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ABSTRACT

Besides a host of technical and logistical questions, more subtle issues, related to teachers' pedagogical visions and beliefs, as well as their perceived confidence for using technology, are also known to impede meaningful classroom technology use. Assuming that most designers and staff developers are fairly well prepared to provide technical skills training for teachers who want it and are prepared to learn from it, this paper focuses on how designers might work with teachers who either don't want training or are not prepared to learn from it-or both. The paper emphasizes the role that teachers' beliefs play in the adoption and change process and specifically discusses how those beliefs might be addressed through teacher development efforts. A model of teacher development is proposed that builds on, and responds to, teachers' unique needs, specifically those with lower levels of skill and confidence. This model represents a responsive approach to instructional design, that is, training needs are described in terms of users rather than instruction, and instructional decisions are based on users' goals and needs, not those of designers or instructors. The following steps in the model for responsive instructional design are each described: Reveal Current Beliefs; Propose Strategies; Implement Changes; Reflect on Changes; and Refine Beliefs. (Contains 28 references.) (AEF)

Responsive Instructional Design: Scaffolding the Adoption and Change Process

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According to the most recent report of the National Center for Education Statistics (NCES, 2000), 99 percent of all public school teachers now have access to computers or the Internet in their schools. However, despite this growing presence of technology, teachers all over the country continue to grapple with both practical and philosophical problems posed by the integration process. Nearly 70 percent of teachers still report not feeling well prepared to use computers and the Internet in their teaching (NCES). According to the 1998 Technology in Education Report (Market Data Retrieval), only 7 percent of schools, nationwide, boast a majority of teachers at an advanced skill level (i.e., able to integrate technology into the curriculum). Even among our newest teachers, instructional use is not as high as might be expected. Although beginning teachers report wanting to use computers, they often find it difficult to do so when so much of their time is consumed by the routine tasks of teaching and managing their classrooms. The use of computers, then, becomes an extra task which, although seen as important, is of lower priority than more basic activities (Hruskocy, 1999; Novak & Knowles, 1991).

Clearly, the growing increase in teachers' technical skills is insufficient to guarantee the effective use of technology in the classroom (Carvin, 1999; Marcinkiewicz, 1994). Through previous research efforts (Ertmer, 1999; Ertmer, Addison, Lane, Ross, & Woods, 1999; Ertmer & Hruskocy, 1999; Hruskocy, Cennamo, Ertmer, & Johnson, 2000) we have identified a number of challenges that teachers face as they begin to integrate technology within their curricula. Besides a host of technical and logistical questions (e.g., How does this software package work? Where and when should we use computers?), more subtle issues, related to teachers' pedagogical visions and beliefs, as well as their perceived confidence for using technology, are also known to impede meaningful classroom use.

Assuming that most designers and staff developers are fairly well-prepared to provide technical skills training for teachers *who want it* and *are prepared to learn from it*, this paper focuses instead on how designers might work with teachers who either don't want training or are not prepared to learn from it, or both! This paper, then, emphasizes the role that teachers' beliefs play in the adoption and change process and specifically discusses how those beliefs might be addressed through teacher development efforts. Elsewhere (Ertmer, 1999) I have described how teachers' beliefs may function as second-order barriers to change (i.e., barriers that are intrinsic to teachers and that challenge fundamental beliefs about current practice). Again, I am assuming that designers are capable of helping teachers deal with first-order barriers, those that are extrinsic to teachers and which include skills training and equipment needs. Even if these assumptions are false, second-order barriers are still likely to present the biggest challenges to those charged with coaching/assisting reluctant teachers/adopters.

Teacher Beliefs

In summarizing research on teachers' beliefs, Pajares (1992) noted that "there is a strong relationship between teachers' educational beliefs and their planning, instructional decisions, and classroom practices" (p. 326). In particular, teachers' beliefs about their *ability to use computers* in instruction may be key, given the role self-efficacy is proposed to play in determining behavior. In a recent study by McKinney, Sexton, and Meyerson (1999), participants with lower efficacy beliefs expressed concerns typical of those in an early stage of change (self-concerns) while those with higher efficacy had concerns that were more characteristic of later stages of change (impact-concerns).

