Establishing Acceptable Evidence: Taking Technology-related Action Research beyond the Classroom

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Abstract: This paper first describes a novel online tool developed to collect teacher inquiry information about classroom-based student achievement, aggregates the results of 46 teacher inquiries projects related to technology and student learning collected during the 2006-07 school year, and describes plans to substantially revamp and expand the tool for use nationwide. The current results document student achievement as a result of teacher inquiry, frequently observed conditions conducive to learning, and long-term impacts on the professional growth of teachers involved.

Introduction

It is widely recognized that teacher inquiry (also known as action research) leads to a series of benefits for teachers including improved practice, heightened professionalism and activism for positive educational change (Carr & Kemmis, 1986; Cochran-Smith & Lytle, 1993). More recent research has also suggested that teacher inquiry is a vehicle through which teachers can systematically and intentionally study the ways that technology integration impacts student learning and serves as a lens through which teachers may experience conceptual change regarding their beliefs about technology integration practices (Dawson A, 2005, 2006, 2007).

However, lessons learned from teacher inquiries are rarely shared beyond the school or district level. Some organizations have developed forums for sharing teacher inquiries across multiple districts. For example, The Fairfax County Public School hosts an Annual Teacher Research Conference and the University of Florida in collaboration with the Northeast Florida Educational Consortium (NEFEC) hosts an annual Teaching, Inquiry and Innovation Showcase. These events provide great opportunities for wider dissemination of inquiries. Each organization also publishes conference proceedings that enable attendees to access results of all the teacher inquiries presented in any given year.

These events provide valuable opportunities for educators, but many in the research community have voiced concerns regarding the quality and generalizability of teacher inquiry efforts (Clausen, 2006). Yet, a need for more school-based research (Bull, Knezek, Roblyer, Schrum & Thompson, 2005) and the importance of documenting classroom-based student achievement (Schrum, Thompson, Sprague, Maddux, McAnear, Bell & Bull, 2005; Dawson, 2006) suggest teacher inquiry may provide a strategy for researchers to aggregate data from multiple classrooms while simultaneously enabling teachers to reap the personal benefits of systematically and to intentionally study their own practice through inquiry.

The purpose of this paper is threefold: 1) to describe a novel online tool to aggregate information about classroom-based student achievement, 2) to study the aggregate results of action research efforts focused on classroom-based student achievement with technology and 3) to describe our plans to significantly overhaul and expand our tool for use nationwide.

Tool Design and Overview

The tool and this associated study merges Dana and Silva's model of teacher inquiry (2003) and the concept of acceptable evidence in educational technology research (Schrum et. al, 2005). The concept of acceptable evidence in educational technology research highlights the importance of conducting research on technology's impact on student learning in real classrooms while simultaneously pointing to the inherent challenges associated with classroom-based research.

Dana and Silva's model (2003) of teacher inquiry outlines a systematic process by which teachers can intentionally study their classroom practices. It also provides a mechanism by which we can gain valuable knowledge about classroom-based uses of technology. Teachers inputted information about their inquiry into a system that was designed to parallel the process of inquiry on which they were being mentored. Table 1 provides an overview of these steps and provides information about kinds of information teachers were asked to provide.

Table 1: AR process and associated database inputs.

Step	Description	Database Input
Step 1: Identify an AR Inquiry	AR teachers will specify a question related to how their laptop efforts influence student learning. This question could relate to a single lesson, a unit, a project-based activity, use of a particular simulation or strategy, etc. This question could also relate to a whole class, specific group or individual child.	Textbox for the action research question
Step 2: Specify context	AR teachers will provide contextual information	Textboxes for grade level(s), content areas, years of teaching experience and years of experience teaching with technology
Step 3: Data Collection	AR teacher will specify strategies to best answer their question	Checkboxes for potential data collection strategies (i.e Digital photographs, Tests, Student Artifacts, Informal Interviews, Survey, etc.)
Step 4: Data Analysis	AR teachers take information collected, synthesize it and answer question	Textbox for each finding and an upload button to include supporting data
Step 5: Implications and Actions	AR teachers think about broader implications of their findings & describe what actions have or will result from their AR efforts	Textbox for each implication and/or action supported by the inquiry

Figure 1 provides an annotated example screen shot of the action research submission system. Each step in the action research submission system provided teachers with simple navigation mirroring the action research process, suggested due dates, clear instructions about the information being requested, a location to provide the necessary information, related chapters within the Dana and Silva book and an example to serve as a scaffold. Two actions were available at every step in the process: view and save. The view option would open a separate window with the current information provided, and save would store the current state of the screen. The system was developed using XHTML/PHP/MySQL/JavaScript/CSS.

