Using Action Research Projects to Examine Teacher Technology Integration Practices

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Abstract

This study examined the technology integration practices of teachers involved in a statewide initiative via one cycle of action research. It differs from other studies of teacher technology integration practices because it simultaneously involved and provided direct benefits to teachers and researchers. The study used thematic analysis to provide a macro-level view of the technology integration practices of more than 350 teachers within 16 districts. Specifically, it reveals the content and objectives, audience, classroom implementation strategies, hardware and software use, and outcomes associated with technology integration. This article discusses implications for this and similar initiatives, research, and professional development. (Keywords: technology integration practices, action research, statewide technology initiatives)

Teachers play a critical role in the ways technology is used in classrooms, and such classroom practices influence student learning (Darling-Hammond, 2000, 2010; Weglinski, 2000). Thus, it is important to study and understand these practices (Schrum, Thompson, Sprague, Maddox, McAnear, Bell, & Bull, 2005). This study is situated within a statewide technology integration initiative and examines how 353 teachers used technology during one cycle of classroom action research (AR). It provides insights into the ways that teachers use technology tools and resources in classroom practice by answering the following research question: In what ways do teachers involved in a statewide technology integration initiative use technology in their classrooms during a cycle of AR?

Literature Review

Teacher Practices with Educational Technologies

Many studies have used surveys to examine teacher technology integration practices. These studies include surveys to determine the kinds of technologies and technology-related activities used in classrooms (Becker, 1991), surveys seeking to identify the practices of effective technology-using educators (Hadley & Sheingold, 1993), and studies comparing the practices of exemplary teachers with others (Becker, 1994). Survey research is still common strategy for studying teacher technology integration practices (Russell, Bebell, O'Dwyer, and O'Connor, 2003), and some studies are now looking at the relationship between practices and perceived student outcomes (Lei, 2010). Researchers have also used observations to study technology integration practices in many contexts, including at state (Dawson, Cavanaugh, & Ritzhaupt, 2008) and international levels (Kozma, 2003). Interviews and case studies (Cuban, Kirkpatrick, & Peck, 2001; Warshauer, 2008) also contribute to knowledge about teacher technology integration practices.

Taken together, these studies suggest the majority of classroom technology use involves Type 1 (Maddox & Johnson, 2006) or incrementalist uses (Schofield, 2002), in which technology makes traditional strategies—such as rote memorization, drill and practice, or lecture—faster, more efficient, or otherwise more convenient. Type 2 (Maddox & Johnson, 2006) or transformational uses (Shofield, 2002), in which teachers use technology in innovative ways that are authentic, purposeful, and supportive of higher-level thinking, are more infrequent but growing in number when comparing results of early studies to more recent ones.

This study takes a new approach to exploring teacher technology integration practices by analyzing data from AR projects.

Action Research

Action research, also known as teacher inquiry, is a strategy for systematic, intentional study practitioners' practice (Cochran-Smith & Lytle, 1993; Dana & Yendol-Hoppey, 2000; Hubbard & Power, 1993). In general, the process begins with teachers defining an inquiry question that emerges from their practice and developing a research plan for data collection through such mechanisms as journals, student work, interviews with students, and field notes. It also involves teachers analyzing this data in relationship to the question to develop a picture of their learning and taking action to implement what they learned. The process typically concludes with teachers sharing the results of their work with other professionals (Dana & Yendol-Silva, 2009).

AR is widely recognized as a powerful tool for professional development (Cochran-Smith & Lytle, 2009; Zeichner, 2003). It can 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, 1993; Meyer & Rust, 2003). Recent research suggests that AR is a vehicle through which teachers can systematically and intentionally study the ways that technology integration affects 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). This study used AR to examine the technology integration practices of teachers involved in a statewide initiative.

Context

Participating teachers were employed in districts receiving funds from a competitive statewide grant program. Districts had considerable autonomy to implement locally relevant plans aligned to the goals of improving teaching practices and influencing student learning. Thus, teacher experiences were dependent on the programs implemented in their districts. All participating teachers (559) from the districts received the opportunity to participate in an AR experience in which they received support from a trained AR coach to inquire about technology use in their classroom. All AR inquiries were related to using tools and resources provided through the initiative. Some teachers from all districts elected to participate.

