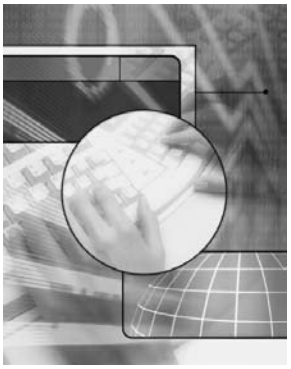

Reflecting on the Affordances and Constraints of Technologies and Their Impact on Pedagogical Goals

Joseph R. Freidhoff

Abstract

Teacher educators must examine how technology selection facilitates and constrains the learning outcomes of the courses they teach. This article introduces a process for selecting and evaluating technologies that meet the important principles of each learning task. As an example from his own practice, the author details how he used the process to evaluate two technologies—discussion boards and blogs—as potential technologies for teacher reflection and to assess whether implementing blogs as part of a semester-long teacher education course yielded evidence to support his evaluation. These findings speak to both the potential and difficulty of developing sustainable practice.

Integrating technology is complex both in theory and in practice. Theory casts technologies as non-neutral tools (Bromley, 1998; Bruce, 1993; Mishra, Spiro, & Feltovich, 1996) used by teachers for specific purposes—an interactive process that reflexively affects both the participants and the desired outcomes (Burbules & Callister, 2000). Because of such interactivity, researchers increasingly view technology selection not as an inert decision, but as one where the intersections of technology, pedagogy, and content must be carefully considered (Koehler & Mishra, 2008; Mishra & Koehler, 2006). In practice, such consideration is complicated by the rate of change in new technologies where technologies evolve rapidly and newer technologies are created (Leu, 2000). As a result, teacher educators must perpetually examine how technology selection facilitates and constrains the intended learning outcomes of the courses they teach.

This article introduces a three-step process for selecting a technology that best fits a learning task and for evaluating whether the chosen technology served its intended purpose. The three steps are: identifying principles of the learning task to be supported by technology, evaluating the affordances and constraints of specific technologies against these principles, and assessing technology implementation by instantiations of the principles in practice. To illustrate this process, the author shares how he evaluated two technologies—discussion boards and blogs—as potential technologies for reflective writing and how he assessed whether implementing blogs as part of a semester-long teacher education course yielded evidence to support his evaluation.

Step One: Identifying Technology Pertinent Principles

The first step of the process is to identify principles of the learning task to be supported through the affordances of technology. These principles are not synonymous with the learning outcome, but rather are the attributes of the task that might benefit the most from technology use. An example of a typical learning task in teacher education is reflection.

Teacher education coursework frequently attempts to foster and assess reflective habits in preservice teachers (e.g., Mansvelder-Longayroux, Beijaard, & Verloop, 2007; McIntyre, Chatzopoulous, Politi, & Roz, 2007; Segall & Guadelli, 2007). Teacher educators view reflective tasks as significant for a variety of reasons. For example, some argue that with the increasing heterogeneity of the K–12 student population (National Center for Educational Statistics, 2000) teacher education programs must assist preservice teachers to examine their beliefs about students. Others favor reflection as a strategy for challenging the a priori beliefs beginning teachers hold about learning and pedagogy. Whether for these reasons or others, teachers educators tout reflection as a mechanism for professionals to rethink experience in order to improve practice and reform education (Richardson, 1990, 1994; Schön, 1983).

Though technology may help instructors develop reflective practitioners, it does not do so in a generic manner. Therefore, rather than having the mindset that technology will impact the learning outcome directly, it is advisable to focus on selecting technologies that address specific principles of the learning task. In the example of teacher reflection, a review of the literature suggests that teacher reflective practices should be *individually sustainable*, but should emphasize *interconnectedness with other teaching professionals*. These two principles might be targeted as areas where choice of technologies could impact learning outcomes.

Reflection as an Individualized Practice

Teaching historically has been a personal and isolated practice (Jackson, 1986; Lortie, 1975). Similarly, Pugach and Johnson (1987) argue that a common theme of reflection literature is its portrayal as a "personal and isolated act that typically occurs while teachers engage in their craft within the classroom" (p. 186). This view of reflection as an individualized practice mirrors preparation in teacher education programs that have traditionally focused on the development of knowledge, skills, and dispositions in prospective teachers rather than on the socialization and establishment of communities for collaborative participation (Putnam & Borko, 2000). Given these historical tendencies and practical constraints, the technologies in which reflective practices are situated should emphasize affordances that focus on the individual.

