Chapter 20

ARTI: An Online Tool to Support Teacher Action Research for Technology Integration

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ABSTRACT

Action research is recognized as a powerful tool for professional development and teacher preparation (Cochran-Smith & Lytle, 2009; Zeichner, 2003) and teachers require powerful professional development to effectively integrate technology (Hew & Brush, 2007). ARTI (Action Research for Technology Integration) is an online tool designed to support the merger of action research and technology integration. This chapter provides an introduction to ARTI followed by a discussion of its theoretical foundations. Next, the conceptual design of ARTI is described in terms of the three main purposes for its development which are to provide: (1) an online scaffold for teachers to inquire about their technology integration practices, (2) a mechanism to synthesize action research information from multiple teachers, and (3) a mechanism to capture evidence of student learning within technology integration inquiries. Finally, examples of ARTI implementation, implications and future possibilities for the tool in teacher preparation are discussed.

INTRODUCTION

Action research (also known as teacher inquiry) is widely recognized as a powerful tool for professional development and teacher preparation (Cochran-Smith & Lytle, 2009; Zeichner, 2003). It involves teachers systematically and intentionally studying their practices (Dana & Yendol-Hoppey, 2009) and has been shown to improve teacher practice, heighten teacher professionalism, lead to positive educational change, expand the knowledge base for teaching and provide a platform for teachers’ voices in educational reform (Carr & Kemmis, 1986; Cochran-Smith & Lytle,$\ldots$)
Technology integration refers to the ways teachers use technology to support and enhance teaching and learning. Technology integration is an important aspect of teaching (National Educational Technology Plan, 2010) and appropriate use of technology can support students in content area learning (Howland, Jonassen & Marra, 2011), provide students with essential workforce skills such as the ability to communicate and collaborate digitally (President’s Report, 2010), prepare students for participation in an increasingly digital democracy (Partnership for 21st Century Skills, 2011) and enhance student motivation and engagement (Dawson, Cavanaugh & Ritzhaupt, 2008).

Successful technology integration requires opportunities for professional development (Hew & Brush, 2007) and, given the positive results associated with action research (Dana & Yendol-Hoppey, 2009), recent research has attempted to merge the two. This research suggests that action research is a vehicle through which teachers can systematically and intentionally study the ways that technology integration impacts student learning and as a lens through which teachers may experience conceptual change regarding their beliefs about technology integration practices (Dawson, 2006, Dawson, 2007; Dawson & Dana, 2007). In part as a result of this research, action research has been used with hundreds of teachers involved in statewide technology integration efforts across the state of Florida. An online tool, known as ARTI (Action Research for Technology Integration), was developed to support these teachers. The chapter describes the theoretical and conceptual foundations of ARTI’s design, examples of ARTI implementation, ARTI implications, and future possibilities for the tool in teacher preparation.

BACKGROUND

This section provides an overview of the theoretical and conceptual design of ARTI.

ARTI: Theoretical Framework

Cochran-Smith and Lytle’s seminal work on teachers knowledge domains (1999) informed ARTI development. These domains described different types of knowledge teacher acquire through different types of professional experiences. In particular, they discuss three domains: knowledge for practice, knowledge in practice and knowledge of practice. This section provides an overview of these domains and explains why ARTI is built on the knowledge of practice domain.

Knowledge for Practice

Teacher preparation and inservice professional development programs have historically done an inadequate job of preparing effective technology-using educators (Milken Exchange on Educational Technology, 1999; Hew & Brush, 2007; Lawless & Pellegrino, 2007). The primary way prospective teachers learn about technology integration is through stand-alone technology integration courses or possibly through content-specific lessons offered as a part of methods coursework (Pierson & Thompson, 2005) while inservice teachers primarily learn in after school workshop formats (Broughman, 2006). These approaches emphasize the development of a certain type of knowledge referred to as knowledge for practice (Cochran-Smith & Lytle, 1999). This type of knowledge helps prospective and practicing teachers understand definitions, theories and concepts associated with technology integration. However, these experiences are rarely transferable to a classroom context because they negate the complexities of classroom technology integration and often teach isolated skills (Wei, Darling-Hammond, Andree, Richardson & Orphasno, 2009).
Knowledge in Practice