Self-efficacy refers to personal beliefs about one's capability to learn or perform actions at designated levels (Bandura, 1997). According to Bandura, self-efficacy is based, not solely on the level of skill possessed by an individual, but on judgments about what can be done with current skills. As such, self-efficacy is thought to mediate the relationship between skill and action. Simply put, without skill, performance isn't possible; yet without self-efficacy, performance may not be attempted. According to Bandura, "beliefs of personal efficacy constitute the key factor of human agency" (p. 3). Thus, teachers who have high levels of efficacy for teaching with technology are more likely to participate more eagerly, expend more effort, and persist longer on technology-related tasks than teachers who have low levels of efficacy.

So what does this mean to designers and others who are responsible for teacher development? How can we design professional development experiences that address teachers' second-order barriers, or more specifically, that build teachers' efficacy for using computers in instruction?

Addressing Efficacy Beliefs through Design Efforts

Consider the following scenario: A new principal has just assumed leadership of the local high school and has some fairly strong ideas about how technology should be used within her school. The high school building is well-equipped, having all the necessary resources. The principal approaches you, as an instructional designer, to help her people get up to speed. She admits that many of her staff are not convinced of the need for technology in their teaching, but believes that if you present a few good reasons why technology should be used, they will jump on board. Where do you begin?

Researchers in the area of self-efficacy (c.f., Schunk, 2000) describe four primary sources of information that can influence judgments of efficacy: vicarious experiences (observing models), social persuasion ("I know you can do this!"), physiological indicators (emotional arousal, relaxation), and personal mastery (successful task completion). However, teachers may be more or less influenced by each source of information depending on a host of other factors--their current skill level, their beliefs about teaching and learning, their attitudes towards computers in general, and so on. For example, providing models of exemplary users may not be effective for teachers whose confidence and skill levels are at the low end of the continuum. In fact, the use of this type of efficacy information may prove detrimental for teachers who can't imagine ever attaining these high levels of use (Snoeyink, 2000). Instead, teachers with low skill and confidence levels may need to experience a few small-scale successes in order to establish even an *initial* level of efficacy.

Acknowledging that teachers in any given school are likely to represent a range of levels of confidence, skills, and teaching beliefs, designers can not expect to implement a one-size-fits-all training program. Still, within each stage of development (novice - expert), growth in one area is likely to be related to growth in other areas. Thus, by increasing confidence, skill, or a change in beliefs, we may be able to support teachers' efforts toward adoption and use. Certainly, growth in skill and growth in confidence have been demonstrated to be positively correlated (Ertmer, Evenbeck, Cennamo, & Lehman, 1994). Furthermore, there is some evidence to support the idea that pedagogical beliefs and technology use are also related (Becker & Riel, 1999) and that as teachers use technology more their beliefs become more constructivist-oriented (Dwyer, 1996).

Consider the following teachers who are likely to comprise part of the teaching staff at the local high school:

Teachers with low skills and low confidence. Low skills and low confidence typically translate into resistant or reluctant teachers who see no reason to initiate change in their classrooms. Trying to convince these teachers that they need to use technology is pointless; strategies that worked to convince early adopters are not likely to work with late adopters. According to Moore (cited in McKinzie, 1999), "crossing the chasm between these groups (early and late adopters) requires a mammoth campaign that includes special attention to the vastly different needs, perspectives, and demands of the late adopters." Whereas social persuasion may be a great strategy for convincing early adopters, this strategy usually won't work with late adopters.

Neither is it likely that teachers at this level will be swayed through vicarious experiences, or observing successful others. Teachers at this level are not ready to embrace, or even consider, technology integration ideas. Although many educators have suggested that technology training efforts should focus on the conceptual and pedagogical levels (Carvin, 1999; Clouse & Alexander, 1997), others disagree (Milone, 2000; Snoeyink, 2000). Stapel (cited in Milone) explained, "In the past, I think we made a mistake by rushing too quickly into the integration phase of staff development. In many cases, teachers just weren't ready" (p. 58).