Reflection as a Social Practice

Despite a history of isolation and personal practice, educational reformers have tried to alter these norms through increased interaction and collaboration (Little, 1990) and through attempts to create communities of practice (Lave & Wenger, 1991; Wenger, 1998). Thus, a second component of teacher reflection is the need for it to be a social practice that emphasizes interconnectedness with other teaching professionals. Zeichner (1996) notes that neglecting to reflect upon the social conditions in which teachers work can lead teachers to "see their problems as their own, unrelated to those of other teachers or to the structures of schools and school systems" (p. 205). This is concerning as it may lead to increased self-blame and high teacher attrition rates whereas more social,

collaborative forms of reflection might lead to more complex understandings and reduced feelings of inadequacy. Furthermore, social forms of reflection may lead to increased agency. Zeichner (1992) writes that "the empowerment of teachers as individuals is considered inadequate and the potential for institutional and social change is considered greater, if teachers see their individual situations linked to those of their colleagues" (p. 167). Pugach and Johnson (1987) see peer involvement as a necessary component of reflection to push each individual's thinking beyond personal limitations. Finally, drawing from the social theory work of Mead (1934), Cinnamond and Zimpher (1987) charge that individuals have a social responsibility to their communities to "engage in dialogue with the community of which they are a part and to bring about change through their intervention" (p. 63).

Step Two: Evaluating Potential Technologies

Having identified principles of the learning task to be supported through technology use, the next step is to evaluate technologies in terms of the affordances and constraints they offer. Ideally, the goal is to select technologies whose affordances possess the strongest traits necessary to satisfy the principles while simultaneously attempting to minimize constraints that might adversely affect intended results.

Discussion Boards

Recent research on preservice teacher reflection suggests that some teacher educators are choosing writing in online discussion forums as a pedagogical strategy and technological environment for developing reflective habits (Levin, He, & Robbins, 2006; Paulus & Roberts, 2006; Ruan & Beach, 2005). Given the prevalence of Course Management Systems (CMS) such as Blackboard or ANGEL at the university level (Market Data Retrieval, 2005) and the range of tools they make available—attendance taking, electronic gradebooks, e-mail, content folders, drop boxes, discussion boards, etc.,—they possess many affordances that are attractive for educators. From an instructor's point of view, they are relatively easy to set up. Students are often automatically enrolled in course sections. Required logins allow instructors some safeguarding of intellectual property and privacy while simultaneously allowing students access to course content, grades, and participation structures. Structures such as discussion boards expand the audience so that writers can receive feedback from more than just the instructor. Thus, the apparent advantages of CMS discussion boards are that (a) students already have access to them, (b) students can use them to be successful on course assignments, and (c) they expand the audience to include other students in the course.

At first appraisal, CMS discussion boards appear to offer attractive attributes for assisting preservice teachers to develop reflective habits. However, there are four technological constraints that seem to outweigh these affordances. These constraints are cost, control, continuity, and community.

The first major constraint is cost. Universities, thus far, have been willing to finance the cost of Course Management Systems; however, many K-–12 school districts are not willing to or are not capable of paying these costs. Rather than banking on preservice teachers entering districts where specific commercial software is available, assuming that teachers can acquire funding to purchase software through school funds or grants, or expecting teachers will pay for software out of their own pockets, teacher educators need to consider technologies that are freely available through the Internet. Although free, open source CMS such as Moodle (http://www.moodle.org/) exist, the financial costs are replaced with the increased opportunity costs of finding a server to host the software, downloading it, and maintaining the system. These costs threaten individual sustainability beyond the immediate course. One way to maximize the likelihood that preservice teachers can sustain their habits developed through university coursework is by utilizing free-web based applications whenever possible.

A second constraint worth pondering is control. Rather than placing control in the hands of each individual student, CMS privilege instructors. Instructor control is evident in how space is configured, how permissions for individuals are granted and for how long, and how new content such as discussion boards are created. In addition to course instructors, universities themselves can act as controlling mechanisms by making access to CMS contingent on enrollment. Because most of the management decisions for the environment are outside of the hands of the student users, the prospects of long-term sustainability seem scant. Reflective tools must allow users the autonomy and flexibility to meet their individual needs and contexts.

