Web-Based Tools for Enhancing Teacher Preparation Programs
Helping to Build a High Quality Teaching Workforce

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Abstract: This paper presents the ongoing work for designing, developing, and deploying a web-based support tool for pre-service credential candidates in special education teacher training programs. Our application is divided into two major components: E-portfolio Manager and Lesson Plan Creator. To help reduce the workload of credential candidates as well as improve their professional teaching skills, we have designed the lesson plan creator system with an idea of shortening the amount of time required for creating sound lesson plans. Another parallel and equally important goal is to help faculty manage credential candidates' progress throughout their university credential program. Additionally, ePortfolio collects and manages statistical data for program improvement, thus increasing the quality of teaching. This paper offers our discussion on the advantages of the presented technology, as well as our future plans for further development of this evolving system.

Introduction

Improving educational outcomes for *all* students is the overarching goal of two pieces of recent legislation in the United States. The Individuals with Disabilities Education Act of 2004 outlines regulations to ensure *all* students, especially students with learning differences, have access to evidence-based instructional strategies to benefit from a more stimulating general education curriculum. The No Child Left Behind Act (NCLB) requires that all teachers be highly qualified in content areas and all students be included in annual assessments of student outcomes (NCLB Pub.L.No.107-110, 2002). In response to these stringent new requirements, educational leaders are seeking innovative solutions to improve teacher preparation programs, especially addressing areas of severe shortages like special education, math, and science. We contend that innovative technological tools can strengthen the infrastructure of teacher preparation programs and improve the quality of teachers entering the field. Addressing Barrett's (2004) challenge of creating a tool that simultaneously manages a) an authentic reflective teacher candidate portfolio, and b) an assessment accountability system; we created a tool that effectively achieves both management goals. While an important component of our system is the collection and management of data for our program evaluation and improvement, our central focus here is how our system facilitates an iterative learning relationship between credential candidates, teachers, faculty, and field supervisors that informs and improves teacher efficacy.

Due to the dramatic shortage of special education teachers, new teachers often enter the classroom as the teacher of record at the same time they begin their teacher preparation program. In essence, they are building and flying the aircraft at the same time. Kauffman et al. (2002) report new teachers are receiving little or no guidance about what to teach and how to teach it despite learning about standards-based instruction in their credential programs. The cornerstone of special education for students who require additional services to access the general education curriculum is the Individualized Education Plan (IEP), and every student must have a plan written specifically to meet their individualized needs. In turn, new teachers must create lesson plans that include objectives aligned with IEP goals and state content area standards. In addition, instructional strategies to address lesson plan objectives must be evidence-based, meaning they are promising or proven effective strategies. Finding and implementing empirically sound instructional strategies and interventions is a tall order for special education teachers who enter the field and their own classrooms (at the same time they begin a teacher preparation program) with little or no pedagogical training and less content knowledge in challenging areas such as science and math than

their general education peers (Boe et al. 2007). They face the immense challenges of learning and teaching new content areas, and identifying appropriate strategies to address their students' various learning challenges. Adding to the stress, credential candidates who are also first year teachers are overwhelmed with university work in addition to designing classroom activities. Our technological tools can assist teachers in becoming immediately effective in the classroom by addressing these pressing needs: a) developing an efficient system to manage the numerous tasks required by a university credential program, which includes providing evidence of demonstrated competence in all areas of teaching; and b) providing support in writing effective, evidence-based lesson plans.

In this paper, we describe our ongoing work on designing and developing a web-based tool that consists of two major parts: E-portfolio Manager and Lesson Plan Creator (Electronic Portfolio & Lesson Plan Creator., 2009). The E-portfolio Manager provides a simple-to-use web-based service that manages credential candidates' progress throughout their university credential program by placing critical pedagogical and administrative information at the fingertips of candidates, educators and administrators. A portfolio is an essential part of a candidates' credential program in that it serves as both a tool to reflect on one's developing pedagogical skills, and a tool to demonstrate mastery of the teaching standards required by each state. Prior to the development of electronic portfolios, candidates were overwhelmed with the collection of paper documents that resulted in a cumbersome three to five inch binder. Our system moves paper-based assignments, artifacts and evaluation forms, typical requirements of many U.S. university credential awarding programs, into digital format for efficient management and assessment of credential candidate work. The collected digital data is organized in a searchable database with an intuitive user interface. Additionally, the system collects statistical data for improving our program, thus increasing quality of teaching. This system is designed specifically to meet the needs of program candidates who previously tried to use a commercial program with similar capabilities. However, candidates found the commercial program to be extremely difficult to use, unwieldy, costly, and unable to change to meet developing state and federal teacher requirements.