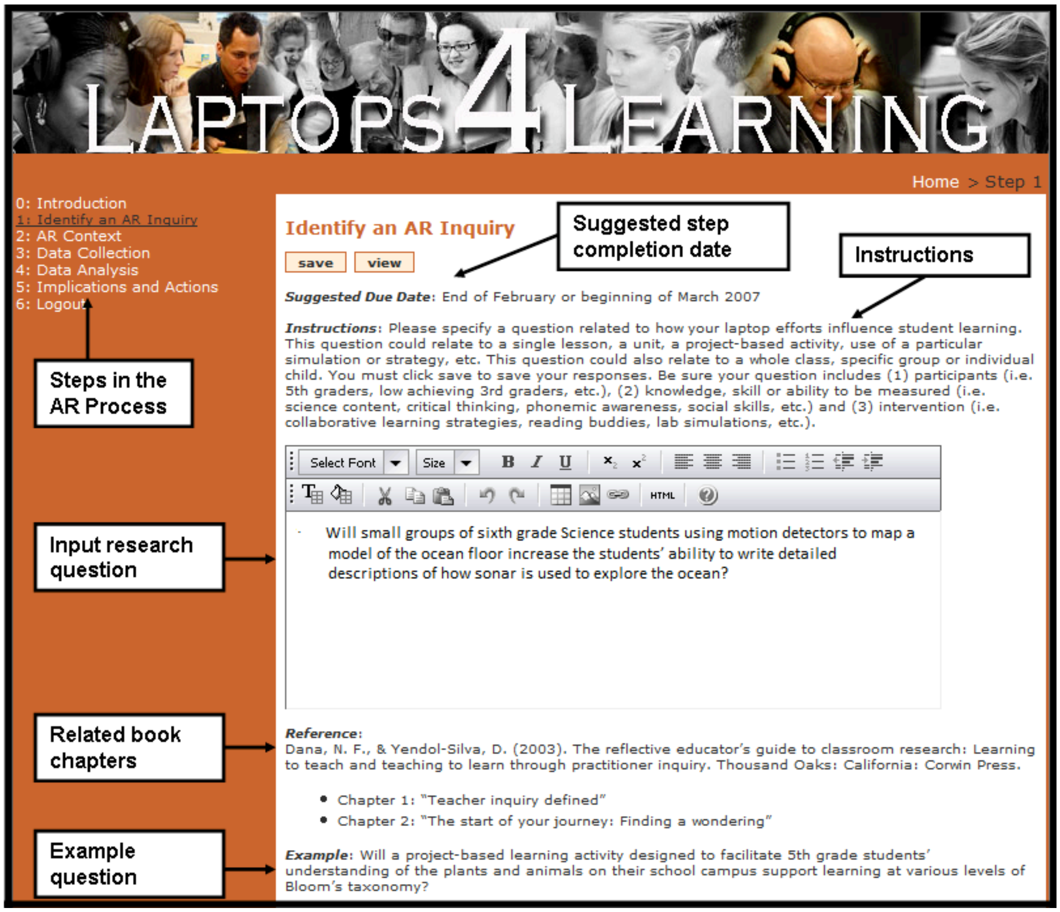

Figure 1. Annotated example step in action research submission system.

Method

This study is part of a larger statewide initiative designed to look at the impact of statewide technology funding and systemic professional development efforts on teaching practices and student achievement in the 2006-07 school year. Teacher inquiry/action research was selected as one of the mechanisms to study student achievement because of the time frame of our study, the inherent problems using standardized test data to document the effect of technology use (Haertel & Means, 2004) and the importance of documenting classroom-based student achievement (Dawson, 2006, Schrum et. al., 2005).

Fifty-five teachers from 10 school districts were recruited to participate in this research (46 teachers completed the process) – an 84% completion rate. Each teacher received a monetary stipend, a copy of Dana and Silva's book about teacher inquiry and access to a mentor well-versed in the process of teacher inquiry and technology integration. The mentors provided guidance on the process of completing the inquiry project. All teacher inquiries related to the impacts of technology on student learning in their classroom. These inquiries could then be aggregated using an action research submission system.