Continuity is the third constraint of discussion boards and refers to how writing is organized. The affordances of discussion boards allow individuals to post new writings in the space as well as reply to each other's writings. This threaded design of arranging posts in discussion boards privileges topic continuity. In doing so, it fractures individual student's writings across different areas of the board and, over the course of a semester, across multiple discussion boards. This organizational structure creates problems for individually-sustainable reflection. Because an individual's writings are scattered about—both within a course and across courses—students may have greater difficulty in monitoring their own thoughts over time and making connections across topics. This could inhibit them from recognizing consistencies or inconsistencies in their beliefs, thoughts, and experiences that could become fruitful fodder for reflection. A technology that aggregates individual's writings in a single, self-controlled space, but that also facilitates the sharing of this writing with others would be more congruent with the identified principles of teacher reflection.

A final constraint worth mentioning is that while discussion boards facilitate collaboration and communication among students in a course, they simultaneously inhibit pertinent outsiders from participating in these communities. In addition to limiting who can enter conversations, discussion boards also restrict the flow of content out of the course's confines. Outsiders interested in participating in the discussion boards cannot do so without *instructor* permission, nor can students readily share their discussion board writings with people outside the course. Thus, the affordance of creating a course environment limits its possibilities for students to use it in other communities of their choice. Instead, reflective technologies should allow users to easily share their work with multiple audiences and communities.

In sum, though discussion boards offer appealing affordances, they seem less desirable when evaluated as individually-sustainable environments capable of emphasizing interconnectedness with other teaching professionals. For some learning tasks, this might be acceptable. However, the affordances and constraints of discussion boards become problematic when considered from the identified principles of teacher reflection. Put simply, discussion boards are the wrong tool for reflective writing. Teacher educators must embed the reflective practices of coursework within digital environments that are individually sustainable and that facilitate the sharing of writing with other colleagues.

Alternative Options

In thinking about individually sustainable technologies that might be available to preservice teachers in their future classrooms, one must consider free Internet-based tools. As of 2005, virtually all public schools in the United States had Internet access including 94% of all public school instructional rooms with an across-school range between 88 to 98 percent (Wells & Lewis, 2006). Additionally, as of March 2007, 70% of college graduates reported having broadband Internet access at home (Horrigan & Smith, 2007, June). Whether at work or at home, it is likely preservice teachers will have access to the Internet when they graduate.

In addition to individual sustainability, digital reflective tools should facilitate collaboration and communication. The affordances of Web 2.0 tools, namely the ease with which individuals can create, share, and organize text and media, have allowed individuals to collaborate and communicate in new ways and on an unprecedented scale (Alexander, 2006, March/April). Modern phenomenon of individuals collaborating en masse include wiki projects such as Wikipedia (http://www.wikipedia.com/), social bookmarking and folksonomic tagging sites such as del.icio.us (http://del.icio.us/), and social networking sites like MySpace (http://www.myspace.com/) and Facebook (http://www.facebook.com/). A Web 2.0 tool that teacher educators should consider for reflective writing is blogs. The argument below is not specific just to blogs, but could be adapted to other Web 2.0 technologies, though one should carefully examine the specific affordances and constraints of any technology in question.

Blogs as a Web 2.0 Example

Blogs, short for weblogs, are Web sites that usually focus on a particular topic, include postings in reverse chronological order, and allow readers to post comments directly on the same page. A key feature of blogs that makes them different from most Web pages is that blogs have RSS (Really Simple Syndication) feeds, which permit people to subscribe to them using an aggregator (e.g., http://www.google.com/reader/ or http://www.bloglines.com/). This feature allows a person to monitor changes on multiple blogs by accessing only a single site—similar to a person checking her e-mail inbox. Because blogs are Web-based, no special software is needed, and currently there are multiple sites that allow people to host their blogs for free (e.g., http://www.edublogs.org/ or http://www.blogger.com/).

Statistics demonstrate that blogging is increasing at a phenomenal rate. As of April 2007, Technorati, a leading blog search engine monitoring over 70 million blogs, calculated that 120,000 new blogs were being added daily along with 1.5 million new posts each day (Sifry, 2007, April 05). Recent reports from the Pew Internet and American Life Project estimate 87% of 12 to 17-year-olds are online (Lenhart, Madden, & Hitlin, 2005, July 27, p. 1). Of this online age group, 19% maintain their own blogs and 38% read them (Lenhart & Madden, 2005, November 2, p. 2). These researchers reported that an even higher percentage, 25%, of girls ages 15 to 17 keep a blog (p. 3). Given that the current population of teacher education candidates tend to be overwhelmingly female (Zumwalt & Craig, 2005), these findings suggest a significant number of students being admitted into colleges of education across the U.S. will already possesses some familiarity with blogging.

