Gerace, Leonard, & Dufresne, 2006); classroom communication system (CCS) (Beatty, 2004; Hall, Collier, Thomas, & Hilgers, 2005); electronic response systems (ERS), personal response system (PRS), audience response system (ARS) (Hall et al., 2005; Kenwright, 2009); audience response technology (ART) (MacGeorge, Homan, Dunning, Elmore, Bodie, Evans, Khichadia, Lichti, Feng, & Geddes, 2008), or simply "clickers" (Kenwright, 2009). However, not all can be used interchangeably. For the purpose of this literature review, SRS will be used to describe the interactive electronic response system or electronic application where a receiver located in the teacher's computer can receive information sent electronically from student keypads in response to a question the teacher posed.

According to Edens (2009), there are several different types of SRS. Various systems use a keypad and receiver to communicate between teacher and student, while other types use handheld, laptop, or desktop computers with wireless or wired connection to the Internet. Additionally, some of the more sophisticated systems allow both selective-response questions (e.g., multiple choice, true/false, or opinion survey) and constructive-response questions (e.g., short-answer or essay). Using a keypad and receiver type of system, the teacher develops selective-response questions in the software, which is usually through PowerPoint, and then

displayed through a projector. Using their keypads, students select one of the keys to answer a question while pointing toward the receiver. The keypad then sends one- or two-way infrared, or radio frequency transmission to the receiver. Responses are processed by the computer and feedback is available in organized histograms and detailed reports (Edens, 2009). Using wireless or wired technology, students respond with handhelds, laptops, or desktop computers. Student responses can be transmitted through the Internet, which are then displayed on the teacher's computer and can be shown through a screen projector as well (Johnson & McLeod, 2004).

Typically, SRS are utilized in a variety of ways, which include the following: taking attendance, administering informal and formal quizzes, polling student opinions, reviewing for formal assessments, and providing spontaneous feedback (Edens, 2009), integrating questions from textbooks, associating questions with standards, remote controlled presentations and assessments, and integrating student responses in PowerPoint presentations (Johnson & McLeod, 2004). As a result of the multifaceted uses of SRS, effective integration can build strong class communities (Edens, 2009) by promoting class discussion (Johnson & McLeod, 2004).

Hence, the purpose of this instructional design project is to design a module for elementary teachers to instruct them how to create a lesson plan using the Interactive SRS Lesson Plan Template, Before designing the module a series of literature was selected, analyzed, and synthesized to make generalizations about the topic and review the existing background information that is relevant to this topic. As a result, various topics and subtopics were identified as well as interesting discoveries deemed as valuable and pertinent information that supports this instructional design project.

Interaction and engagement

In terms of interaction and engagement several different related topics are referred to. These topics can include student participation in class activities and class discussions, and completing assignments (Kenwright, 2009); interaction between peers, teacher, and course content (Lowery, 2005); attendance rates (Caldwell, 2007); improved learning retention and conceptual knowledge as well as student personal attitudes (Edens, 2009). Many of these topics are either directly related to or are highly influenced by student-teacher interaction and engagement.

According to research findings, SRS has a significant impact on student motivation and engagement (Hall et al., 2005). On the other hand, the subset of research available on the role of K-12 classroom SRS effects is relatively small, but at the same time very valuable. This technology provides the students with anonymity, speed of response collection, and the ability to share visual representations that help enhance recognition (Roshelle, 2003). According to Penuel, Boscardin, Masyn and Crawford, "students' responses are anonymous and are immediately aggregated and displayed for the teacher and students, thus making student thinking visible" (p. 316). Hence, this technology could be a valuable tool to use in the classroom to increase student motivation and engagement.

According to Homme, Asay, and Morgenstern, didactic routine lectures fail to engage all students in the learning process. Using a much more interactive approach such as implementing SRS has deemed to be a more effective method when instructing adults (Homme, Asay, & Morgenstern, 2004). A sense of camaraderie is developed amongst classmates, as the whole class cheers when students answer all the questions accurately (Kenwright, 2009). Additionally, students may enjoy using SRS because they are fun and questions generated by SRS encourage

discussion. Caldwell (2007) reports that students are less likely to fall asleep during class and are generally more alert.