After teachers inputted their information, the researchers downloaded the data for analysis. Analysis involved transforming the separate inquiries into an aggregate picture of how technology was being used within and across districts. Qualitative analytic procedures (Rossman & Rallis, 1998) were used categorize the data inputted in Steps One, Four and Five. In some cases these categories were transformed into a numerical format (i.e. types of technology used, ways technology was used, etc.) Descriptive statistics were compiled from the data inputted in Steps Two and Three.

Results

Nine projects were conducted in elementary classrooms (grades 1-5), 22 took place in middle school classrooms (grades 6-8), and 15 were carried out in high school classrooms (grades 9-12). Eighteen of the projects focused on a science topic, eleven centered on an English/language arts topic, six were oriented toward history or social studies, four happened in mathematics, four in speech or other exceptional education setting, and three studied general student outcomes or behavior.

Teacher backgrounds varied widely. The teachers that completed the inquiry projects had been teaching for average 11.4 (*SD*=9.16) years and using technology for teaching for an average of 5.79 (*SD*=5.77) years. The teacher inquiry projects ranged widely in scope and purpose. The following three questions provide insight into the types of questions explored by in the teacher inquiry projects:

- How does the use of Audacity for brainstorming and Kidspiration for outlining influence the quality of writing produced and classroom behavior exhibited by a 3rd grade student with emotional needs?
- Will a project based learning activity for 10th grade Biology students and interactive website simulations improve student understanding of cellular respiration when compared to the traditional reading and writing approach?
- Will small groups of sixth grade Science students using motion detectors to map a model of the ocean floor increase the students' ability to write detailed descriptions of how sonar is used to explore the ocean?

The technologies used in the projects varied and are listed by frequency in Table 2. About one-third of the projects used online services and resources and approximately one-fourth employed media and presentation tools. A smaller number of inquiry projects used other available technology, including word processing, concept mapping and many more productivitylike tools. Ten of the 46 projects focused on project-based approaches as an instructional strategy.

Table 2: Types of technologies used.

Technology	Number of projects (N=46)
Online resources	16
Media and presentation tools	11
Word processing, publishing and other productivity tools	9
Concept mapping software	6
Probes and data tools	6
Virtual labs, simulations, and games	4
Other: audio production, clickers, e-portfolios	4

The educational results reported by the teachers were positive. Seventy-eight percent of the teachers documented changes in student achievement including test scores, higher level thinking skills, retention, and transfer of learning. In one elementary classroom and two middle school classrooms, negative effects such as a decrease in writing scores and a high level of frustration were reported, and in each case these effects were attributed to inexperience of the students with the technology that they were learning to use simultaneously with learning the class lesson. In all other cases, teachers reported noticeable or substantial improvements in student performance, in some cases exceeding the teachers' expectations.

Over 60% of the teachers reported increases in conditions that support learning: enjoyment, motivation, engagement, on-task behavior, and positive school experience. Thirteen teachers stated that students had demonstrated strong 21st Century Skills such as collaboration, computer skills, workforce skills, producer abilities, communication skills, leadership abilities, innovation and creativity. Smaller numbers of teachers documented positive changes in their teaching, changes in the classroom culture or dynamic due to unique technology affordances, and improved ability to reach students of varying abilities.

Each teacher reported the long-term impacts that the process of inquiry has caused in his or her professional life. Nineteen teachers expressed commitments to continue using, investigating, and learning to teach with technology. Fifteen teachers had taken leadership actions including sharing their successes with colleagues either informally or through presentations and other formal venues. Other teachers explained ways that they had become advocates for technology for students.

Discussion

This study suggests it is feasible to use teacher inquiry as tool for teachers' professional learning while simultaneously using it as a research tool to document student learning. By narrowing the inquiry focus to technology and student learning we were able to gain substantial knowledge about how technology is being used in classrooms while minimizing the disruptions and teacher inconvenience often associated with classroom-based research. We were also able to temper the intense writing requirements often associated with action research so it is more feasible for teachers who are not completing an inquiry as part of an academic degree to participate.