Individuals that district leaders identified as competent technology-using educators served as AR coaches. AR coaches received synchronous training on the five stages of the Reflective Educators' Action Research protocol (Dana & Yendol-Hoppey, 2009) and on how to support others through the process. The five steps of the protocol include:

1. Identifying an inquiry
2. Identifying the context of their work
3. Developing a plan for answering their question through such mechanisms as classroom assessments, journals, student work, interviews with students, and field notes
4. Analyzing their data in relationship to their question
5. Considering the implications of their work

Coaches also had opportunities for just-in-time support through their coaching experiences.

The researcher introduced the AR opportunity to teachers in early September 2010, and coaches' training occurred during September and October. Teachers then complete an action research cycle between November 2010 and May 2011.

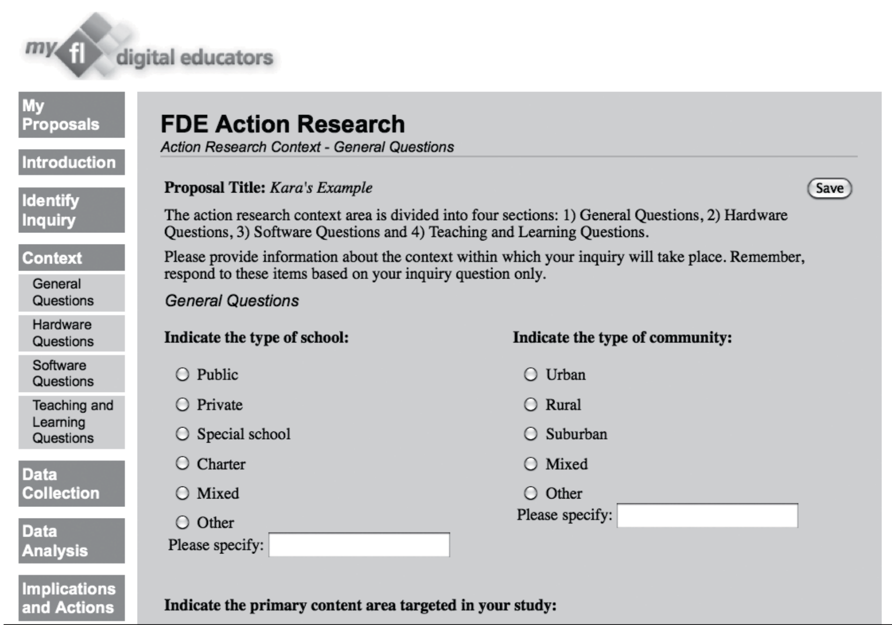

Figure 1. Online scaffolding and data collection tool.

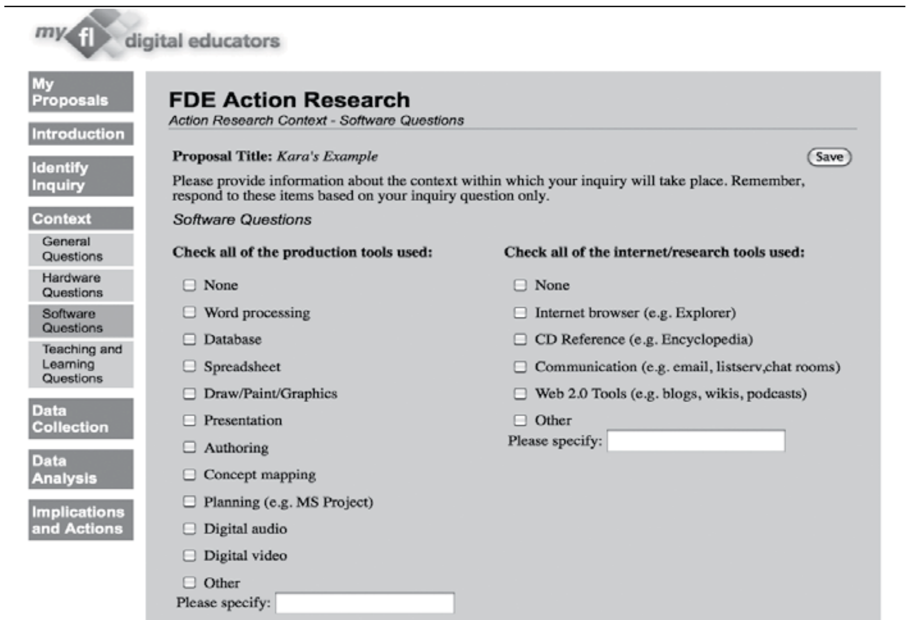

Figure 2. Example of checklist item derived from literature.

