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Rapid Prototyping as Method for Developing Instructional Strategies for Supporting Computer-Mediated Communication Among University Students

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Abstract: Because rapid prototyping results in the quick development of curriculum, materials, and processes, it is a form of design that could be particularly useful to professors in higher education. Yet, literature documenting the use of rapid prototyping in higher education is scarce. This paper offers a case example of rapid prototyping being used as a design process. After presenting the case, the author points to necessary considerations for other faculty members who are considering using rapid prototyping. These considerations include the need to gain perspective on the roles of instructional strategies and computers within teaching and learning processes, understand the distinction between traditional research rigor and design rigor, and the importance of approaching design systematically.

I. Introduction and Purpose

Designing meaningful learning experiences is difficult for professors. True instructional design often is too expensive of a process to be viable in higher education; and while carefully-constructed constructivist learning environments are becoming more widely used across the academy, such environments, too, require a high level of detailed planning, particularly when computers are involved. College professors simply cannot enter each semester with a solid constructivist design of all assignments and course activities. Sometimes, then, the best a professor can do is to design "something" as a part of a new course preparation and tweak it over time. In general, this process of designing and tweaking is referred to as rapid prototyping (Reiser, 2001).

While a professor's efforts to use rapid prototyping can result in the quick development of instructional materials or activities (Resier, 2001), the quality of resulting materials and activities often is suspect. Why? Models of rapid prototyping are surprisingly complex and are largely based on "progressive refinement"—"putting a first version of a design into the world" and then revising that design "until all the bugs are worked out" (Collins, Joseph, & Bielaczyc, 2004, p. 18). The process is not complete, then, when materials have been developed. Revising implies a detailed and systematic process; it is the iterative nature of designing that makes rapid prototyping a successful design approach (Jones & Richey, 2000). In fact, rapid prototyping often involves an entire support team to manage the design process (cf., Lohr, Javeri, Mahoney, Gall, Li, & Strongin, 2003), but most professors do not have access to such a level of human capital.

The purpose of this paper is to offer a case example of the rapid prototyping process that I used to develop assignment guidelines for supporting students' use of an online discussion board. Notably, this paper emphasizes the systematic development of the assignment guidelines

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across three semesters of implementation. Perhaps this type of case example can be illustrative for other professors who need to systematically prototype assignments, sans formal training in rapid prototyping and support team. This paper begins with a description of the context in which the assignment was prototyped and then temporally describes the prototyping process. In the last section of this paper, I offer generalized principles for using rapid prototyping to develop assignments for the higher education classroom.

II. Context in which Rapid Prototyping Occurred

Part of my teaching responsibilities within a School of Education at a Midwestern university included serving as a member of a faculty team that supported the efforts of preservice teachers (undergraduate students majoring in elementary or secondary education) in a two-year, field-based teacher-certification program. The preservice teachers who were enrolled in this program were assigned to K-12 classrooms in partnership schools. Because this was only the second implementation of the entirely field-based certification program, much of the context supporting the program was still developing. During the first semester of the two-year program, the preservice teachers often assumed a periphery role within the classroom—serving more as a teacher's aide than as a practicing teacher. During the last semester of the two-year program, though, the student teachers participated in a formal "student-teaching" experience. The field-based program was designed to support the preservice teachers' development from aide to professional teacher.

Throughout the two years, a team of university faculty supervised weekly content seminars. Within the seminars, faculty members sometimes resorted to lecture as a means of orienting the preservice teachers to various educational theories and methods; more often, though, within these seminars, preservice teachers were given opportunities to discuss their experiences in the classroom. During each of the first three semesters of their field experience, the preservice teachers were enrolled for one credit hour of educational psychology—the content that I was responsible for overseeing. In principle, though, "courses" were non-existent. Instead, each courses' content was integrated into seminar activities and discussions.

While the faculty team and preservice teachers came together for the weekly seminars, communication throughout the rest of the week was difficult. Most of the professors on the faculty team had other responsibilities that prevented them from spending substantive time within the partnership schools, and the preservice teachers were placed in a variety of schools across three school districts. Therefore, the team of faculty determined that since WebCT's (the university's approved online course management tool) discussion board depended on neither face-to-face communication nor real-time interactions, it would be a useful and efficient tool to help the preservice teachers stay connected with each other and with the faculty team.