According to a study conducted by Caldwell (2007), students reported that they were twice as likely to answer questions using SRS as opposed to more traditional methods. Furthermore, Caldwell (2007) determined that SRS increased students' participation by giving all students, including those who are more reserved, an opportunity to answer questions posed by the teacher. Students' self reported that they enjoyed using SRS and claimed to be more attentive in class, which results in better understanding of course concepts (Judson & Sawada, 2002). Also, using SRS helps to avoid calling on the same students to answer questions over and over again since SRS forces every student in the classroom to respond (Ribbens, 2007). This form of anonymity provides the students with the courage to participate more actively.

SRS in Higher Education

Recently, SRS have been widely used in college campuses. Specifically, this technology has become more and more popular with large lecture classroom instructors (MacGeorge et al., 2008). Many of the teaching practices used in higher education are also being used in K-12 grade classroom environments (Boscardin, Masyn, & Urdan, 2006; Penuel et al., 2007). According the Penuel et al., teachers in higher education use SRS to assist with both instructional and assessment purposes. Instructors in higher education also see the value of using both peer and classroom discussions to make the use of SRS most effective. As a result of a survey study conducted with 498 elementary and secondary teachers, Penuel et al. conclude that the teaching practices used in conjunction with SRS in higher education were also used at the K-12 level.

A study at Midwestern Technological Research University revealed several important benefits of SRS implementation into a large lecture classroom (Hall et al., 2005). A general

feeling amongst the chemistry instructors revealed that their students were not acquiring the necessary skills to advance to subsequent classes. Within the chemistry courses, there was an apparent lack of teacher and student interaction, which was demonstrated by the lack of student questioning. As a result, the department implemented SRS into the chemistry lectures to evaluate the effectiveness of the system and increase student-teacher interaction. Throughout the study, several factors became apparent. According to Hall et al. (2005), in terms of engagement and motivation, significant amounts of students agreed in a survey that SRS had a positive impact.

Additionally, at Illinois Institute of Technology in Chicago there was a growing belief that the traditional methods of teaching physics were no longer effective. The main issue at hand was the large class enrollment, hence, diminutive teacher-to-student ratio. The large sizes of the class and impersonal nature of these courses resulted in high student dropout rates (Burnstein & Lederman, 2001). SRS was incorporated into this physics course, in which students' electronic responses were worth 15% to 25% of their final grade. Consequently, attendance rates increased which deems to be a result of the SRS questions that accounted for 15% of students' final grades.

Attendance rates at Penn State University increased to 90% in the middle of the semester and an average range from 81% to 84% over the two years of the study in an Earth Science course after implementation of SRS (Greer & Heaney, 2005). After implementation of an audience response system at Mayo College of Medicine, Homme, Asay, and Morgenstern (2004) determined an increase in attendance by 50%. According to Ribbens (2007), after using an audience response system in a large introductory biology course the attendance record improved by 20% from two years prior. Caldwell (2007) reported in a literature review that various college physics instructors reported an increase in attendance by 80-90% when SRS quiz scores contributed to more then 15% of the students' final grade. An increase in student motivation and

engagement can be shown to positively influence student attendance, which has radically transformed the former one-way interaction between teacher and students to a much more functional and interactive relationship.

According to Caldwell (2007), active engagement increases achievement for some students. After SRS implementation, the number of students receiving A's in a mathematics course increased by 5% and the number of failing students decreased. Ribbens (2007) reported that after implementation of SRS, students' grades increased by an average of 8% compared to the previous year in which SRS were not used.

In addition to being more engaged in the learning process, Beatty (2004) suggests that students also develop a more conceptual understanding of the materials. Researchers conclude that once students submit their answers through SRS, they become emotionally invested in the problem and are more inclined to pay deeper attention to the successive lecture (Beatty, 2004). With the frequent and immediate feedback SRS provides, students become much more responsible for their own learning by seeking out the information they need to be successful. Student surveys from a Penn State University Earth Science study revealed that majority of the students believed that the integration of SRS into the classes increased the quality of the content and increased higher-order thinking; 65% to 77% of students felt that SRS helped to gauge their level of understanding; 71% to 85% of students agreed that SRS helped to reinforce important concepts; 65% to 81% of students believed that SRS generally helped them throughout the learning process (Greer, & Heaney, 2005). According to Lowery (2005), in addition to areas of motivation, engagement and attendance, SRS can also improve areas of comprehension, participation, peer collaboration, learning and retention, and student satisfaction. Additionally, 89% of students recommended SRS usage in future courses (Greer & Heaney, 2005), therefore,

suggesting that students are being actively engaged and motivated with the content of the course as well as being given the opportunity to become interactive with peers and instructors.