The Lesson Plan Creator, a basic tool for new teachers to efficiently create evidence-based lesson plans, is embedded in the larger management system. Our system assists in accomplishing the federal requirement of locating and implementing evidence-based instruction that often takes teachers hours to find. Our first step is development of the *educational strategy search engine*. Here we address the design and implementation of an *education research article search engine*. This tool links the IEP goals to specific content standards and allows users to issue a specialized search of literature databases to locate research articles that provide information about evidence-based content-specific strategies at chosen grade levels. We accomplish this task by building a client-server web-system that includes relational databases for the content standard using MySQL. As an example, we discuss an implementation specific for California Content Standards (CACS). Though the United States Department of Education initiated a website in 2002, *What Works Clearinghouse*, to source scientific evidence for what works in education, their strict requirements for inclusion as an evidence-based empirical study prohibit many promising effective strategies from being included (What Works Clearinghouse, 2009). Addressing this shortcoming, we created our system to enable teachers to examine peer-reviewed journal articles that report on both proven *and* promising strategies that may or may not have been tested in randomized controlled trials as well as smaller pilot, single subject, or qualitative studies.

Our technological design may benefit all teacher preparation programs, thereby moving beyond our specific goal of special education teacher preparation. For instance, the developing tool could be helpful in preparing general pre-service teacher candidates for teaching demanding content subjects, such as mathematics and science. A convergent body of research (Cobb et al. 2002; Heibert & Grouws, 2007; Hill et al. 2008; Rose & Meyer, 2006) suggests pre-service teachers need explicit guidance in how to achieve conceptual engagement and counteract the tendency to focus only on specific contents and/or procedures. In addition, scaffolds for engaging students in demanding content areas are important because beginning teachers need explicit alternatives when their first approach with students does not succeed. It is imperative that techniques and strategies to teach difficult concepts to groups of heterogeneous students in inclusive classrooms be chosen with efficacy and ease of implementation in mind. Instructional design must address teachers' discomfort with teaching difficult mathematics concepts (Frykholm, 2004) and the lack of conceptual instructional guidance in classroom materials and texts (Sood & Jitendra, 2007). To address the needs of new teachers who are struggling to become effective special education teachers, our work aims to develop and deploy a web-based tool that exploits evidence-based pedagogical ideas and facilitates building a community to support new and returning teachers.

Our tool directs teacher candidates to proven and promising research-based instructional strategies and curriculum designs that they can utilize in their classroom or professional practice. In this way, new teachers can avoid fads, ineffective practices and personal biases in choosing instructional strategies. In addition, our tool encourages teacher candidates to become informed consumers of educational research. By generating cumulative knowledge of effective practices, these new teachers will contribute to the field's capacity. Our Lesson Plan Creator

immerses pre-service teachers in educational research and enables them to continually move between research and practice. Through the experiences mediated by these web-based tools, our teacher candidates have the following opportunities: a) to deepen their own content knowledge; b) to develop key pedagogical skills; and c) to support beneficial use of technology in teaching. Thus, we address the profound need to build a high quality workforce skilled in teaching foundational content knowledge to diverse and struggling students.

System Requirements

One key point of implementing this web-based application is to study carefully the specifications and requirements since its domain is very specific to issues in typical special and general education programs. Six different types of users with different privileges are first identified. Credential candidates are students of education programs who teach heterogeneous groups of children. Program faculty and instructors are authenticated with one or more of the following roles: program administrator, faculty and university supervisor. Program administrations are responsible for granting user accounts. Faculty and university supervisors are instructors of general and advanced courses. Additionally, mentor teachers are experienced teachers at the schools where credential candidates are student teaching or employed. Finally, our system is also available for guest users such as credential candidates' potential employers.

To ensure the application is secure and easy to maintain, we employ three-tier client-server architecture per the J2EE specification that is widely used. The tiers are separated functionally into user interface, business logic and data access. The user interface tier represents the components that display data and tasks available to the user, as well as handling input. Here, we used J2EE as the system platform and implemented user interface with JSP, HTML and JavaScript technologies. Tomcat served as our servlet container because it is free and endorsed by Sun (Murach & Steelman, 2008). The business logic tier represents application components that make computational and procedural decisions based on calls from the user interface. We created convenient Servlet and Java classes for this layer and applied Object Oriented Design to break the layer into smaller components. The data access layer represents parts that organize, store, and retrieve data. This approach allows us to write reusable and flexible programming code that can be easily extended for new features (Weaver et al. 2003). We use MySQL to manage all of the important system data.