Recognizing the shortcomings of relying solely on workshops or university-based courses, many teacher education and inservice programs have experimented with a variety of ways to help prospective and practicing teachers use technology in real classrooms or other authentic contexts. Some teacher education programs explicitly provide opportunities for prospective teachers to use technology within traditional components of their programs such as the internship experience or methods courses (Strudler & Grove, 2004; Glazewski, Berg, & Brush, 2002; Dawson, Pringle & Adams, 2003; Hernandez-Ramos & Giancarlo, 2004). Other programs have sought to facilitate learning communities focusing on technology integration (Yendol-Hoppey, Dawson, Dana, League, Jacobs & Malik, 2007; O’Bannon & Nonis, 2002; Jacobsen & Lock, 2004). Others have experimented with virtual technology-based experiences (Knight, Pederson & Peters, 2004; Davis & Roblyer, 2005) or adding innovative technology-based experiences to programs (Dawson & Nonis, 2000; Schmidt, 2001).

Inservice strategies that have been described as effective for technology integration in practice include curriculum planning, grade level or vertical team planning, teamwork to analyze student data, teacher leadership academies, and collaboration with school based coaches (Wei et. al., 2009). The nature of these strategies emphasizes a certain type of knowledge referred to as knowledge in practice (Cochran-Smith & Lytle, 1999). Knowledge in practice is the most transformational type of knowledge educators can gain (Cochran-Smith & Lytle, 1999). This knowledge emerges from teacher questions about their practice and results from the systematic study of their teaching (Cochran-Smith & Lytle, 1999), typically through action research. Merging action research with technology integration provides a scaffold for teachers to focus on student learning and contextual factors (Dawson, 2006; Dawson & Dana, 2007). As previously mentioned, action research also yields many other benefits for teachers and, thus, as ARTI scaffolds teachers through cycles of action research it supports the knowledge of practice domain.

ARTI: Conceptual Design

ARTI was developed for three purposes:

- To provide an online scaffold for teachers to inquire about their technology integration practices.
- To provide a mechanism to synthesize action research information from multiple teachers.
- To provide a mechanism to capture evidence of student learning within technology integration inquiries.

This section describes each purpose and the ways in which ARTI was designed to help meet each.
Purpose 1: To Provide an Online Scaffold for Teachers to Inquire about their Technology Integration Practices

ARTI was designed to scaffold teachers through The Reflective Educators’ Action Research Cycle (Dana & Yendol-Hoppey, 2009). This cycle includes five stages: (1) developing an inquiry question, (2) identifying context, (3) planning data collection, (4) conducting data analysis and deriving findings and (5) determining the implications of the work. Here, we will briefly describe each stage in the cycle and how ARTI was designed to support them. However, it is important to note that while we will be presenting action research as a singular cycle, ideally teachers participate in multiple cycles throughout their teacher careers to support continual improvement of teaching practice and to examine new practices that build on previous action research findings. In addition, while we will present the cycle in a linear fashion, it is important to note that an action research cycle rarely follows a neat linear sequence. Rather, it is an iterative cycle. Given the focus of this chapter is on the ARTI tool, general information about action research is necessarily brief. However, a thorough overview of action research and its importance is provided in Chapter 19 of this book. To help readers better visualize ARTI, a screenshot is provided in Figure 1. The five stages of the Reflective Educators’ Action Research Cycle (Dana & Yendol-Hoppey, 2009) are visible in the left-hand menu bar. When users click on each stage content in the main window adjusts accordingly.

Stage 1: Developing an Inquiry Question

Teachers begin the action research process by specifying a question about their practice. This question, often referred to as a “wondering” or “passion,” might be about a teaching practice, a single lesson, an individual child or a small group of children. Within ARTI, teachers are guided to develop a question related to how their technology integration efforts influence student outcomes in the classroom. In particular, teachers are encouraged to include three components within their question: participants (i.e. 5th graders, low achieving 3rd graders, etc.), knowledge, skill or ability to be measured (i.e. science content, critical thinking, phonemic awareness, social skills, etc.) and intervention/strategy (i.e. collaborative learning strategies, reading buddies, lab simulations, etc.).