Despite these positives, we encountered obstacles during the data analysis stage. It was difficult to aggregate such diverse data. Some teachers provided information about how many students participated; others did not. Some teachers provided rich information about their instructional strategies; others provided superficial details. As a result we have taken steps to improve and streamline the data collection and analysis processes. Specifically, we have revised the tool to further streamline the process teachers use to input data by creating a research-based codebook developed from previous technology and learning meta-analyses (Cavanaugh, 2004; Waxman, Linn, and Michko, 2003) and research-based categories related to effective teaching (Ross, Smith & Alberg, 1999).

Overview of Follow-up Year

To overcome many of the challenges, the revised Year Two system provides data that is exportable in quantitative format and provides a deeper understanding of how technology is impacting classroom practices. Figure 1 shows a small annotated screen shot of the first step in the action research process in its revised form. The revised tool mirrors the same elements that are shown in Figure 1 with three differences with the revised tool: 1) requests more specific and quantifiable information, 2) provides a glossary of related terms available to support teachers in the process, and 3) replaced the view button with a close window action.

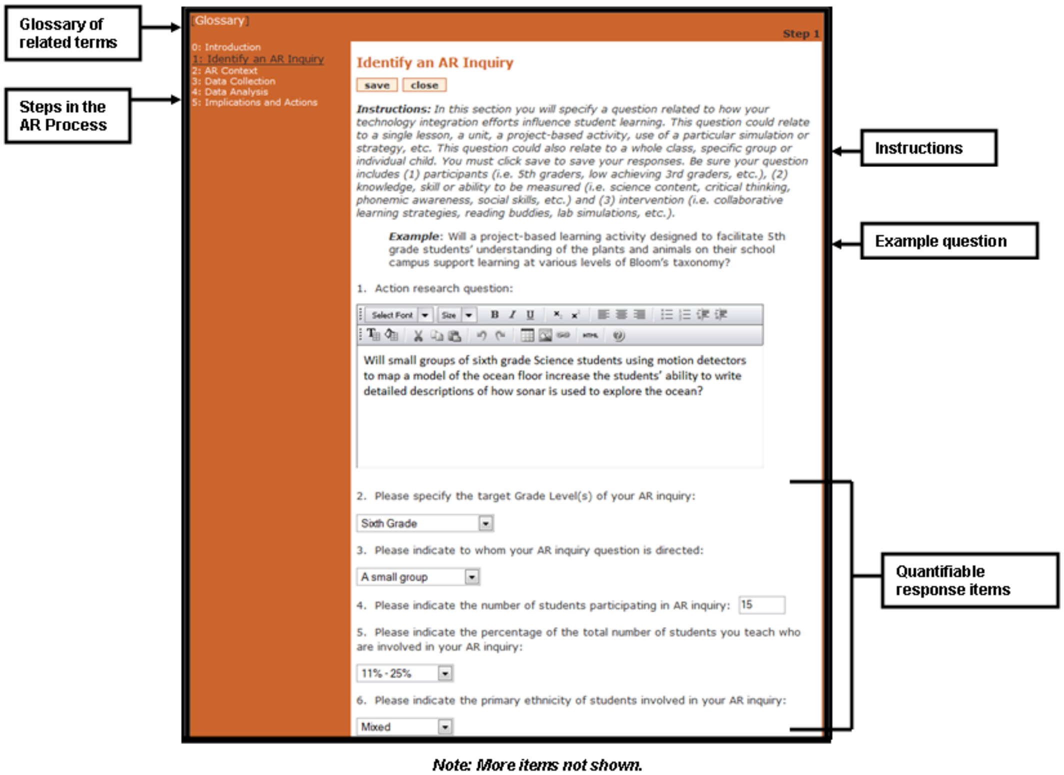

Figure 2. Tool in Year 2 (revised).

The second year of data collection is near completion and preliminary data analysis has begun. During the 2007-08 school year, 50 inservice teachers and 30 preservice teachers participated in inquiry projects. However, the inservice teachers are a part of the statewide technology research program while the preservice teachers provided additional perspective for which to improve the tool's design. Thus, the inservice teachers' results will be explored in a separate analysis.

Of the 50 participating inservice teachers, only 39 – to date – had completed a teacher inquiry project. The teachers that completed the inquiry projects had been teaching for average 11.52 (*SD*=10.37) years and using technology for teaching for an average of 6.42 (*SD*=7.01) years. Seventeen of the participating teachers taught in elementary schools (Grades PK-5), 5 in middle schools (Grades 6-8) and 14 in high school (Grades 9-12). The teachers reported an average of 30 students involved in the teacher inquiry projects. Fifty-percent reported the economic status of the students were from lower middle income families.