Of the four techniques recommended for increasing self-efficacy, personal mastery is likely to be the most beneficial for novice computer users. Experiencing even small success can increase confidence. Furthermore, establishing relevancy may convince reluctance users to "have a go." A designer in the situation described earlier might begin with the teachers' own personal or instructional needs as one way to create relevance. Perhaps the teacher has a nephew or a grandchild who is having a birthday--would she like to send a virtual bouquet? What particular classroom issues are consuming the teacher's time? Could technology ease some of the load by allowing her to easily modify newsletters or student progress reports or calculate weighted grades? Is there a particular concept that is hard for her students to grasp that could be demonstrated through a simulation? The idea is to find out what the teacher needs and then collaboratively develop a plan that efficiently meets those needs. Similar to the idea of creating an individual educational plan (IEP) for each student, a designer might consider co-creating an individual teaching/technology plan (ITP) with each teacher. As with any good instructional design, designers are advised to start with what teachers know and then use strategies that meet their unique learning needs.

Teachers with medium skills and medium confidence. Teachers at this level have typically achieved some level of competence with technology but may not have found the desire or means to bring these tools into the classroom. Because they teachers have at least an initial level of confidence, they may be at a point where they will benefit from observing similar others who have achieved higher levels of use. These applications no longer seem out of reach for these teachers and may now serve as inspiration. Training emphases and methods that were appropriate for novice technology users (step-by-step procedures, skill building) are not likely to be as effective for intermediate users. Teachers at this level may benefit from shadowing similar others, do-it-yourself manuals, and collaborative efforts. While skills will need to be continually refined and updated, it's not as important to focus development efforts strictly on skills; skill instruction can now be embedded within meaningful projects or relevant tasks.

Teachers at a medium skill level are probably just starting to imagine some specific classroom applications and may not be able to extrapolate from ideas used at other grade levels and in other content areas (Snoeyink, 2000). Thus, it may still be important at this level to include concrete ideas for the teacher's grade level and content area. A designer charged with helping teachers at this level will need to have a strong working knowledge of various curricular standards, or have ready access to someone who can help translate these standards into workable technology solutions. Unfortunately, this is not nearly as easy as it sounds.

Responsive Instructional Design

In the following section, I propose a model of teacher development that builds on, and responds to, teachers' unique needs, specifically those with lower levels of skill and confidence. I propose that this model represents a responsive approach to instructional design; that is, training needs are described in terms of users rather than instruction, and instructional decisions are based on users' goals and needs, not those of designers or instructors. Although the model is similar to the ADDIE approach, each step requires that more attention be paid to users' perceived needs and goals. This suggests a greater need for both communication and analysis skills. Steps in the model are described below.