Stage 2: Identifying Context

In the second stage, teachers describe the specific context or setting for their action research. This enables teachers to think consciously about their classroom design, students, schedule and a host of other issues that may help inform the action research question. Within ARTI, teachers are scaffolded to think about items related to technology integration including, but not limited to, technology implementation strategies, student activities, technology configurations and types of technology used.

Stage 3: Planning Data Collection

In the third stage, teachers consider what forms of data will help inform their action research question. Ideally, data comes from activities already taking place in the classroom. For example, teachers might keep anecdotal records on student behavior or conduct informal interviews with students during a center time. Other strategies might include student created media, pre/post tests, samples of student work, interviews or surveys. Within ARTI, teachers are provided a list of potential data collection strategies and encouraged to consider which ones make the most sense for answering their particular question.
Stage 4: Conducting Data Analysis and Deriving Findings

In the fourth stage, teachers analyze data collected, synthesize it, and interpret it for insight into the action research question. Within ARTI, teachers are asked to submit their findings and associated artifacts to support them.

Stage 5: Determining the Implications of the Work

The action research cycle concludes when teachers consider broader implications of their findings and describe the actions that have or will result from their efforts. In most cases, this work is also shared with others either formally through some sort of showcase or informally through outlets such as grade level meetings. In ARTI, teachers are provided with spaces to share the implications resulting from their action research effort.

Purpose 2: To Provide a Mechanism to Synthesize Action Research Information from Multiple Teachers

Action research work typically occurs in a single classroom and action research results are seldom shared beyond the school level (Dana & Yendol-Hoppey, 2009). In fact, the isolated nature of most action research work has drawn criticism about usability of action research beyond a classroom context (Clausen, 2006). Thus, another purpose of
ARTI is to provide a mechanism to synthesize action research information from multiple teachers. This synthesis may provide a more generalizable pool of data to make implications beyond a single classroom. To do this, ARTI is designed, whenever possible, to collect easily aggregated data within each stage of the Reflective Educators’ Action Research Cycle. Whenever possible, teachers input data using radio buttons, checkboxes or drop-down menus. This streamlines the aggregation process and provides teachers with a certain level of scaffolding while working through an action cycle. Decisions about what items to include in ARTI were strongly influenced by literature within educational technology, teaching and learning and action research. The next sections overview the types of data collected within each stage of the action research cycle.

**Stage 1: Developing an Inquiry Question**

Given the personal and unique nature of each question, teachers are asked to type their question into a textbox. They are also asked to specify their years of teaching experience and years of teaching with technology.

**Stage 2: Identifying Context**

In this stage teachers enter information about their context. Context is particularly important when aggregating information and, whenever possible, information collected here aligned with other research in the field. For example, teachers enter information about their community, school and classroom and this information is based on what was used in a well known technology and learning meta-analysis (Waxman, Linn & Michko, 2003). Teachers specify whether their school is private, public, charter or mixed and whether their school is urban, rural, suburban or mixed. They also specify information about the socioeconomic status, ethnicity and grade level of their students.

Teachers also specify information about their implementation strategies and student activities.

For example, teachers identify the types of activities their students were engaged in throughout the action research cycle. Activity choices were derived from research-based categories related to effective teaching (Ross, Smith & Alberg, 1999) such as student discussion, experiential/hands-on learning, seatwork, individualized instruction and independent inquiry. Space is also provided for teachers to add student activities.

Finally, teachers specify the technology used during their action research cycles. Lists of hardware and software choices were modified from an observation protocol designed to study technology integration (Lowther & Ross, 2001) and teachers reported the types of hardware and software used, quantities used and frequency with which they were used during the action research cycle.

**Stage 3: Planning Data Collection**

Here teachers specify the types of data collection strategies used during their action research cycles using checkboxes. The list of data collection strategies were derived from Dana and Yendol-Hoppey’s book on action research (2009) and included strategies such as test scores, pre/post artifacts, field notes, anecdotal records, surveys, journals and informal interviews. Blank textboxes are also provided for teachers to add strategies not included in the list. Here teachers also recorded the duration of their inquiries and the number of times students used technology during the action research cycle.