Methods

Participants

Three hundred fifty-three (353), or approximately 63%, of teachers involved in the statewide initiative voluntarily completed one AR project. The teachers were evenly divided among elementary, middle, and high school grades and had an average of 11 years teaching experience and 5 years experience teaching with technology.

Data Collection

Teachers provided information related to their AR projects through an online tool known as Action Research for Technology Integration (ARTI). See Figure 1 (Dawson, Cavanaugh, & Ritzhaupt, in press). Researchers developed this tool to collect similar data across teachers and scaffold the AR process for teachers and coaches. The Reflective Educators' Action Research protocol (Dana & Yendol-Hoppey, 2009) appears on the left side of

Table 1. Description of A Priori Categories

A Priori Category	Description	Format of Data Reviewed
Identify inquiry	Includes information about the inquiry question, the teacher's experience level, and the students involved	Mixed
Context	Includes information about general information about the inquiry, teaching practices, student practices, and technology used	Quantitative
Data collection	Includes information about strategies used to inform the inquiry	Quantitative
Data analysis/ findings	Provides space for teachers to report inquiry findings and uploaded artifacts to support them	Mixed
Implications	Provides space for teachers to share consequences of their participation in the inquiry process	Mixed

ARTI, whereas items related to each section appear on the right. When possible, items were structured using dropdown menus, radio buttons, and checkboxes. This enabled more uniform data collection across AR projects.

Items were strongly influenced by a technology and learning meta-analysis (Waxman, Linn, & Michko, 2003), research-based categories related to effective teaching (Ross, Smith, Albert, & Lowther, 2004; Ross, Smith, & Alberg, 1999), and categories of effective technology use (Lowther & Ross, 1999). For example, teachers were able to select from a checklist of commonly used technology tools and teaching practices derived from this literature. They were also given opportunities through open-ended textboxes to add information related to each item. See Figure 2 for example items.

Dropdown menus, checkboxes, and other structured format did not make sense for some items. For example, teachers reported their AR questions, findings, and implications through open-ended textboxes and uploaded artifacts to support their findings.

Coaches learned how to use ARTI during the abovementioned training, so they could support teachers in both conducting AR and understanding the items in ARTI. Coach feedback during the training session resulted in minor revisions to ARTI. Teachers created an account in ARTI to submit data, but names were not included in data downloaded for analysis.

Data Analysis

I analyzed data entered into ARTI using a template analytic technique of thematic analysis (Crabtree & Miller, 1999). Thematic analysis is the process of identifying themes of importance in describing a phenomenon (Miles & Hurberman, 1994), and the template analytic technique involves using a priori categories to structure initial coding (Crabtree & Miller, 1999; Fereday & Muir-Cochrane, 2006).

The first step in the analysis process involved organizing data into usable formats. Quantitative data were associated with numerical codes. For example, in Figure 1, I coded public schools with a 1, private schools a 2, special schools with a 3 and so on. I exported these codes into an Excel spreadsheet, then calculated frequencies and percentages for each item to summarize this data. I exported open-ended items into a Word document for qualitative coding.

Next, I created a priori categories structured around the Reflective Educators' Action Research protocol (Dana & Yendol-Hoppey, 2009) to guide analysis. Specifically, I organized data around the following categories (see Table 1):

- Inquiry Question
- Context
- Data Collection
- Data Analysis/Findings
- Implications

The a priori approach is particularly helpful when dealing with large datasets, and the a priori categories proved helpful in making sense of data from more than 350 teachers.

Once data were organized in a priori categories, I began a search for patterns careful reading and rereading of the data (Miles & Huberman, 1994). From this process, initial themes to describe teacher technology integration practices emerged. Some a priori categories proved more useful than others. For example, the Context section was the largest and most diverse a priori category, and it was further divided into information about teaching and learning, hardware and software, and environment. Conversely, the data within Data Collection provided interesting information about how teachers studied their practice but did not provide information related to their technology integration practices. Similarly, data within the Implications category was interesting but did not relate to the research question. Therefore, I did not include data from these two a priori categories in subsequent analysis iterations. The five themes presented below emerged from the data. Table 2 (p. 120) summarizes these themes and indicates from which a priori categories they emerged.