Blogs as Reflective Technologies

Blogs are technologies whose affordances emphasize individual sustainability and facilitate the sharing of content with larger audiences. Individual control is noticeable in the way that blogs are set up and personalized, and the way content is managed and organized.

In contrast to CMS where instructors create discussion boards and invite students to participate in these spaces, blogging requires that each student goes through the process of registering and setting up a personal blog. Such a process encourages students to exercise their personal control by allowing them to select from several potential sites to host their blog (e.g., Blogger (http://www.blogger.com/), Edublogs (http://www.edublogs.org/), or WordPress (http://wordpress.com/). Because blogs belongs to individuals, users choose from themes that govern font sizes, font color, background color, etc., which personalize the space for users, but which also controls how other users view it. While CMS often have themes, these themes only change the individual's view; they do not govern how other users view another's work.

This personalization feature also allows individuals to manage what information they make available through their public profiles, whether they make their blogs public or private (or in the case of certain blogging services, such as Edublog or WordPress, whether individual posts are public or private), and whether the content of their posts is made available through search engines. Whereas the writings of students in CMS are password-protected and course-restricted regardless of student preference, blogs let users control the degree to which their writings are made available to the public.

Blogs also represent a solution to the problem of student writing being fractured across discussion board postings. Instead of posting in multiple discussion boards, blogs permit writers to keep all of their writings in their own space. This cohesive repository of one's writings may help students monitor their own thoughts over time and make connections across topics, while at the same time increasing their feelings of ownership.

Because their work is in one space, bloggers usually rely on folksonomic tagging as an organizational strategy. Folksonomic tagging refers to user-generated or community-agreed upon labeling of posts ("Folksonomy," 2007, July 20). Bloggers can tag or label each of their post under one or multiple tags and can then search through their blog using these tags as keywords. For educational purposes, it would be feasible for an instructor to require students to post work for a class under a specific tag in order to help identify which of the posts pertain to the class. The flexibility in the tagging structure makes it possible for the student to host their writings for multiple audiences in a single space, but yet still clearly identify which may be of interest to the different groups.

Even though blogs favor individual control and space, they also have affordances that facilitate collaboration and communication. The obvious example of this is the commenting function. Users can decide whether they would like to allow others to comment to their posts. (This is another example of individual control). Readers can compose responses directly on another's blog by typing in a textbox on the post's site. Or, by using features such as "ping-back," "trackback," or "backlinks," bloggers can create posts on their own blog that also shows up in the comment section of another's post. This feature is important because it provides the technological capacity for giving and receiving feedback to and from others who read the blogs.

Another technological feature of blogs that indirectly facilitates reading and the construction of micro-communities is the presence of an RSS feed. RSS feeds (the RSS stands for Really Simple Syndication) are file formats that contain the content portion of pages while stripping away the formatting language. One advantage is that the file size is greatly reduced. More importantly, each time the page is changed, the RSS feed is updated to reflect those changes. Technologies called aggregators (e.g., http://www.bloglines.com/ or http://google.com/reader/) can be used to monitor RSS feeds. Aggregators allow the user to specify which feeds to monitor and automatically pulls the content from the feeds into the aggregator without the user needing to go to each blog. Furthermore, each time one of the feeds is updated, the aggregator will pull in the new content and mark it as unread. The beauty of this partnership is that whereas one would need to go to each individual web page or discussion board to see if people published new content, one need only login to her aggregator account to view which blogs were updated since her last check. Aggregators also allow for organizing the feeds into folders or to tag them so that groups of related feeds can be easily identified.

Though blogs feature many affordances that make them intriguing options as digital reflective writing environments, they are not without their share of constraints. To a large extent, these constraints are the flipsides of transitioning control from instructor to student and moving from semi-private to more public forms of writing. One constraint is time. A teacher educator can create a discussion board in a matter of minutes if not seconds, and students can be granted permission to

access this space in just as little time. However, helping each student in a course set up an individual blog and an aggregator account so that they can subscribe to each other's writings can take a substantial amount of time and energy for instructor and student alike.

More time and energy may also be spent on creating assignments and grading them. Because students can submit assignments through their blogs, their responses, and often the prompts themselves, are readily available to other students in the same course as well as to students who enroll in future courses. This suggests that certain kinds of assignments—open ended, essay or short response—may be better suited for blogging environments and that these assignments must be carefully reconsidered each semester.