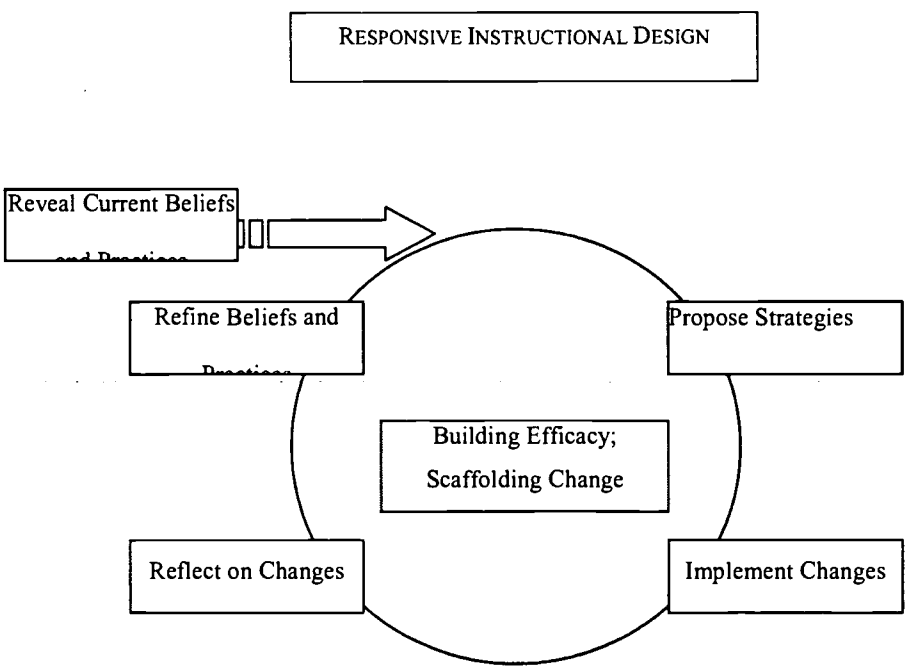

Figure 1. A Model for Responsive Instructional Design

Reveal. Responsive instructional design is based on the assumption that teachers are more likely to embrace pedagogical and classroom change if these changes address the real issues they face in practice. Teachers are encouraged to reveal the goals they want to accomplish in their classrooms, the barriers that hinder their work, and the instructional and/or administrative concerns they have, *unrelated to technology*. Teachers also are asked to

reveal their beliefs about teaching as well as the incentives that motivate them to teach. At these early stages of technology adoption and use, the focus is not on technology skills or needs. Teachers are encouraged to consider their needs as both teachers and learners prior to considering their needs as technology users. Teachers and designers work collaboratively to develop an individual teacher profile, followed by the development of an individual teaching/technology plan (ITP) in the next step. Thus, an individual teacher profile might include information about teachers' 1) classroom practices, 2) classroom context, 3) perceived issues and barriers, 4) beliefs about teaching, 5) motivation for teaching, as well as 6) preferred ways of learning and teaching. By beginning with teachers' perceived needs, we remove the focus from the innovation and place it instead on teaching practices and the important issues teachers face.

Propose. During this step, teachers and designers co-develop an individual teaching/technology plan by considering various means for meeting specific needs identified in the teacher profile. After reviewing the issues teachers face, designers help translate these important questions into technology-based learning opportunities. Depending on the type of support teachers request or require, different types of support should be offered (one-on-one consulting, just-in-time training, formal classroom training, peer collaboration and observation, etc.). Some strategies will work more readily and be more appealing than others, depending, at least to some extent, on the barriers teachers describe. Different barriers (e.g., lack of confidence vs. lack of support) typically suggest the use of different strategies. For example, if teachers mention not yet feeling comfortable with technology, they probably are not ready to begin using technology in the classroom. Instead, they need to increase their personal comfort through increased individual and personal use. By acknowledging and helping teachers work through specific first- and second-order barriers, we help them identify strategies that work for them and simultaneously build confidence in their ability to address future barriers.

Implement. As teachers' test their ideas in their classrooms, they experience first-hand what works and what doesn't. As Maddin (1997) emphasized, "the real learning begins in your classroom" (p. 56). Information obtained through direct experience is one of the most powerful means to shape future practice. Because self-efficacy is a fluid construct, it changes with new experiences. While early success can raise efficacy, early failures may lower it. For this reason, it is probably important that reluctant teachers experience as much success as possible during their first few attempts to use technology within the classroom. Additionally, teachers should set realistic goals for themselves since they will measure their success by how closely they meet the goals they have set (Pintrich & Schunk, 1996). It is not critical that reluctant teachers implement a highly sophisticated lesson with lots of bells and whistles. What's most important is that they are successful. Risk and surprise need to be eliminated, or at least greatly controlled.