**Stage 4: Conducting Data Analysis and Deriving Findings**

In this section of ARTI, teachers write their findings in a textbox and upload an artifact with data supporting the finding. This is discussed in more detail later in the chapter.
Stage 5: Determining the Implications of the Work

In this section of ARTI, teachers record the implications of their work during their action research cycles. Teachers are provided with descriptions of implications that commonly result from action research efforts such as changes in teaching practices, changes among school or grade level colleagues as a result of the action research work and feelings of professionalism. Then, they are asked to describe what they perceive to be the implications of their action research work.

Purpose 3: To Provide a Mechanism to Capture Evidence of Student Learning within Technology Integration Inquiries

There is a clear need for more school-based research related to technology integration (Bull, Knezek, Roblyer, Schrum & Thompson, 2005) and a need to document classroom-based student outcomes when technology is integrated (Schrum, Thompson, Sprague, Maddux, McAnear, Bell & Bull, 2005; Dawson & Ferdig, 2006). Such information could be derived from action research conducted by teachers in their classroom. However, the process of deriving findings often causes teachers “some discomfort or uncertainty” (Dana & Yendol-Hoppey, 2009, p. 52). In particular, they often struggle to ensure their findings align with the data they collected. This is a natural part of the action research process and scaffolding can help teachers make sense of their data and derive findings based on them (Dana & Yendol-Hoppey, 2009).

Several features are built into ARTI to support teachers in deriving findings aligned with the data they collected. First, ARTI provides a list of common categories from past action research efforts. These categories were generated from hundreds of action research cycles conducted using ARTI (Cavanaugh, Dawson, Nash & Ritzhaupt, 2008) and provide starting points from which teachers can consider their data (See Figure 2). For example, a teacher may look at her data and consider whether it demonstrates student achievement, evidence of conditions supporting learning, impact on different types of learners or a category not currently listed.

Once a teacher has created a general category for a finding, she writes the finding and provides supporting data. An important feature of ARTI is the fact that a finding cannot be submitted without an artifact displaying data supporting it. This helps to ensure teachers are aligning their findings with the data they collected. Figure 3 shows the screen to which teachers are taken when they submit a finding. Artifacts submitted by teachers range from spreadsheets of test scores to pre-post rubrics to student-created digital products.

ARTI IMPLEMENTATION

The following sections describe how the three purposes described above have played in practice.

Purpose 1: To Provide an Online Scaffold for Teachers to Inquire about their Technology Integration Practices

While American K–12 education has a decades-long history of action research, for the most part teachers have learned action research in face-to-face experiences from college instructors, professional development facilitators, school leaders, and peer mentors (Cochran-Smith & Lytle, 2009). The ARTI system represents a step forward in connecting greater numbers of teachers to mentors who share their interests and an understanding of their teaching context. The majority of US teachers work in schools with enrollments below 600 students (US Department of Education, 2010), making the chance small that they have local access to action research mentors in their subject, grade level or area of interest. ARTI provides a
platform in which distributed teachers and mentors can share their action research expertise.

ARTI has been used for this purpose in a variety of ways. At the University of Florida, prospective teachers used the system to document their inquiries during their field experiences, thus adopting action research as a professional habit of mind even before their induction as professionals (Dawson, 2007). A multi-year statewide university-led research program used ARTI with hundreds of practicing teachers who documented their classroom technology implementation. Their action research work illuminated the impacts of the state’s educational technology initiatives on student learning (Dawson, Ritzhaupt, Liu, Drexler, Barron, Kersaint & Cavanaugh, 2011). In addition, a group of virtual school teachers used ARTI.
to examine their online teaching practice (Dana, Dawson, Krell & Wolkenhauer, 2012).

In each use of ARTI, the success of the action research teachers depended on the guidance they received from their mentors. Leaders at the university coached the distributed network of mentors. The web-based ARTI system included accounts for teachers who logged in to add their individual action research materials, accounts for their mentors who logged in to view the materials of their mentoring groups and to send feedback to teachers, and for the mentor coaches whose accounts allowed them to view all teacher materials and feedback. Each mentor was provided with synchronous online training sessions conducted by university educators. Dana, Krell and Wolkenhauer provide additional details about this in Chapter 18. Each mentor had access to the training materials throughout the year in which they mentored teachers and was able to contact the university educators for support at any time. Thus, while ARTI has served as an online scaffold for teachers to study their technology integration practices, the role of an action research mentor or coach is still critical to its success.