Critics of blogging have also offered the notion of greater public visibility and tracking as a drawback of blogs. For example, an article in the Chronicle of Higher Education featured a discussion surrounding a professor that may have missed out on tenure because of his blog ("Can blogging derail your career? 7 bloggers discuss the case of Juan Cole," 2006, July 28). Some teacher educators are leery, and rightfully so, of having students post in environments that are not password protected. In addition to concerns over privacy issues, the potential exists for students to post content that reflects negatively on the student, the instructor, and the university. While these are legitimate concerns, the reality—as demonstrated by the blogging statistics cited above—is that students entering colleges of education (and their future students) are already reading and writing in these spaces, and the percentages are only projected to increase. Use of blogs in teacher education coursework affords instructors the opportunity for teachable moments regarding public versus private representations, lasting digital footprints, and ethical responsibilities of new outlets for individual expression. Constructing experiences for preservice teachers to struggle with these issues first-hand in a professional manner may be beneficial both to the student and to the instruction of their future students.

In sum, blogs offer affordances that adhere more tightly to the recommendation that reflective tools be individually sustainable while simultaneously facilitating the sharing of writing with larger communities. Also, the constraints that accompany them appear acceptable. Teacher educators should seriously consider blogs when assigning reflective writing tasks to preservice teachers.

Step Three: Assessing Technology Implementation

While the above examples demonstrate a process for selecting among potential technologies, the question of how to assess a technology after implementation remains. Traditionally, researchers have asked, following the example of reflective writing above, if the use of a specific technology leads to increased incidences (or increased complexity) of reflective writing. Such a question, however reverts to thinking of technology as a neutral tool and ignores the effects of the interplay between technology, pedagogy and content (Koehler & Mishra, 2008; Mishra & Koehler, 2006). For example, the absence or presence of reflective writing evidence may be more of an indication of the content and pedagogy of a course and less about the technology. Furthermore, assessing a technology, in the case of the reflective writing example, on the basis of reflective writing artifacts often misconstrues the reason the technology was selected in the first place. The rationale for selecting blogs, in this instance, was not because of a belief that they would increase incidences of reflective writing or lead to deeper levels of reflection. Rather, blogs were selected because they seemed well-suited for supporting two principles of teacher reflection. Thus, a more appropriate assessment of using blogs as reflective technologies is to look for evidence that individual students were capable of sustaining their blogs once a course ended.

During the spring 2006 semester, the author taught an undergraduate content-area literacy course at a large public university in the Midwest. Eighteen females and six males from disciplinary backgrounds including art, biology, history, physical education, math, music, and the social sciences were enrolled. Based on the arguments above, the author decided to have students create and maintain their own blogs using Edublogs (http://www.edublogs.org/), a free blog-service designed for educators and teacher researchers. To facilitate reading the posts of other students in the course within a single, convenient setting, both the instructor and the students registered for individual accounts through Bloglines (http://www.bloglines.com/) and used these accounts to subscribe to each other's blogs. They also subscribed to other blogs or Web sites of professional and personal interest.

To evaluate whether the use of blogs yielded the anticipated results, two related criteria needed to be satisfied. First, preservice teachers needed to show signs that they were writing for public audiences by creating posts on their blogs that were not password-protected. Second, to evaluate whether the technology was sustainable by individuals, preservice teachers needed to continue to create these posts after the course ended when there was no institutional requirement to do so.

Each preservice teacher's blog was reviewed eight months after course completion to see if they continued to use their blogs once the course ended. The eight-month follow-up revealed four students had produced 33 writings since they had completed the course. These results indicate that the conceptual reasons for choosing blogs because of their affordances of individual sustainability and writing for larger audiences were being realized, at least in part, in terms of student action.

An additional important finding, though perhaps somewhat predictable given the situated nature of learning (Brown, Collins, & Duguid, 1989) and the influence of content and pedagogy, was that the types of writings the preservice teachers produced of their own accord mirrored the forms of writing that were required as part of coursework. During the course, students engaged in writing assignments organized into four categories: *Class Readings,* critiques of assigned readings; *Personal Reading,* critiques of personally-selected readings; *Personal Comments*, responses to classmates' posts; and *Tutoring Reflections*, writings about their experiences tutoring in an urban middle school. Interestingly, a few preservice teachers sustained writings similar to three of the four categories—Class Readings, Personal Readings, and Tutoring Reflections—after the course ended.