The primary objective of using technology in the teacher inquiry projects varied widely. The most frequently cited objective was the assisting students in learning specific content (60%) followed by discovering new ideas and information (46%) and improved computer skills (46%). Teachers also provided the primary student cognitive, affective and behavioral outcomes that should result at the completion of their inquiry projects. Approximately 25% of the teachers suggested students would perform better on teacher authored tests as a cognitive outcome, while approximately 40% indicated that improved student attitudes towards computing, content areas, anxiety, or instruction is the target affective outcome. In terms of behavioral outcomes, 25% of teachers indicated that improved success rates are the primary targets of the inquiry project.

Preliminary results demonstrate substantial improvements from the previous year in that that the AR tool overcomes many of the stated limitations and improved reporting capabilities. Further analysis of the context, findings, implications and actions will provide the researchers a deeper understanding classroom practice and its relationship to technology. With this said, there is still substantial room for improvement.

Future Directions

The tool, now titled the Action Research for Technology Integration (ARTI), has the potential to positively impact practicing and prospective teachers across the nation. However, in its current form, it is not easily accessible to a wide scale audience for a number of reasons. First, the tool does not reside on a robust server capable of handling a large user base. Second, the interface design and field inputs are reflective of a tool in its initial stage of development. Third, the text-based descriptions within the system are inadequate to guide large numbers of teachers through the process. Finally, teachers doing action research for the first time require the collaboration of an experienced mentor, assistance that the ARTI system is being designed to include as embedded coaching. To date, all users have had dedicated mentors funded to support them. Fourth, the input choices have not been field tested and no guidance is associated with the input choices making it difficult for teachers to use without the support of dedicated mentors. Finally, aggregating data is laborious as there is currently little automation of reporting outcomes and patterns within the system. Table 3 contrasts the current features of our tool with the improvements we propose for it to become a flexible, scalable system known as ARTI. It is our vision that ARTI will be available to teacher education programs, school districts and alternative certification programs throughout the country.

Table 3: Action Research Technology for Technology Integration features.

Current Version of Tool	Proposed Improvements for a scalable ARTI
The tool resides on a server with little capacity to handle large numbers of users.	ARTI will reside on a dedicated server located at an established technology leader – The Florida Center for Instructional Technology.
The interface design is inadequate for a large user base.	We will improve the appearance, usability and accessibility of ARTI using principles from the human-computer interaction literature.
Text-based descriptions provide a few sentences about each step in the action research process.	Multimedia video to mentor ARTI users through each step of the action research process. These mentoring videos may include, but will not be limited to, excerpts from teachers talking about their AR work, examples of technology integration strategies used by other AR teachers, classroom footage of the AR process, and suggested ways to excel during each step of the process.
Database fields where teachers can input information about their action research process.	The database fields for the original tool were created using a research-based codebook developed from previous technology and learning meta-analyses (Cavanaugh, 2004; Waxman, Linn, and Michko, 2003) and research-based categories related to effective teaching (Ross, Smith & Alberg, 1999). These codes will be refined and revised via

	usability tests. In addition, embedded help will be created to assist teachers in accurately coding project context and data collection. The help may be in the form of video, animation, text, and/or audio as best suits the instructional need.
Simple coding to aggregate data into a spreadsheet that is difficult to manage and use for decision-making.	Functionality will be added to ARTI to allow for the automated creation of PDF (Adobe Portable Document Format) reports of individual action research projects. An online administrative form will allow project personnel the opportunity to review the project and input comments and analysis, which will be included in the PDF report. Additional reporting functionality will be added to allow project administrators to view summaries of current projects.

The goals of ARTI are to support collection and dissemination of acceptable evidence on technology's impact on student learning in real classrooms while simultaneously developing professional skills and habits of mind in teachers. As teachers learn the action research process, they are learning to be systematically reflective educators who continually refine their research-based practices. As teachers use the ARTI system, they create a record of data for themselves and their colleagues. When ARTI data are aggregated for a grade level, subject department, school, or district, educators are able learn from the patterns of performance, which leads to improved learning outcomes for students.

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