Results

Theme 1 (Content and Objectives): Classroom AR efforts occurred in many different content areas, but teachers were consistent in stating their main goal was for students to learn specific content.

Teachers conducted projects across content areas, and the core subjects of language arts (35%), mathematics (15%), and science (28%) accounted for 87% of the inquiries. More than 74% of the teachers stated a main objective for their inquiry was for students to learn specific content. For example, a fifth grade teacher studied the ways that the use of online resources contributed to greater depth within content-area writing. An eighth grade math teacher studied whether an online simulation would help lower-level students articulate and apply the concepts of volume and surface area. A science teacher studied whether having students create digital concept maps improved their ability to articulate the concepts of work and machines. Analyzing information, remediating skills not learned, and finding ideas and information were also frequently cited objectives. Communicating with others electronically was the objective teachers reported least often.

Table 2. Themes: Teacher Technology Integration Practices

Label	Theme	A Priori Categories
Content and objectives	Classroom action research efforts occurred in many different content areas, but teachers were consistent in stating that their main goal was for students to learn specific content.	Identify inquiry, Context
Audience	Students targeted by the AR efforts varied but included a large proportion of rural and minority students.	Identify inquiry, Context
Classroom implementation	Classroom implementation was divergent in terms of instructional strategies and student activities, but more than half the inquiries focused on a whole class of students.	Context
Hardware and software use	Teachers reported using an abundance of hardware, and although their software use varied considerably, uses of traditional applications were more common.	Context
Outcomes	Outcomes that teachers reported fell into three main categories: student learning, conditions that lead to learning, and instructional benefits of using technology.	Data analysis/findings

Theme 2 (Audience): Students targeted by the AR efforts varied but included a large proportion of rural and minority students.

The majority of the AR inquiries were conducted in rural settings (59%). More than 28% of these inquiries focused on Black or Hispanic students, whereas 31% focused on a mixed group of students and 38% focused primarily on Caucasian students. More than 79% of these efforts focused on students of lower-middle to low socio-economic backgrounds, and less than 1% of the efforts focused on upper-middle- to upper-class students. Inquiry questions frequently included references to supporting "low-level students" or "level 1 and 2 students."

Theme 3 (Classroom Implementation): Classroom implementation was divergent in terms of instructional strategies and student activities, but more than half the inquiries focused on a whole class of students.

Direct instruction was reported as the primary instructional strategy in 43% of the inquiries. In many cases, the computer provided direct instruction in the form of online tutorials, whereas 30% reported using drill-and-practice software for this purpose. Collaborative or cooperative learning was reported as the primary instructional strategy in 38% of the inquiries. Many inquiry questions referred to project-based learning activities where students were working together to create products or analyze information.

Student activities were similarly divergent. Hands-on learning was reported as the primary student activity in 33% of inquiries while 23% reported independent seatwork and 13% reported independent research. Over half the inquiries (61%) focused on a whole class of students.

Theme 4 (Hardware and Software Use): Teachers reported using an abundance of hardware, and, although software use varied considerably, uses of traditional applications were more common.

More than half the inquiries reported using more than nine classroom computers (56%), whereas less than 10% reported using three or fewer computers. Nearly 25% reported computer lab use or one-to-one access. Word processing (63%) and presentation tools (61%) were the most commonly used productivity tools, whereas authoring tools (12%) and databases (7%) were the least commonly used. Teachers reported using digital video (34%), digital audio (41%), draw and paint programs (31%), and concept mapping software (26%) in many of the inquiries. Eighty-three percent (83%) of the inquiries used Internet browsers, whereas 20% used Web 2.0 tools and 12% did not use the Internet.

Theme 5 (Outcomes): Outcomes that teachers reported fell into three main categories: student learning, conditions that lead to learning, and instructional benefits of using technology.