The rapid prototyping process that is the basis of this paper involves the design of strategies to support the effective use of bulletin board discussions. Table 1 provides (a) an overview of the factors that influenced the development of each version of the discussion assignment, (b) the characteristics of each version, and (c) a summary of evaluation findings for each version.

III. The First-Semester Use of the Electronic Bulletin Board

The first-semester guidelines supporting the preservice teachers' use of the bulletin board proved ineffectual as a tool for promoting communication, much less learning. Within this

Table 1: Factors contributing to assignment design, assignment characteristics, and evaluation.

First Semester Version	Second Semester Version	Third Semester Version
Factors Influencing Design	**Factors Influencing Redesign**	**Factors Influencing Redesign**
• Need for flexible and efficient communication tool • Emerging nature of the field experience • Lack of information about the preservice teachers' knowledge and skills • Need to introduce basic educational psychology principles	• First version was ineffectual • Shifting Responsibilities of preservice teachers • Changes to the use of weekly seminar time • Need for preservice teachers to gain skill in using web-based communication tools	• Evaluation of revised version • Elimination of seminar time for educational psychology • Continued shifting responsibilities of the preservice teachers
Initial Design Characteristics	**Characteristics of Redesign**	**Characteristics of Redesign**
• Laissez-faire • Preservice teachers were simply made aware that discussion board existed.	• Preservice Teachers assigned to two groups • Discussion based on three-week cycles • Discussion centered on student-initiated problems and proposals for practical solutions	• Addition of a Privacy Statement and job aid emphasizing conventions of CMC • Additional direction to focus on "instructional problems"; more scaffolding to support "good" contributions • Added reflection writing and self report form
Evaluation of First	**Evaluation of Second**	**Evaluation of Third**
• Ineffectual and rare use • Preservice teachers reported that they didn't see practical value of using CMC	• Problems were narrow in scope • Interaction among the preservice teachers was limited • Grading was cumbersome • Perservice Teachers noted workload was heavy and contrived	• Scaffolding of third week contributions did broaden the types of input from the preservice teachers

section, the factors contributing to the first-semester guidelines and a description and evaluation of those guidelines are discussed.

A. Factors Contributing to the First-Semester Guidelines

Commonly, careful analysis of both the educational context and learners precedes rapid prototyping (Jones & Richey, 2000). Because the context of the partnership school was still emerging, analysis was based largely on generalization. From a macro-perspective, it seemed that the unique context of the field experience would continue to emerge as implementation progressed. This symbiosis between context and implementation required that I give the preservice teachers plenty of latitude in their use of the bulletin board, which might include their decision not to use it at all.

Furthermore, as the initial guidelines needed to be in place the day that I met the preservice teachers, I had no knowledge of the skill of the learner for which I was designing. Had they used a bulletin board before? Did they even know how to find the university's WebCT site and log on? I did know that these preservice teachers had never before taken educational psychology. Some content, then, needed to be transferred to these preservice teachers. In a pedagogical age of open-ended learning environments and within the context of a field experience, I recognize the vulgarity of suggesting the need for knowledge transfer. Nevertheless, because of both the school of education's accreditation process and certification tests that the preservice teachers would need to pass, the preservice teachers needed to obtain a basic understanding of educational psychology concepts and principles. This requirement further accentuated the need to de-emphasize the use of the bulletin board (which often is more well-suited for promoting open exploration than for supporting direct concept attainment) and emphasize activities and assignments that were more likely to promote direct knowledge transfer.

B. Characteristics of the First-Semester Guidelines

At the start of the first semester of the field-based program, the faculty team simply made the preservice teachers aware that WebCT had a discussion board where they could share ideas with each other and ask questions in a forum that would expedite communication. Once the preservice teachers were aware of WebCT, I informally suggested that they might use the bulletin board to collaboratively make sense of assigned readings and prepare for seminar activities. Admittedly, this laissez-faire approach contradicts much of the practical advice for using bulletin board discussions. Some literature suggests that if professors do not scaffold the "hows," "whens," and "whys" of using asynchronous discussion then students will not use it effectively, or even at all (e.g., Knowlton, Knowlton, & Davis, 2000).

C. Evaluation of the Discussion Board's First-Semester Use

Predictably, the bulletin board was used rarely. When it was used, the contributions were most often in the form of close-ended questions: "What chapters are we supposed to have read by next week's seminar?" Several preservice teachers noted that it was nice to know the bulletin board was available, but they did not have a need to use it often. That is, they did not see how sharing ideas on the bulletin board would help them prepare for their day-to-day activities in the K-12 classrooms. After all, their argument went, they daily had access to their mentor teachers—

the full-time teachers in the classroom to which each preservice teacher was assigned—who could guide them in their decision-making processes.