**Purpose 2: To Provide a Mechanism to Synthesize Action Research Information from Multiple Teachers**

During one year of the statewide study in which ARTI was used, over 350 action research efforts were collected in the system and together they formed a comprehensive view of teaching and
ARTI learning in classrooms where teachers had access to new technology (Dawson & Cavanaugh, 2010; Dawson, in press). ARTI provided a demographic picture of the teachers that showed their experience in teaching and in teaching with technology. Data collected from ARTI also showed that the majority of the action research efforts occurred in rural school settings and with students in a wide range of ethnic and socioeconomic backgrounds. This suggests the power ARTI as a professional development platform for teachers who might otherwise be isolated in rural areas and it offered examples of ways that teachers were working to level the digital divide in rural districts. The data collected from these inquiries in ARTI showed that teachers had success in integrating technology for learning across all content areas and grade levels and with widely varying group sizes in their classrooms.

Data collected from ARTI has also provided insight into the nature of the action research efforts. Teachers using ARTI documented their efforts to achieve specific objectives through strategies that they had reason to believe would improve outcomes. In particular, the vast majority of inquiries occurred within the core content areas of mathematics, language arts or science with the primary goal of helping students master that content. Instructional strategies implemented by teachers varied but included a large number of project-based learning efforts in which a range of student-centered technology tools such as digital video/audio, productivity tools and the Internet were used during projects lasting a week or more. The information teachers provide through ARTI enables researchers, administrators and professional development providers to identify patterns of technology integration and shifts in technology integration over time which can guide improvements in teacher education and professional development programs. (Dawson, in press)

Purpose 3: To Provide a Mechanism to Capture Evidence of Student Learning within Technology Integration Inquiries

As previously mentioned, teachers document their findings in ARTI. For example, they might upload student samples of work, spreadsheets showing pre and post data, or results from other instruments they used to measure outcomes. This documentation provides insights into how teachers support student learning through technology integration.

For example, one teacher explored whether the use of technology-supported project-based learning would increase her 5th grade students’ higher level thinking skills. This particular project related to a science unit on insects and students were to create a documentary about the plants and insects found on the school grounds. During her inquiry, she analyzed student work and one of her findings was that: “Sophistication of student knowledge increased as students progressed through stages of project development.” Figure 4 shows the students’ initial notes related to a particular plant on campus. The notes are factually based and do not exhibit much in terms of higher-level thinking. Figure 5 is a screen shot taken from the documentary and shows evidence of higher-level thinking as the students’ had opportunities to engage with and think more deeply about the assigned topic.

In addition to artifacts documenting student learning, teachers also submitted artifacts that demonstrate changes in conditions that support learning, including time on task, perseverance, tasks attempted and completed, student success rate in learning activities, positive interactions in learning activities, attitude, self-concept or motivation. In addition, at least half of the teachers using the ARTI system so far have reported that the action research experience coupled with their broader technology integration efforts resulted in changed teaching practices. This suggests that teachers may rethink their instructional practices.
when their reflection is scaffolded using a system like ARTI.

**IMPLICATIONS FOR ARTI**

As a support system for teacher inquiry, professional development, research, and evaluation, ARTI has potential in a range of contexts. Initial teacher preparation programs can integrate ARTI into their courses and internship experiences in order to document inquiry efforts of Education majors at all stages of an education degree program. Application of ARTI in teacher education serves several purposes for students and faculty. Student growth over time in their technology integration practices could be documented at the level of the individual student, as well as at the level of cohort or program groups. Individual student data could be a valuable addition to a student’s professional portfolio. Group and program level data could be useful in internal program evaluation efforts and to support program accreditation reviews. Faculty could also use ARTI to document their own faculty development initiatives as a stage in the scholarship of teaching (Austin & McDaniels, 2006).