Teachers documented student learning outcomes in 23% of the inquiries. For example, a fourth grade teacher explored whether having her students use digital cameras and presentation software would improve her students' knowledge of geometric terms. Pre-assessment showed only 3 out of 18 students were proficient with geometric terms. Students then worked in cooperative groups to find examples of geometric terms around the school campus, take digital pictures, insert them into presentation software, and add labels and audio. After completing this project, all 18 students demonstrated proficiency with geometric terms on a traditional test.

Similarly, another fourth grade teacher used Glogster, a website for creating interactive posters, to help teach English language learners (ELL) about core concepts related to interdependence and food chains within an ecosystem. These ELL students had previously struggled with this concept, but after creating interactive poster presentations about the ways that interdependence and food chains relate to one particular species, they were able to pass the science assessment related to this standard.

Teachers reported conditions that lead to learning, such as student enjoyment, motivation, engagement, on-task behavior, or positive school experiences, in 24% of the inquiries. For example, a teacher working in a high-poverty school focused her inquiry on two low-performing students. She sensed their off-task behavior was the result of inability to read comprehension tests. Consequently, she used audio recording software and laptops to enable these students to both see and hear the questions. Figure 3 (which this teacher created) shows that these two students exhibited more on-task behaviors when allowed to use technology.

Benefits of technology such supporting repeated practice, providing instant feedback and supporting independent learning were document in 22% of the inquiries. For example, an elementary teacher targeted students struggling in reading by having them create podcasts of their reading. She charted fluency test scores (see Figure 4) and reported gains for all students.

1–5 Low–High	Pre-Test #1	Pre-Test #2	Post-Test #1	Post-Test #2
Willingness to take the test	1	1	5	5
Focus on the test	3 – staring off	3 – staring off	5 – very focused	5 – very focused
Avoidance behaviors during the test	3 – repeated attempts to use the restroom, sharpen pencils	3 – repeated attempts to use the restroom, sharpen pencils	5 – no avoidance behaviors	5 – no avoidance behaviors
Questions asked during test	5 – repeated requests to read questions to student	5 – repeated requests to read questions to student	1 – asked no questions	1 – asked no questions
Completeness of the test	4 – left the extended response questions (ones that require more reading) blank	4 – left the extended response questions (ones that require more reading) blank	5 – completed the whole test	5 – completed the whole test

Figure 3. Teacher-created artifact displaying on-task behavior.

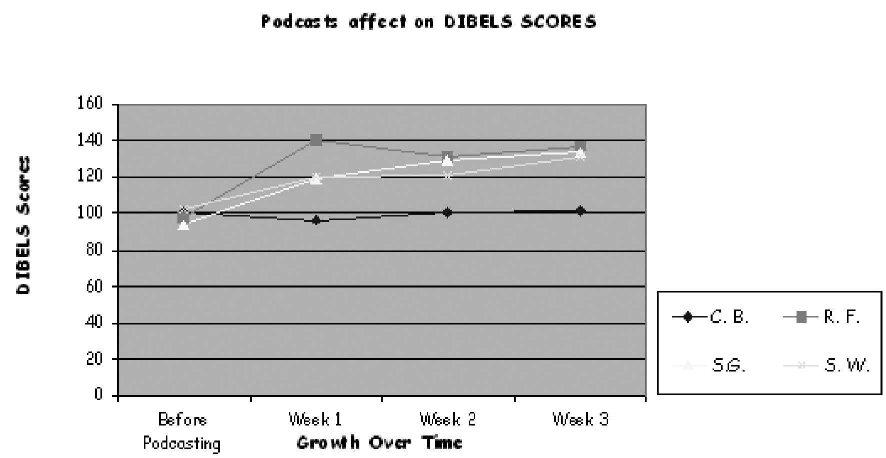

Figure 4. Teacher-created artifact displaying fluency scores.

Discussion

Summary of Results

This study examined technology integration practices using AR projects from teachers participating in a statewide technology integration initiative. Thematic analysis yielded five themes. Data within the first theme (content and objectives) show that teachers at elementary, middle, and high school levels participated equally and that most of these teachers focused on using technology to help their students master content objectives. The importance of content within successful teaching and learning is certainly not new (Schulman, 1986), and scholars within major content areas, including mathematics (Lederman & Niess, 2000), social studies (Mason et. al., 2000), English (Borsheim, Merritt & Reed, 2008), and science (Kim, Hannafin & Bryan, 2007), have noted the importance of using technology to support interaction with and learning of content. This finding refutes arguments that most teachers view technology as a separate subject area removed from the core content areas (Oppeneheimer, 2003; Healy, 1998).