IV. The Second-Semester Use of the Electronic Bulletin Board

The laissez-faire approach to support learning through the bulletin board was not effective. To aim for more educational effectiveness, I shifted the emphasis toward a computer-mediated communication (CMC) assignment by designing instructional strategies that would more likely secure the preservice teachers' participation. The formalized design showed some promise, but evaluation suggested the need for refinements to the assignment's design.

A. Factors Contributing to the Second-Semester Guidelines

Both the preservice teachers' "readiness" for a higher level of professional thinking and their shifting responsibilities in the classroom necessitated formalized guidelines to support the use of the computer-mediated discussion. During the first semester of the partnership program, I had assigned readings from the adopted educational psychology book (see Eggen & Kauchak, 1997). These readings served the purpose of introducing the preservice teachers to the large issues that fall within the domain of educational psychology. Once the preservice teachers had been exposed to key educational psychology concepts, they needed experience applying those concepts by making connections between textbook theory and real-world classrooms. Such connections can be useful in supporting students' problem-solving efforts in field experiences (Beckett & Grant, 2003). This shift from "knowing" to "applying" seemed further appropriate because it paralleled the preservice teachers' shift within the partnership school. The preservice teachers slowly were moving from serving as paraprofessionals—by taking class attendance and organizing materials, for example—to participating as true professionals—by designing lesson plans and teaching the entire class.

A second contextual factor also created the need for more exact guidelines to support the use of the discussion board. The team of faculty members who supervised the weekly seminars decided that more organization was needed within the seminars. No longer would the faculty team collectively guide discussion and facilitate activities; rather seminar time was divided among content areas—"Today is an Educational Psychology seminar; next week will be a reading methods seminar." Such a shift was problematic because it violated one of the very foundations of a field-based program—that content should be integrated and directly based on the preservice teachers' field experiences (cf., Beckett & Grant, 2003; Scanlon & Ford, 1998; Weber, 1996). Successful professionals must learn to think holistically about their experiences, not about "courses" from a program of studies. Designing and implementing more exact strategies to support CMC served as a means for prompting the preservice teachers to continue making integrated connections, even though seminar time was less integrated.

B. Characteristics of the Second-Semester Guidelines

Participants were divided into two groups and the electronic discussion was based on three-week cycles of sharing and response. Assessment of students' efforts was integrated across the cycle. At the end of each cycle, roles were reversed so that preservice teachers in group one performed the responsibilities of the preservice teachers in group two and vice versa. This general approach has been supported elsewhere in the literature (cf., Knowlton, 2002).

Week One of the Discussion Cycle. Preservice teachers assigned to group one were responsible for describing a problem that they were experiencing within their partnership school. The assignment guidelines noted that the "problem might be *interpersonal* (e.g., a conflict with a mentor teacher or parent); *instructional* (e.g., students not meeting the objectives of a lesson); *behavioral* (e.g., a student who constantly ignores classroom rules); or *contextual* (e.g., a lack of adequate textbooks or other supplies)." This emphasis on a variety of problem types was purposeful. As I have noted, one goal of the assignment was to help the preservice teachers see the ways educational psychology was integrated with other "content," such as cultural foundations of education, instructional methods, and classroom management. If the scope of the problems that students shared was broad, then opportunities for connections to content beyond educational psychology equally would be broad.

Week Two of the Discussion Cycle. Preservice teachers in group two were responsible for using the index and table of contents of the educational psychology textbook to theoretically frame the problems that had been shared during week one. The textbook, then, became a learning-on-demand resource, where preservice teachers were self-selecting readings that would most likely contribute to an analysis of the problem-at-hand. In addition to making connections between the problem and educational psychology, preservice teachers were encouraged to make connections to content areas that were the basis of their weekly seminars. These connections were designed to help the preservice teachers understand that neither the problems that they encountered nor educational psychology were discrete. Instead relationships existed *among* problems encountered in classrooms, educational psychology, and other content areas.