Reflect. Kagan (1992) explained that changes in teachers' beliefs are rarely the result of reading and applying research findings. Teachers base most of their ideas on their own and others' experiences. In order to promote professional growth in novices, Kagan recommended that teachers' awareness of their own beliefs be raised followed by experiences that challenge those beliefs and promote integration of new ideas into current belief systems. Such reflection initiates the revision process. After implementing new ideas or tools in the classroom, the teacher takes time, with or without the designer, to reflect on the teaching/learning processes and outcomes achieved. Teachers consider how the teaching and learning that occurred compared to what was expected. As teachers realize that their "ability to successfully utilize technology has increased, they are motivated to attempt to learn more about technology, it's uses, and benefits" (George & Camarata, 1996, p. 51). However, as with most teaching experiences, there are usually many opportunities for improvement. Teachers should be encouraged to focus their reflections primarily on what the students did or did not do in response to the lesson. Based on this information, teachers can consider what changes need to be made to effect the types of student performances or levels of thinking desired.

Refine. In this final step, teachers are encouraged to discuss their instructional changes with others and consider the overall usefulness and effectiveness of the changes they have initiated. Based on conversations with others, teachers are encouraged to outline their next steps for development. This may include implementing a revised version of the lesson, adding one more idea to the lesson, or reading relevant literature to examine what others have done. Revisions made after each iteration are not likely to be substantial; however, continual refinements, over time, can add up to noticeable differences. As teachers continue to converse with others about how they addressed a relevant issue in their classrooms, as well as the results they obtained, they initiate, in effect, new cycles of development.

Relationship of Model to Current ID Practices

Designers who have been trained to design programs/instruction using the instructional systems approach already have the basic tools they need to work with teachers and students in a responsive manner. For example, using analysis tools, we determine teachers' goals for their students, their classrooms, and themselves. We identify the specific supporting (or limiting) contextual factors in the environment in which teachers currently apply their skills. As part of a learner analysis, we identify teachers' current levels of skills and confidence. Given these goals and current skills, we determine the gap that exists, and then identify specific needs that must be met. As part of the design and development process, we devise instructional strategies, materials, and job aids that will meet teachers where they are and start to move them forward toward the goals they have identified. As teachers implement new skills within their classroom practice, we have the opportunity to co-reflect on what is working and what is not, and to make adjustments (in both training and implementation) to better achieve the intended outcomes. Ongoing evaluation allows teachers and designers to determine the effectiveness of selected approaches and to make revisions that bring us closer to our mutual goals.

Even though the design steps for the ADDIE and the responsive ID models are similar, designers need to be aware of critical differences, including the different starting points and the increased involvement of the end-users. To summarize, some specific suggestions for instructional designers who intend to assist teachers with their technology efforts include:

1) Ask teachers about their visions and goals for their classrooms. What do they want to be able to do? What are their priorities for teaching and learning?

2) Listen to teachers' specific needs. What kind of barriers do they encounter? What do these barriers suggest about their readiness for technology use and the strategies that may be needed to assist them at different levels?

3) Co-create flexible solutions. Be prepared to meet changing needs. Be sure that problems and solutions are rooted in teachers' work. Use the reveal-reflect-refine cycle described above.

4) Adapt innovations to fit teachers' needs. Teachers are great adapters--help them locate and select programs or software that will work for them and their particular set of students.

Conclusion

A number of researchers have suggested that training strategies should be varied to meet the needs of teachers at different levels of technology use (Dwyer, Ringstaff, & Sandholtz, 1991; Sherry, Billig, Tavalin, & Gibson, 2000). Given the long-term nature of the integration/adoption process, it is recommended that staff developers/instructional designers meet implementation needs in a responsive fashion--that is, through "iterative interventions" (Frame, 1991) that meet and challenge individual teachers at their current levels of use. As teachers face changing needs, the strategies designed to meet them must also change. Furthermore, different strategies are likely to be more or less effective for people with different levels of efficacy. It is important not to discourage teachers who have low levels of confidence by surrounding them with others who are much more experienced and confident. By designing development programs that start with the concerns that these teachers have, and helping them experience some initial success in solving their own problems, we have a better chance of making headway in the adoption process.

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