Presenting to and communicating with others were the objectives that teachers reported most infrequently within the AR projects. It is possible that, although teachers used technology to facilitate content area learning, they may not fully embrace the current participatory culture, which relies on digital communication, personal and social creation, digital dissemination of ideas, and digital collaboration and engagement (Jenkins, 2006).

The second theme (audience) showed that teachers in the initiative used technology to target rural, minority, struggling, and/or lower-socioeconomic-status (SES) students. The emphasis on lower SES students within this initiative is particularly positive, given a recent trend analysis showing a clear digital divide between high- and low-SES schools (Hohlfied, Ritzhaupt, Barron, & Kemker, 2008). Likewise, the emphasis on rural schools is important to note, given the well-documented relationship between geographical location and lack of digital opportunities (Warren, 2007). These results suggest that when teachers are provided opportunities to integrate technology, they often do so to support a range of students. However, this study did not explore whether the strategies used with rural, minority, struggling, and/or lower-SES students were markedly different from strategies used with other types of students. This will be important to study in the future, because research suggests teachers often use technology to support lower levels of technology integration with such populations (Weglinsky, 2005).

Data within the third theme (classroom implementation) mirrors the nature of previous studies, in that teacher practices varied considerably (Kozma, 2003; Lei, 2010). These data were particularly difficult to decipher because of their dichotomous nature. Some teachers reported direct instruction as their primary instructional strategy, whereas others emphasized collaborative learning. Similarly, some teachers reported hands-on learning as the primary student activity, and others reported independent seatwork. It is impossible to definitely deduce why this is the case, but the fact that teachers typically choose to explore AR topics central to their teaching (Dana & Yendol-Hoppey, 2009) leaves open several possibilities. First, the dichotomy may represent variations in how teachers perceive teaching and teaching with technology. Beliefs about teaching and teaching with technology play a central role in integration (Ertmer, 1999; Hew & Brush, 2006), and different beliefs result in different implementation (Ertmer & Ottenbreit-Leftwich, 2010). Second, the dichotomy may represent variations within instructional goals. The majority of inquiries sought to improve content knowledge, but it is unclear what type of knowledge was targeted. It is possible that teachers selected strategies aligned to instructional goals, many of which might have involved knowledge acquisition or memorization skills supported through direct instruction and seatwork. Third, it seems plausible that these instructional choices represented the stages of technology integration at which teachers were operating when the AR began (Sandholtz, Ringstaff, & Dwyer, 1997). Typically, teachers new to technology integration begin by using it as a substitute for teacher-centered strategies such as direct instruction and seatwork. Over time (Hadley & Sheingold, 1993; Becker, 1994; Ertmer & Ottenbreit-Leftwich, 2010), they progress to more student-centered uses, such as collaborative and hands-on learning. Finally, it may be that these divergent patterns of practice are based on student population. It will be important to compare technology integration practices within AR projects focused on lower-SES and minority student with those focused on other students.

Data within this theme also suggests teachers may not necessarily meet the needs of all students because of the large percentage of AR projects that use technology in a whole-class setting. It is unlikely that the needs of all students will be met during instruction that involves all students within a class. Thus, during these AR projects, teachers may not have capitalized on the power of technology to support the needs of individual learners (Tomlinson, 2001; Hipsky, 2008).

Data within the fourth theme (hardware and software use) paint a picture of teachers with adequate resources using a range of tools and applications. More than half the teachers reported using more than nine classroom computers during their inquiries, and resources are key ingredients in successful technology integration (Hew & Brush, 2006).

Likewise, the teachers used a wide range of productivity software within these inquiries. Word processing and presentation software were among the most common, but the relatively high use of digital audio and video suggests teachers are using more advance multimedia features as well. Similarly, Web browsers dominated Internet use, but there was evidence of Web 2.0 use. It is plausible to interpret from this finding that some districts are beginning to figure out how to provide access to these tools while maintaining a safe learning environment for students and that some teachers are beginning to grasp the creative, collaborative, and communicative potential of such tools.