Pedagogy

SRS is only a technological tool that cannot function on its own. The instructor using SRS needs to focus on the strategies he or she is using to implement the tool appropriately. SRS can be a successful as long as certain pedagogical principles are addressed. "Ultimately, … the pedagogical practices of the instructor, not the incorporation of the technology [is] key to student comprehension" (Judson & Sawada, 2002, p. 167). According to Palfrey and Gasser (2008), in order for schools to adapt to the needs of Digital Natives, "educators need to accept that the mode of learning is changing rapidly in the digital age" (p. 239). Hence, the way the instructor views the class, the way the instructor designs the curriculum, and the questions that are developed to immerse the students in higher level thinking (Beatty, 2004) is essential for meeting the needs of Digital Natives. Prior researchers agree that—when SRS are used in conjunction with effective questioning, discussion, and feedback—the technology "constitutes a powerful catalyst for conceptual change, heightened student engagement in class, and, because involvement and feedback for all students is equal" (Penuel et al., 2007, p. 316) greater equity is created.

Knowing how to operate the technological tool is the easiest part, while implementing it with effective pedagogy in a learning environment is the biggest challenge. According to Beatty, Gerace, Leonard, and Dufresne (2005), creating effective questions, refining productive classroom activity, and effectively integrating SRS with the current curriculum are the hard parts. "Telling student[s] what to think is notoriously ineffective; eliciting their thinking, confronting it with alternatives, and seeking resolution works better" (Beatty et al., 2005, p. 33).

To develop quality questions when using SRS in an educational environment, it is important to consider the steps within the "question cycle" model. These steps include three important aspects: 1) questions are presented in an encouraging significant cogitation, rather than just recalling facts, 2) questions are followed by detailed discussions, first with small groups then as a whole class, 3) the instructor continues adjusting the lesson to the needs of the learners—a term referred to as "agile teaching." (Beatty et al., 2005). Using this "question cycle model," teachers can design questions to be used with SRS that meet the needs of the learners and offer meaningful and genuine learning experiences.

The implementation of SRS along with other strategies, such as small group discussions, reflective writing and role-plays, can be used to increase learner engagement (Coupal & Premkumar, 2008). Student learning, critical thinking skills, motivation, retention, and transfer of new information are increased when students are actively engaged in the material (Beatty, 2004); therefore, it is important that SRS be concept and topic appropriate, non distracting from learning, and questions should be clear and beneficial to the learner, not just the teacher (Coupal & Premkumar, 2008).

SRS can also help improve teaching effectiveness with timely feedback, which allows students to assess themselves, and allows for "agile teaching" to meet the learners' needs (Beatty, 2004). Additionally SRS helps to reduce paperwork associated with attendance, testing, grading, and calculation (Johnson & MeLeod, 2005). Using SRS the teacher knows immediately what the students understand and any misconceptions they may have. This immediacy, allows the teacher to determine whether a review of the topic is necessary or to save time and move on to the next concept (Coupal & Premkumar, 2008; Kenwright, 2009). The teacher must be

flexible enough to redirect the lecture to meet the changing needs of its students—a practice referred to as "contingent teaching" (Stuart, Brown, & Draper, 2004).

Edens (2009) reports that continued research and professional development to focus on specific pedagogical practices needs to be conducted in areas including self-regulation and motivation-goal orientation as well as pedagogical practices appropriate for diverse populations. Additionally, other areas of SRS warrant empirical investigation such as pedagogical uses that foster concept development in a variety of content areas. More research is needed to determine the effects of question types as well as the sequencing of questions on student conceptual knowledge. Specific ways to help build conceptual development should be investigated during student discussions and feedback (Edens, 2009).

The use of SRS requires focused planning and commitment from the teacher. For example, the teacher must become familiar with navigating through the software. In addition, features such as a participant list, which allows a student to be linked to a specific response, needs to be created prior to implementation. With all technology, technical difficulties are inevitable; therefore, the teacher using SRS should always be prepared with alternatives. Some potential problems include the following: failure of a battery in a transmitter, the receiver not receiving responses, the software not responding to the receiver and computer failures (Coupal & Premkumar, 2008).

A combination of the tool itself and the use of pedagogical practices make the implementation of SRS most effective, rather then just the tool itself (Collier, 2005). SRS interactions should be designed and implemented based upon sound pedagogical practices to best facilitate learning. When used in association with other best practices such as, higher-level conceptual questioning and collaborative interaction, SRS can promote high-level learning

(Beatty, 2004). Not being effective at operating the software, planning lessons and developing questions and curriculum with SRS can negatively affect the learning outcomes.