System Design

Lesson Plan Creator

Our target groups (current credential candidates) have experimented with commercial software named "Live Text" (Live Text, 2009), which provides a web based platform for users to create new lesson plans, mange existing lesson plans, and search state content standards. However, users need to pay for the software and spend too much time learning how to use comprehensive functions. Moreover, all of the created data in "Live Text" is treated as propriety and cannot be shared with the general public. Thus, developing an easy-use system that enables candidates to save time and money, and increase efficacy in the classroom provides the basic motivation of our work. When creating a lesson plan, several questions need to be taken into consideration: a) what kind of standards should be used? b) How can users quickly locate appropriate standards? c) How can we ensure a lesson plan is evidence-based? (Kazunori et al. 2009). In the system development, we answer all three of these questions. First, we provide the latest California Content Standards (CACS) covering nine subjects and thirteen grades. Second, all standards are stored in our own database making retrieval fast and easy. The user can find content information by using the standard search function. Third, upon aligning the IEP goals with lesson plan objectives and appropriate content standards, the user can initiate a search for peer-reviewed journal articles from which they retrieve promising and proven strategies for teaching the lesson. We will discuss more details further on.

One of the core features of our Lesson Plan Creator is the flexibility to find appropriate CACS and add them into a lesson plan. There are nine general content areas in California and each of them has hundreds of content standards; looking for an appropriate standard is a tedious and time-consuming task. Candidates can search for the most suitable content standard by entering pertinent information from other fields. For example, a user can choose English Language Arts, grade 3, and writing, to locate the related content standards (refer to Fig. 1). All satisfied results will be returned in a table format ordered by original content standard ID in order to increase readability with

all input keywords highlighted (refer to Fig. 2). In this way, our system quickly narrows down the search scope for the user and easily adds the content standards they requested by selecting content standard ID. This capability enables the user to create the lesson plan efficiently.
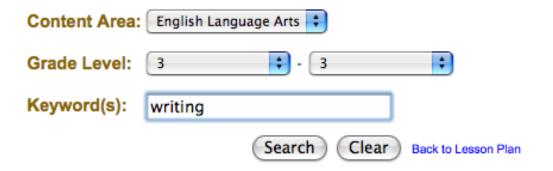

Figure 1: Search criteria for locating certain CACS.

Figure 2: User interface for CACS result list.

The other feature we provide is an article search function that helps users search for peer-reviewed journal articles through the university library. The article search page (refer to Fig. 3) is divided into three parts. First, we display the CACS that have been previously selected by the users for references. Then, we provide a list of article databases related to special education. Users can choose one of the databases and search for an article. The last part of the page allows users to save the information to locate articles for future reference. By using such function, users do not need to hesitate about where to find an article and can save time when searching for appropriate articles.

Figure 3: User interface for article search page.
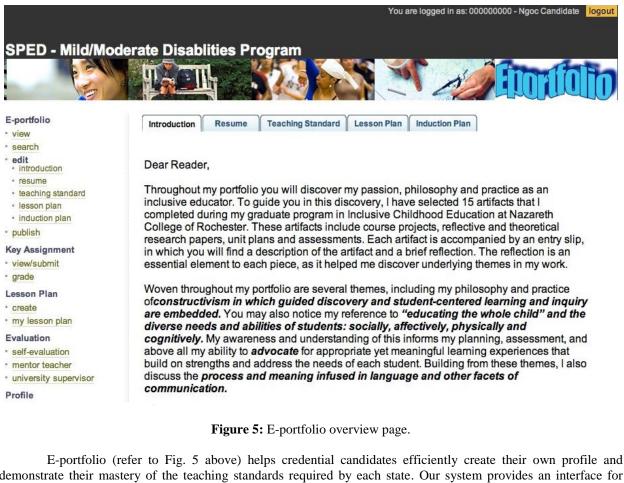
E-Portfolio Manager

E-portfolio manager consists of several parts: key assignment management, credential candidate's e-portfolio, program evaluation and program assessment management. Key assignments and artifacts that provide evidence of teaching competency are unique to education credentialing programs: they are designed to evaluate whether or not credential candidates meet state teaching standards. All required courses are associated with one key assignment which is identified by the administrator of the program. Our application provides a site (Fig. 4) where a

Figure 4: Key assignment management page.

credential candidate can easily submit their key assignment by uploading the file onto the system. In addition, students can create electronic versions of artifacts to upload into the portfolio. Easy management of teaching artifacts and key assignments allows a candidate more time for self-reflection and self-evaluation of his/her developing teaching practice. In turn, faculty can electronically grade key assignment for courses and examine the quality of artifacts. With digitized key assignments and artifacts, as credential candidates' progress through the program, their ability to meet teacher competency standards can be carefully tracked by faculty and staff. In this way, the quality of teachers and their credentialing program can be continuously evaluated and improved.