Week Three of the Discussion Cycle. All of the preservice teachers—regardless of whether they were assigned to group one or group two—were responsible for three contributions to the computer-mediated discussion. The assignment guidelines dictated that not all three contributions should be posted on the same day of the week. The purpose of this criterion was to build in reflection time for the preservice teachers. They were to consider the discussion in its entirety before adding further to the discussion. The assignment guidelines directed the preservice teachers' efforts with week three contributions by noting that they should "further define and work to solve the problems-at-hand through dialogue." They should "read what [their colleagues had written] within a 'thread' of discussion and interact by responding to [each other's] ideas."

Assessment across the Discussion Cycle. The assignment guidelines noted that the preservice teachers would "receive most credit for the number of contributions that [they offered]." The rest of the credit would be earned by meeting the stated purpose of each week's contribution. For example, a stated purpose of week two and week three contributions was that the preservice teachers should theoretically frame the problem with citations. The assignment guidelines did offer a caveat to this loose assessment structure, however:

> "After the first two cycles, if we all feel that we are doing more than 'going through the motions,' then the assessment criteria can stay equally 'loose.' That is, we all should be working as professionals to help classmates solve real problems. If, however, I sense—or we agree as a class—that the criteria are not rigorous enough to foster collaborative problem solving, I will [offer] additional criteria (for example, specifying the length of contributions) to enhance the educational potential of this assignment."

C. Evaluation of the Second-Semester Design

Two data sources served as a basis for evaluation. First, my assessment of the preservice teachers' efforts served as a basis for determining additional changes that were needed to improve the efficacy of the assignment. Second, during a weekly seminar, I engaged the preservice teachers in a discussion about the use of CMC.

Assessment as Evaluation Data. As I assessed the preservice teachers' participation in the computer-mediated discussion, I made judgments about the design of the assignment itself. This approach of combining assessment with evaluation to determine the educational viability of CMC is not unprecedented. In fact, "only the integration of assessment [with] evaluation can produce a clear picture of an online discussion's educational viability" (Knowlton, 2001, p. 164). Numerous observations suggested the need for additional change. First, I found that students were relatively successful at articulating problems that they were experiencing, but the problems were extremely narrow in scope. Of the approximately ninety posted problems, most focused on discipline problems among the K-12 students. One or two of the posted problems focused on interpersonal conflicts, such as conflicts with their mentor teachers or a parent. Two of the posted problems focused on instructional concerns.

Second, most contributions during week three of the discussion were replies to the original problem posted during week one. In other words, the preservice teachers were not discussing the problems by interacting; they merely continued to offer solutions to the original problem. In fact, it often was unclear as to whether or not the preservice teachers were reading the threads of discussion in which they were responding. While repetition of various ideas across contributions within the same thread of discussion was common, consensus building and synthesis of ideas were scarce.

Third, as I assessed the preservice teachers' participation, I recognized the inordinate amount of time I was spending on *grading*, as opposed to engaging in activities that were related to assessment but more productive toward creating continued learning among students—such as reacting to their discussion contributions, highlighting common themes among their interactions, and offering contributions to the discussion as an authentic participant. Certainly, it was within my purview to grade the preservice teachers' efforts, but grading should not dominate the assessment process (Bauer & Anderson, 2000).

Input from Preservice Teachers. At the end of the second semester, I solicited input from the preservice teachers about the use of CMC. I used two questions as prompts to promote feedback from the preservice teachers. Notably, these prompts emerged as I assessed the preservice teachers' success during the second semester:

- How could the assignment guidelines be adjusted to emphasize the value of collaborative analysis and inquiry in an attempt to solve real-world problems?
- How might the assignment guidelines be structured to foster an environment where the preservice teachers "forget" that CMC is being used as an "assignment" that will be graded and instead remember the need to act professionally and help their colleagues, even if that means offering more input than the minimum expectations require?

During this discussion, two points emerged. First, the preservice teachers noted that many of them still usually were engaged in activities that did not directly relate to teaching. Certainly, they felt that by the third semester of their partnership experiences they would have shifted even more into a key role as the "teacher" of the class. This shift, they argued, would make it easier

for them to participate in the discussion because they would have richer experiences on which to base their contributions to the discussion.

Second, the preservice teachers noted that criteria governing week two and week three contributions were hindering their participation. They urged me, for example, to reduce the number of required contributions in both weeks two and three. This would give them more time to research and find appropriate resources to support the perspectives that they offered within the discussion. One preservice teacher noted that there were so many contributions to each thread that there was nothing left to add for late-comers to the discussion; reducing the number of required contributions would solve this problem. Another preservice teacher agreed and noted that she did not read the threads before contributing because she did not want to know whether she was duplicating ideas that had already been offered.