Data within the fifth theme (outcomes) may be the most interesting in that selected anecdotes demonstrate the potential of technology to positively influence classroom-based learning. Although this article provides only four examples, ongoing research is focusing on the findings and types of supporting artifacts that teachers submit. This will provide insight into how teachers define and measure student learning in their classrooms. In addition, ongoing research is exploring the technology integration practices teachers reported within their AR projects in greater depth. This work will provide more detail about the types of practices they employed and, in particular, will provide examples of Type 1 or incremental uses of technology and Type 2 or transformational uses of technology (Shofield, 2002; Maddox & Johnson, 2006) that teachers participating in a technology integration initiative employed.

Implications for Technology Integration Initiatives and Research

The autonomous nature of district implementation makes it difficult to determine exactly why the results occurred, as each district organized its own professional development opportunities and strategies to support teachers. But it is fair to assume that enabling factors mandated for all districts, such as time, support, and professional development, contributed to the results. The high level of participation (63% of teachers involved in the statewide initiative), as well as the fact that all AR projects examined tools and resources that the initiative provided, makes it plausible to connect these results to the statewide initiative.

As such, this study provides implications for this specific initiative. Results of this study suggest that future iterations of this initiative will benefit from explicit attention to differentiated instruction, use of advanced technology tools, the potential of technology as a communications tool, and increased focus on student-centered technology integration practices. There are also implications for district and school leaders who could use AR projects completed by their teachers to guide technology and professional development planning.

This study also has implications for similar initiatives. It provides evidence that conducting AR projects with the support of trained coaches is a viable strategy to study teacher practices during technology integration initiatives. Although the results presented here do not provide fine-grain details about technology integration practices, they do provide a macro-level picture of practices across more than 350 teachers within 16 districts. From these results, a micro-level analysis could reveal other interesting trends. For example, future studies might examine differences in technology integration practices across content areas or grade levels. They might also look at differences in practices focused on certain types of students or using different technology tools. Such analysis could provide rich details of exemplary (and possibly not so exemplary) practices.

Implications for Merging Research and Professional Development

Educational research is often viewed as something done to teachers instead of something in which they are actively involved (Dana & Yendol-Hoppey, 2009). Unlike other strategies for documenting technology integration practices, AR directly involves and provides direct benefits to teachers and researchers. AR is often credited with improvements in teaching practices, changes in beliefs and attitudes, and renewed feelings of professionalism (Cochran-Smith & Lytle, 2009). There is evidence that many of these teachers experienced such benefits from their AR experiences (Dawson, Ritzhaupt, Liu, Drexler, Barron, Kersaint, & Cavanaugh, 2011).

For researchers, this strategy provides an opportunity to study technology integration practice across multiple classrooms. The classroom is where concrete instructional changes occur, and whether or not researchers are studying a statewide initiative or local professional development, teachers interpret what they learn and what they are encouraged to do through the lens of their classroom practice (Darling-Hammond, 2010; Lincoln & Guba, 1986). Therefore, understanding such practices can improve and guide preservice and inservice education (Bull, Knezek, Roblyer, Schrum, & Thompson, 2005; Schrum et. al., 2005; Dawson, 2006). Given the ever-changing nature of technology and what it can afford for teaching and learning, it may be ideal for teachers to engage in regular cycles of technology integration AR and for researchers to study the ways their classroom practices change over time.

Conclusions

This study examined the technology integration practices of teachers involved in a statewide initiative via one cycle of AR. It differs from other studies of teacher technology integration practices because it simultaneously involves and provides direct benefits to teachers and researchers. The study uses thematic analysis to provide a macro-level view of the technology integration practices of more than 350 teachers within 16 districts. Specifically, it reveals the content and objectives, audience, classroom implementation strategies, hardware and software use, and outcomes associated with technology integration. In some cases, results mirror those of previous studies, whereas in other cases, they refute literature in the field—particularly literature suggesting that most teachers view technology as a separate subject (Healy, 1998; Oppenheimer, 2003) and that technology-enriched opportunities tend to be reserved for high-achieving and higher-SES students (Hohlfield et. al., 2008). Analyzing data from various perspectives can contribute to what we know about technology integration practices. Additional research using the methods presented here can also help build on what we know about teacher technology integration practices.

Author Note

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