Our system also provides for more efficient electronic submission of required forms completed by university supervisors, mentor teachers and credential candidates. For general required courses, credential candidates are evaluated by their key assignment work. For advanced courses, university supervisors assess credential candidates' performance in the field by completing observation and evaluation forms three times over the final semester of the credential program. To provide additional feedback and support to credential candidates, mentor teachers also complete evaluation forms three times over the semester. In turn, credential candidates evaluate university supervisors by completing a separate evaluation form. This mechanism also applies to credential candidates' evaluation of mentor teachers after completing the last semester of student teaching with the mentor teacher.

Figure 5: E-portfolio overview page.

E-portfolio (refer to Fig. 5 above) helps credential candidates efficiently create their own profile and demonstrate their mastery of the teaching standards required by each state. Our system provides an interface for uploading files including key assignments and classroom artifacts along with another interface for adding existing key assignments and lesson plans. Uploaded documents can be converted into HTML and viewed directly in the browser (refer to Fig. 6 below). Furthermore, program faculty can evaluate credential candidates' work directly in e-portfolio, without passing a paper binder around as the current authoritative source. Identified users will be able to access the e-portfolios of all credential candidates with their permission. For example, e-portfolio is also a site where future employers may examine a candidate's work.
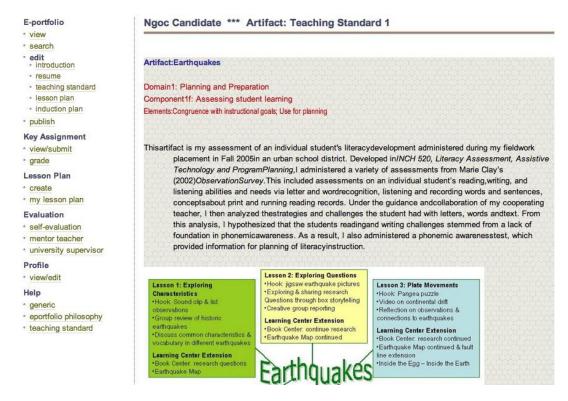
Figure 6: An uploaded document viewed on our site.

Besides helping credential candidates efficiently complete tasks as students and teachers, our application also provides interfaces for administrators to assess their credential program. As mentioned above, faculty can evaluate key assignments, lesson plan and other artifacts and provide feedback to credential candidates. Users with administrator privileges can easily access all candidates' grades as well as the completed evaluation forms. Fig. 7 illustrates how administrators search and view credential candidates' progress throughout the program. In addition, administrators can easily access mentor teachers' demographic information directly in our system. Prior to this system, this information was in paper format making it inconvenient to locate the sources.

Figure 7: Administrator can search/view credential candidates' progress through this page.

Usability Test and Result

In designing and implementing any application, user satisfaction is the most significant metric in measuring success of the product. Applications should undergo user evaluation to test its usability. No matter how careful the designers are and how much of the requirements designers have collected to create the site, they always obtain new ideas from the user evaluation. According to Eccher et al. (2004), users usually spend only 10-20 seconds on the homepage trying to learn about the site. Communication with users through the information shown on each page has to be considered carefully. Therefore, to evaluate the usability of our web tool, we conducted a usability test from July 8 to July 15, 2009.

We randomly selected 11 volunteers from Mild/Moderate credential program to perform the test by answering two questionnaires after completing the given tasks. One questionnaire is related to lesson plan creator part, while the other one is related to E-portfolio manager. There are five scales for each question: Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA). The test is an anonymous self-administrated test that could be done anywhere, at any convenient location, using any available computer.

The statistics data (refer to Tab. 1) for lesson plan creator show that 7 out of 11 answers are positive and 4 questions have negative response. By studying comments from testers, we can divide the disagreements into three parts: 1) Though typeface of character is neat, the font size is too small to view clearly. Currently we are using size 12, but testers prefer a larger size. 2) There are few user instructions in our site, which sometimes make testers confused. An additional user guide will make the site more user-friendly. 3) Compatibility issue for printing. Since we only support Microsoft Word document format, testers who use Mac OS X operating system may have difficulty printing out their lesson plan. We are currently addressing this issue.