For similar reasons, students suggested the need to eliminate any criterion that specified on what days of the week they should participate. Once they planned their contribution they returned to the discussion board only to find that someone else had offered their idea. Also, several preservice teachers noted that they were printing out discussion contributions and sometimes even entire threads of discussion and reading them. So, while their actual contributions might come on a single day of the week, they were spending time considering the discussion across numerous days of the week.

V. The Third Semester CMC Assignment

The third-semester version of the assignment included several changes from the previous semester. Notably, these changes were based on feedback from the preservice teachers, which was reported in the previous section of this paper. In this section, I describe the milieu that contributed to the development of the third-semester assignment guidelines, the changes that were implemented, and evaluation.

A. Factors Contributing to the Third-Semester Design

The feedback that I had solicited from the preservice teachers did contribute to the prototyping of the third-semester design, but other factors contributed, as well. Notably, the format of the weekly seminars once again changed during the third semester of the partnership. It was determined that certain content areas—educational psychology being one such area—would not be given *any* formal emphasis during seminars. Yet, I was still accountable for assessing the preservice teachers and giving an Educational Psychology grade to each of them at semester's end. Because of this dilemma between, on the one hand, needing to assess the preservice teachers and, on the other hand, not having formal seminar time to assess them, continuing to formally use CMC seemed appropriate.

B. Characteristics of the Third-Semester CMC Guidelines

The assignment was still based on the idea of the preservice teachers sharing real problems that they were experiencing and cycles of theoretically framing and solving those problems. Three changes to the assignment guidelines were made in an effort to overcome some of the weaknesses evident in the second-semester version. The first was an administrative change. The second was a change in the types of problems that the preservice teachers should

share. The third change concerned guidelines governing week two and week three discussion contributions.

Administrative Change. During the second-semester version of the assignment, I had spent large amounts of time grading the preservice teachers' contributions, as opposed to assessing and providing participants with the types of authentic feedback that could improve their problem-solving and analysis skills. To shift my own role within the discussion from a grader—which is often viewed as punitive—to a facilitator—which offers the opportunity to be more constructive—I developed a self-report form. At the end of each cycle of discussion, the preservice teachers completed and submitted this self-report, which allowed them to report factual information about their participation. For example, they could list the subject line of the threads in which they participated and cite the various resources that they used in theoretically framing a problem to which they responded. When the preservice teachers submitted their report, I had a list of threads in which I could find their contributions. This made the process of "grading" less time consuming.

Changes to the Types of Problems Offered for Discussion. The third-semester version of the assignment guidelines required that all problems contributed to week one of the discussion cycle must be "instructional problems"—as opposed to the type of behavior and discipline problems that dominated the second semester. Specifying that the problems should be "instructional" in nature was designed to broaden the preservice teachers' thinking regarding what constitutes a classroom problem that was worthy of analysis.

Changes to Guidelines Governing Week Two and Week Three Contributions. I reduced the number of required contributions during week two of each cycle from three to two. The preservice teachers had advocated for the need to lower the number of required discussion contributions. They argued that lowering the quantity of required contributions would allow them to be more thorough in their analysis of the problems contributed to the discussion. While skeptical of such claims, I implemented this change in the hope that my skepticism would be unfounded.

Also, I specified that week three contributions had to be replies to week two contributions, not replies to the original problem discussed during week one of each cycle. I hoped that this criterion would improve interaction among the preservice teachers within the computer-mediated discussion and promote a deeper analysis of the issues embedded within the problems, not just continued (and often redundant) "solutions" to the original problem. Because of this more specific purpose of week three contributions, I developed a list of possible strategies that the preservice teachers might use as they contributed to the discussion during week three. (See Table 2.)

C. Evaluation of the Third-Semester Prototype

Evaluation consisted mainly of the preservice teachers completing an open-ended survey about their views of using CMC. Space limitations prevent a full explication of the survey results. I focus here, though, on feedback that directly related to changes made in prototyping the final version of the CMC assignment.

Changes Governing the Types of Problems Shared During Week One. Several preservice teachers noted that describing an instructional problem was more difficult than describing problems with student behavior or interpersonal conflicts. Many of them acknowledged, though, that being asked to describe instructional problems forced them to look at their own curriculum development and instructional practices in a more detailed way. As one preservice teacher noted,

Table 2: Strategies for replying to week three contributions

As you write contributions to the discussing during week #3, you should work to add a deeper level of analysis to the discussion, not to simply repeat what has already been offered. If you are stuck for ways to contribute during week #3, consider the following possible strategies.