Collaboration efforts

Peer learning is a method of instruction that has proven to be effective—especially in the physics education community (Caldwell, 2007). According to Caldwell (2007), the interaction between students is the value of peer instruction, in the sense that students share similar characteristics, including age, language, and common experience. As a result students are "better at clearing up each other's confusions and misconceptions" compared to the instructor (Wood, 2004). Hence, SRS allow for effective monitoring of progress and problems within collaborative groups. With the use of SRS, instructors can intervene when the class is confused or showing signs of misconceptions (Caldwell, 2007).

According to Lowery (2005), SRS has potential benefits to increase student learning in areas of peer collaboration. The University of Massachusetts Physics Education Research Group (UMPERG) has been using SRS to teach and develop curriculum using pedagogic techniques to support SRS research-based teaching since 1993. At UMPERG "questioning" played a very important factor in the success of the implementation. "The Question Cycle" was used as a model for organizing SRS-based teaching, which involves a four-step process of sending the question, collecting answers through cooperative efforts, initiating class discussions and the display of histograms, and wrap-up activities. During the final two stages, the instructor should be evaluating, adding, or revising the questions. SRS is most successful when used with this type of contingent teaching strategies. In a physics course at Illinois Institute of Technology in Chicago, students were given opportunities to collaborate with teammates when responding to certain questions using SRS (Burnstein & Lederman, 2001), which can result in effective peer

instruction. In addition, studies show that when students participate in collaborative efforts with classmates as they answer questions using SRS, "this type of collaboration interaction, afforded by such a system, is one of the greatest strengths of a student response system." (Judson & Sawada, 2002, p. 167).

Conclusion

SRS has proven to be an effective tool in large enrollment college classes. Students like using SRS because it promotes active learning in large-class environments (Greer & Heaney, 2005). When SRS is used in conjunction with effective peer instruction strategies and best pedagogical strategies, students become more involved in the learning processes and have a sense of personal ownership over their contribution to the class (Beatty, 2004). Ongoing formative, as well as summative assessments become possible with the use of SRS. SRS enable both the teacher and student to receive immediate feedback, which allows for timely remediation and contingent teaching and helps the student monitor their comprehension and self assess their understanding. In addition, when using SRS, clerical and administrative tasks for teachers are either reduced or eliminated, which gives the teacher more time to spend on planning engaging and meaningful learning experiences. With the students' results from SRS, teachers have data at their disposal to assess the needs of their students, which allows for better instructional planning. Better instructional planning results in more motivated and engaged students.

Didactic routine lectures often fail to engage all students in the learning process. Using a much more interactive approach such as implementing SRS has deemed to be a more effective method of instruction. Much research reveals that SRS promotes participation from all students, as it requires all students to respond to the questions generated by SRS. Additionally, SRS promotes communication for the more reserved students who are afraid to speak up in class. As a

result of the greater student participation, a stimulating classroom community is created. Peer collaboration is also an important aspect of effective implementation of SRS. Collaborative strategies can be implemented with SRS.

Although there have been many studies on SRS in higher education, very little research studies are available on SRS in a K-12 educational environment (Penual, Boscardin, Masyn, & Crawford, 2006). However, the studies that do take place in K-12 environments, suggest that many of the teaching pedagogical practices used in higher education are also being used in K-12 classroom environments (Boscardin et al., 2006). Hence, an instructional design module created for elementary teachers deems necessary to support the need for teaching best practices and pedagogy for effective SRS technology integration:

> "Learning to operate the technology is the easiest part of becoming facile with CRS [SRS]-based instruction. More difficult challenges include creating and adapting suitable question, cultivating productive classroom discourse, and integrating CRS [SRS] use with the rest of the course, with curricular material, and with external constraints" (Beatty et al., 2005)

Research on SRS in educational environments reveal abound potential on improving classroom learning. Although much research remains to be done to explicate why SRS are effective tools in the classroom, SRS does appear to enhance learning by creating an active learning environment, increasing participation, and increasing student enjoyment (Caldwell, 2007). Informed by research in higher education settings, through proper implementation techniques, pedagogical strategies, and effective questioning, SRS could also increase motivation, engagement, and learning in an elementary classroom setting.

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