Attitude	Questions (#SD, #D, #N, #A, #SA)
Positive	1. It is easy to figure out where and how to input the data. (0, 0, 0, 6, 3) 2. You find the lesson plan template covers enough information you expected. (0, 0, 1, 4, 4) 3. You find the lesson plan template format is simple and useful. (0, 0, 0, 5, 4) 4. It is easy to find CACS search page. (0, 0, 1, 4, 4) 5. It is easy to locate CACS by using search function. (0, 0, 0, 5, 4) 8. It is easy to find article search page. (0, 0, 1, 4, 4) 11. It is easy to view/modify/delete a lesson plan. (0, 0, 0, 4,5)
Negative	6. The layout of CACS result list is clear and well organized. (0, 1, 0, 6, 2) 7. It is easy to figure out how to add CACS to lesson plan template. (0, 1, 1, 5, 2) 9. It is easy to figure out how to add article references to lesson plan template. (1, 2, 4, 1, 1) 10. It is easy to print out lesson plan. (0, 1, 1, 3, 4)

Table 1: Usability test result for lesson plan creator.

For E-portfolio manager, according to Tab. 2, the most critical problem was over file upload. More than 60% testers reflected that they could not upload documents. There were a couple of reasons for this failure: 1) the

Attitude	Questions (#SD, #D, #N, #A, #SA)
Positive	1. The task of viewing key assignments is easy to accomplish. (0, 0, 0, 1, 10) 2. The task of searching and viewing e-portfolio is easy to accomplish. (0, 0, 1, 3, 7) 3. You find viewing credential candidate's progress page is helpful. () 4. You find filling out evaluation forms easy to accomplish. ()
Negative	5. You find registering to this system is easy. (0, 2, 0, 3, 6) 6. It is easy to log into the system. (1, 1, 2, 2, 5) 7. The features of viewing and downloading artifact are helpful. (0, 1, 2, 3, 4) 8. The task of creating e-portfolio introduction is easy to accomplish. (1, 0, 0, 4, 3) 9. The task of uploading your resume is easy. (2, 3, 0, 1, 2) 10. The tasks of add/remove/upload your teaching standard artifacts are easy. (1, 3, 1, 2, 1) 11. On submitting/resubmitting key assignments, it is easy to upload files. (2, 2, 1, 2, 1) 12. The features of viewing/downloading key assignment submissions are helpful. (1, 0, 2, 4, 1)

Table 2: Usability test result for e-portfolio manager.

system was set to only accept certain file formats which could be converted into HTML. 2) If the uploaded file could not be converted due to JODConverter failure, this file would not be saved on the server. Another issue related to file upload was the E-portfolio resume feature. Originally, candidates could only upload their resume and have the application convert it into HTML to be displayed inside their E-portfolio. The third issue is about registration. Two of the testers failed to determine the username required to log onto the system. Therefore, a little instructional note was added to state the username in the registration page to help guide the users in logging to our system.

Conclusion

This paper describes our ongoing work designing, developing, and deploying a web-based support tool for credential candidates in teacher preparation programs. While we have focused on our special education teacher preparation program, our system may be useful for many teacher preparation programs. We have presented the system design and its pilot implementation, consisting of e-portfolio manager and lesson plan creator. This paper presents the system's advantages for facilitating effective, efficient training of teacher candidates in the university teacher preparation program and those candidates who complete the program but wish to continue building their portfolio and using the Lesson Plan Creator.

One of many exciting ideas for our future investigation is to improve our current lesson plan creator, which currently only outputs research articles. To enhance our current tool, we are collecting relevant and important articles, from which graduate students under our guidance, manually extract proven and promising instructional strategies in their methodology sections. Such collected strategies and interventions can be organized in a database that can be incorporated into our lesson plan creator. With such a tool, teacher candidates will be taken one step closer to implementing research to practice by having easy access to the extracted promising strategies.

Future research ideas include the following: a) covering more content areas than what we are currently supporting; b) deploying the complete system in additional credential programs to examine its efficacy; and c) investigating how to adopt our system to different programmatic contexts in other countries and educational cultures. Our site (Electronic Portfolio & Lesson Plan Creator., 2009) was first released in early September. We are continuing to maintain and improve it.

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