Practicing teachers can use ARTI in their own individual professional development plans, as a gathering place for collaborative teams and lesson study groups, and for broader communities of practice. A district could award continuing education credits for completed inquiries that would enable teachers to use their inquiries toward their recertification, additional licensure, and merit reviews. For professional development programs, ARTI could offer a repository for schools and districts to collect and share examples of innovation that may not only spur improvements at the classroom level, but also may support school improvement plans and school strategic goals. Districts and larger education agencies could use aggregated ARTI findings for technology planning, detection
of needs, and insights into trends that could be magnified with additional support and resources.

Researchers have in ARTI a comprehensive and rich data collection system that is low-impact and non-invasive in that researchers need no specialized instruments, training, or time in classrooms in order to gather information for a variety of analyses; although teachers must receive adequate coaching or mentoring to use ARTI effectively. The data elements in ARTI allow comparisons to be made among schools and other jurisdictions, grade levels, content areas, technology type, teaching strategy or any other category. ARTI is flexible enough that new categories can be added to accommodate shifting needs.

**FUTURE DIRECTIONS**

The ARTI system has been an effective tool for supporting individual teacher inquiry efforts in K-12 classroom technology integration, for understanding the uses of technology in a broad range of classroom contexts, and for capturing impacts of technology on learning on a broad scale. The system has promise for supporting
similar inquiry and understanding in education beyond K-12 classroom technology integration. With modification to the data elements, ARTI can be transformed into a multi-purpose educator and researcher support system. In K-12 schools, an ARTI-based system could be developed that allows users to select a purpose, such as technology, a specific content area or areas, 21st century skills, addressing special student needs, etc., and the system could adaptively present contextual data elements and standards for the needs of the user. ARTI could also be modified to support group inquiries by allowing group accounts and data entry by multiple users on a team.

Because the affordances and demands of learning environments vary, teachers in online or blended courses would benefit from a version of ARTI tailored to practices known to be effective in those environments. Similarly, adapted ARTI systems could support home school and informal education instructors. Not only is the nature of teaching and learning different in adult and higher education, but also the nature of the scholarship of teaching varies in those contexts. Thus an ARTI-based system for adult learning environments could be developed to reflect principles of effective practice there.

Action research is an effective professional development approach in part due to the interactions among teachers and mentors. The ARTI system accommodates action research mentors by giving them access to teacher inquiry information and providing them an integrated channel for feedback to the teachers. But there is great potential for overlaying ARTI with more robust community capabilities and supports for mentors and coaches in the form of synchronous and asynchronous chat, videoconferencing, and discussion, for example. At this time, support and development for mentors occurs outside of ARTI, but could be interwoven throughout ARTI. Further, embedded prompts in text and multimedia forms can be added to enable more independent use of ARTI by teachers.

CONCLUSION

In its current form ARTI provides an online scaffold for teachers to inquire about how their technology integration practices affect student outcomes in their classroom, provides a mechanism to synthesize action research information from multiple teachers and provides a mechanism to capture evidence of student learning within technology integration inquiries. It has been used successfully with prospective teachers, practicing teachers and virtual school teachers.

In the future, ARTI can become a full-featured professional development and research support environment and can be developed in a form that seamlessly embeds it within a school’s learning management system (LMS). Such embedding could include connection of the ARTI data with the LMS data to enable more detailed analysis of teaching and learning. A data system of this type that will further advance teaching and learning by illuminating the effect of technology integration practices on a broad scale.

REFERENCES


ADDITIONAL READING


KEY TERMS AND DEFINITIONS

**ARTI (Action Research for Technology Integration):** A unique online tool that provides an online scaffold for teachers to inquire about how their technology integration practices affect student outcomes in their classroom, provides a mechanism to synthesize action research information from multiple teachers and provides a mechanism to capture evidence of student learning within technology integration inquiries.

**Action Research (also known as Teacher Inquiry):** The process by which an educator systematically and intentionally studies her practice in order to make improvements and share what was learned with others.

**Knowledge for Practice:** Knowledge teachers develop when they learn educational theories, concepts and definitions typically within university-based courses or professional development workshops.

**Knowledge in Practice:** Knowledge teachers developed from the experience of teaching.

**Knowledge of Practice:** Knowledge teachers develop when they study their own practices, make improvements based on what they learn and share with others.

**Technology Integration:** The process of using technology to enhance teaching and learning.

**Virtual School:** A school that offers courses completely or primarily through online methods.