- Pick two replies to the same problem and discuss why you think one would work better than the other.
- Pick a reply to a problem and discuss the strengths and weaknesses of the proposed solution
- Pick a theory that someone mentioned as a help to understanding week #2 and apply that theory differently (or more thoroughly).
- Discuss your experiences with how a solution has/has not worked in the classroom.
- Write a summary of responses to your own problem and describe what the biggest things that you are taking away from your problem are.

"I was surprised that it was more difficult to relate an instructional problem to ed[ucational] psych[ology]. The behavior problems stood out more and the connections were more obvious. Because we had to share instructional problems, I think that I learned how interwoven ed[ucational] psych[ology] and teaching truly are."

Changes to Week Two and Three Contributions. The preservice teachers on average tended to agree that the changes to week two and three contributions were positive. One preservice teacher noted that the changes to the guidelines allowed her to "actually relate different theories and sources of information to the problems [that] others [were] experiencing." Her point was that by being required to offer fewer contributions she could consider those contributions more carefully.

Other students seemed to indicate that the suggestions for week three responses were useful. Many students noted that from these possible responses they realized that they could share their own experiences to a problem. One preservice teacher phrased it this way: "The most helpful responses were not the ones that said, 'On page 276 of the text book, it states.…' Instead, responses that described what [others] were doing in their classrooms to help with similar problems were . . . much more helpful." From this and several similar comments, I infer that the suggestions for week three responses (as shown in Table 2) were useful to students in guiding them toward offering more salient contributions to the CMC discussion.

VI. Implications of this Prototyping Approach

In this paper, I have offered a case example of rapid prototyping as a design approach for developing a CMC assignment for the higher education classroom. The details of such an example should provide faculty members with new perspectives about the iterative nature of development processes. Specifically, several implications of this case cut across many higher education scenarios and are worthy of comment.

A. Instructional Strategies Influence Learning

Noticeably absent from the case example is a discussion of the importance of customizing WebCT to improve the educational utility of the discussion. Instead of focusing on the prototyping of improved media, this case focuses on the development of instructional strategies. Such a focus is fully appropriate, as it is consistent with a view supported in the literature. Namely, instructional strategies, not computers, are the cause of learning (e.g., Clark, 1983, 1994a, 1994b). Admittedly, such a perspective is not without detractors (e.g., Kozma, 1991), but even these detractors agree that there is no credible evidence to suggest that computers influence learning. Professors who are using rapid prototyping to design media-based assignments would do well to consider their own philosophy among media, instructional strategies, and positive learning outcomes. If, in fact, computers do not influence learning, then prototyping should focus on strategy development more so than on media development.

B. Consideration of Design Rigor

For readers of this article who come from a traditional empirical background, this case example may have proved a frustrating read. No method of data collection and analysis was offered and applied, and no discussion of "significant" results was provided. But Edelson (2002) distinguishes between traditional research and design research. With this distinction comes a distinction in approach. For the professor who is interested in achieving a level of understanding to justify change within a course or assignment, empirical rigor is not needed, and may even be misleading. Instead, pedagogical rigor can provide insights sufficient to adjust assignments so that they promote a stronger opportunity for learning among students. The point is that faculty members across disciplines should gravitate toward design processes that allow for functional revision of assignments, even if such gravitation limits one's ability to publish more scientific claims that are indicative of traditional research.

C. Nature of Systematic Design

This third implication builds largely from the second. To suggest that empirical rigor indicative of the positivist research paradigm is unnecessary is not to suggest that design is haphazard and non-systematic. The case example noted here serves as a worthy model for professors across disciplines because it illustrates the relationship between the prototyping process and a dependence on inputs and outputs, which is one characteristic of "systematic" design. Consideration was given, for example, to the macrocontext of the field-based program. Consideration was also given to the changing needs of the preservice teachers. As professors adopt rapid prototyping procedures, they, too, should consider the role of context as a factor that influences and informs their design. As a learning context evolves, design practices must become increasingly iterative and flexible.