For example, one student created posts similar to the Class Readings from the course. In these cases, the student blogged about readings assigned from a subsequent semester even though he was not required to do so as part of that course. This same student also composed posts after the course that were analogous to the course's Personal Readings in that they were personal responses to articles he was reading for his own professional development. In a different form of professional development, two other students spent their summers working in an urban summer teaching program and utilized their blogs to capture their experiences and thoughts about the internship. These writings paralleled the course's Tutoring Reflections assignments where students were required to produce weekly reflections on tutoring in urban middle schools. These findings suggest that the course's marriage of technology, pedagogy, and content led some students to sustain their writing habits beyond the boundaries of the course.

Although there were positive signs of students sustaining types of writing introduced in the course, there was also a prominent absence. The one required category of writing that was not present in the preservice teachers' writings after the course ended was writings in response to classmates' or other individuals' postings. Given the importance of community feedback to the reflective process and the amount of time students spent posting responses to classmates during the semester, it was discouraging to find

no evidence of this occurring once the course was complete. Even though students posted 33 entries, none provided feedback to a classmate, nor did any blogger outside the class community leave any comments. It cannot be concluded, however, that the writings shared were not read by a larger audience. In fact, a summer follow-up survey completed by 13 students indicated that seven still used the accounts they set up during the semester to read posts. Regardless of readership, the fact that these students were not encouraged and helped by others to rethink their experiences limits some of the reflective benefits of writing in a more public space.

Unsatisfying as this finding was, it was not a constraint of blogging technologies per se, but rather points toward the difficulty of constructing communal spaces. Grossman, Wineburg, & Woolworth (2001) use the term "pseudocommunity" to describe the tendency for people in groups, such as university courses, to do what is social expected of them for reasons other than the communal good. For example, the purpose of having preservice teachers comment on each other's blogs was to establish a supportive community. Individuals, on the other hand, can give the impression of buying in to the community by commenting on each other's blogs even though the real motivating force may be to get credit for the assignments.

As Grossman, Wineburg, & Woolworth found, moving from pseudocommunity to community takes a substantial amount of time and effort, perhaps more than is possible within a semester course. The implications for teacher educators is that while the desire to create a safe communal atmosphere as part of an individual course is natural, attention needs to be paid to helping preservice teachers establish communities of practice that transcend the course level and timeframe. Here again, the affordances of blogs with their individual sustainability and flexibility for constructing multiple communities seem to offer an advantage over tools such as discussion boards.

Conclusion

Integrating technology into the classroom can simplify routine teaching tasks. As many teacher educators can attest, Course Management Systems (CMS) often help instructors maintain attendance records, distribute and collect course content, and grade student performance. However, as with any technology, CMS are also fraught with constraints. While these constraints may have little impact on management tasks, other pedagogical outcomes may be adversely affected by the constraints of CMS technologies. Teacher educators need to be sensitive to the ways in which technologies support or undermine learning tasks. Because technologies vary in terms of the affordances and constraints they offer, careful consideration is needed when partnering technologies with learning tasks.

This article introduced a three-step process to assist teacher educators in selecting and evaluating technologies, and it demonstrated how a teacher educator enacted the process in his own practice. The three steps included identifying principles of the learning task to be supported by technology, evaluating the affordances and constraints of specific technologies against these principles, and assessing technology implementation by instantiations of the principles in practice. When this process was applied to the task of teacher reflective writing, the constraints of discussion boards appeared to threaten preservice teachers' ability to maintain their writing habits within these environments beyond the scope of a single course as well as to limit the audiences with whom students could easily share their work. In contrast, the affordances of blogs were found to be more accommodating to the demands of teacher reflective writing principles.

As teacher educators strive to integrate technologies into their courses, they must ironically focus more attention on technologies that assist students outside of them. Though courses are designed to end, the habits and skills sets promoted within them are often meant to be sustained by students. In constructing learning experiences, teacher educators must create curriculums that provide sustained practice using technologies across university coursework and embed these practices within tools that are sustainable in the environments in which these future teachers will be working.

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Joe Freidhoff is a doctoral candidate in Educational Psychology and Educational Technology at Michigan State University. He is currently completing his dissertation research on the online activities of preservice teachers and their instructors.

Joe Freidhoff
Michigan State University
College of Education
401 Erickson Hall
E-mail: freidhof@msu.edu