Furthermore, the evaluation of design is one unique stage of the design process that is particularly dependent on inputs and outputs. Professors who are prototyping assignments across semesters or even within a single semester should plan for evaluating the quality of their own designs. As can be noted within the case described in this paper, the professor's judgment was involved in evaluating the assignment, but the prototyping of the assignments did not stand on the professor's judgment alone. Student input was a part of the evaluation process and the assignment was prototyped—at least to some extent—based on that student input. Within the

case reported in this paper, perhaps I had an obvious advantage in that my students (i.e., the preservice teachers) remained the same across each semester of implementation. This allowed me to develop a rapport with them, and they perhaps felt more invested in assisting with the prototyping of the strategies, since they knew that they would be engaged in CMC discussion in future semesters. Professors who do not have such an advantage might have to go to greater lengths to account for student input as they are prototyping assignments. The use of additional formal surveys, focus groups, or other opportunities for student input may be useful to this end.

References

Bauer, John F., and Anderson, Rebecca S. (2000). Evaluating students' written performance in the online classroom. In Renee E. Weiss, Dave S. Knowlton, and Bruce W. Speck (Eds.), ***Principles of effective teaching in the online classroom*** (pp.65-72). San Francisco: Jossey-Bass.

Beckett Julia, and Grant, Nancy K. (2003). Guiding students toward solutions in field experiences. In Dave S. Knowlton & David C. Sharp (Eds.), ***Problem-Based Learning for the Information Age***, (pp. 67-72). San Francisco: Jossey-Bass.

Clark, Richard E. (1983). "Reconsidering Research on Learning from Media." ***Review of Educational Research***, Vol. 53, No. 4, pp. 445-459.

Clark, Richard E. (1994a). "Media Will Never Influence Learning." ***Educational Technology Research and Development***, Vol. 42, No. 2, pp. 21-29.

Clark, Richard E. (1994b). "Media and Method." ***Educational Technology Research and Development***, Vol. 42, No. 3, pp. 7-10.

Collins, Allan, Joseph, Diana, and Bielaczyc, Katerine (2004). "Design Research: Theoretical and Methodological Issues." ***The Journal of the Learning Sciences***, Vol. 13, No. 1, pp. 15-42.

Edelson, Daniel C. (2002). "Design Research: What We Learn When We Engage in Design." ***The Journal of the Learning Sciences***, Vol. 11, No. 1, pp. 105-121.

Eggen, Paul, and Kauchak, Donald (1997). ***Educational Psychology***, 5th Ed. Columbus, OH: Prentice Hall.

Jones, Toni S. and Richey, Rita C. (2000). "Rapid Prototyping Methodology in Action: A Developmental Study." ***Educational Technology Research and Development***, Vol. 48, No. 2, pp. 63-80.

Knowlton, Dave S. (2001). "Determining Educational Viability in Online Discussions: A Student-Centered Approach." ***Academic Exchange Quarterly***, Vol. 5, No. 4, pp. 162-168.

Knowlton, Dave S. (2002). "Promoting Liberal Arts Thinking through Online Discussion: A Practical Application and Its Theoretical Basis." ***Educational Technology & Society***, Vol. 5, No. 3, pp. 189-194.

Knowlton, Dave S., Knowlton, Heather M., and Davis, Camela. (2000). "The Whys and Hows of Online Discussions." ***Syllabus: New Directions in Educational Technology***, Vol. 13, No. 10, pp. 54-58.

Kozma, Robert B. (1991). "Learning with Media." ***Review of Educational Research***, Vol. 61, No. 2, pp. 179-211.

Lohr, Linda, Javeri, Manisha, Mahoney, Chris, Gall, Jim, Li, Kathy, and Strongin, Dawn (2003). "Using Rapid Application Development to Improve Usability of a Preservice Teacher Technology Course." ***Educational Technology Research and Development***, Vol. 51, No. 2, pp. 41-55.

Reiser, Robert A. (2001). "A History of Instructional Design and Technology: Part 2: A History of Instructional Design." ***Educational Technology Research and Development***, Vol. 49, No. 2, pp. 57-67.

Scanlon, Patricia A., and Ford, Michael P. (1998). Grading Student Performance in Real-World Settings. In Rebecca S. Anderson and Bruce W. Speck (Eds.). ***Changing the way we grade student performance: Classroom assessment and the new learning paradigm***, (pp. 97-105). San Francisco: Jossey-Bass.

Weber, Alan (1996). "Professional Development Schools and University Laboratory Schools: Is There a Difference?" ***The Professional Educator***, Vol. 18, No. 2, pp. 59-65.