WEB-BASED TOOLS FOR ENHANCING TEACHER PREPARATION PROGRAMS

Helping to Build a High Quality Teaching Workforce

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Abstract: This paper presents our ongoing work for designing, developing, and deploying a web-based support tool for pre-service credential candidates in special education programs. Our web-based 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 a lesson plan creator system with the idea of shortening the amount of time required for creating sound lesson plans. Another parallel and equally important goal is to help programs manage credential candidates' progress throughout their university work. Our application will move paper-based assignments, artifacts and evaluation forms into digital format for efficient management and assessment of credential candidate work. Additionally, it 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.

1 INTRODUCTION

Improving educational outcomes for *all* students is the overarching goal of two pieces of recent legislation in the United States (U.S.). The Individuals with Disabilities Education Act of 2004 (IDEA 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 (No Child Left Behind Act 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, Shin, & Cook, 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. 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 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, Yackel, & McClain, 2002; Heibert, & Grouws, 2007; Hill et al., 2008, p 430-511; 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 on-line 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.

This paper introduces our technical contributions in Sections 2 and 3. Section 4 concludes this paper by discussing our contributions and the planned future work of our ongoing study.

2 FUNCTIONAL 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 advance courses. Additionally, mentor teachers are experienced teachers at the schools where credential candidates are employed. Finally, our system is also available for guest users such as credential candidates' potential employers. To manage credential candidates' progress throughout the credentialing program, as well as to provide evidence-based lesson plan preparation, our system is broken down into the following sub-systems.

2.1 Management of Teacher Competency

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 where a 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 artefacts 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.

2.2 Evaluation of Credential Program

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.

2.3 Lesson Plan Creator

Our target groups, teacher candidates, have experimented with an existing commercial software, "LiveText" (Live Text, 2009). Although this software provides a comprehensive platform for users to create a lesson plan, it is costly, inefficient, and difficult to change. Moreover, all of the created data in "LiveText" is treated as propriety and cannot be shared with the general public. Our candidates have limited computer background and even less time to spend learning how to use complicated software. Thus, developing our own system that enables teachers 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 content standards should be used? b) How can teachers find the appropriate standards? and c) How can we ensure a lesson plan is evidence-based? In the development of our system, we answer all three of these questions. First, the user can search all state content standards by using the standard search function. Second, we store all California content standards in our own database making retrieval fast and easy. 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.

2.3.1 Lesson Plan Template

The Lesson Plan Template guides the user in the creation of an evidence-based lesson plan that meets the stringent new requirements for implementing sound instruction in the classroom. The template enables the user to create, modify, and view lesson plan template items, and then print the lesson plan or save in the template form.

2.3.2 California Content Standard

Our system provides an interface for credential candidates to search CACS, select appropriate standards from the result list and add them into their lesson plan. Credential candidates can efficiently find CACS by inputting content areas, grade levels and possibly keywords into our search engine.

2.3.3 Peer-reviewed Journal Article

Our system also provides another similar interface for searching and adding peer-reviewed journal articles into lesson plans. We are currently collaborating with various departments to gain access to multiple digital databases and return the search result to our users.

2.4 E-portfolio Manager

E-portfolio helps credential candidates efficiently create their own profile, including background and resume, in a short time period. Credential candidates can demonstrate their teaching competency with key assignments and classroom artifacts, which include but are not limited to PDF files, video clips, and lesson plans. Our system provides an interface for uploading PDF files and video clips along with another interface for adding existing key assignments and lesson plans. 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 e-portfolio of all credential candidates with their permission. For example, e-portfolio is also a site where future employers may examine a candidate's work.

3 SYSTEM DESIGN AND IMPLEMENTATION

The following describes our ongoing system design and implementation work.

3.1 Application Structure

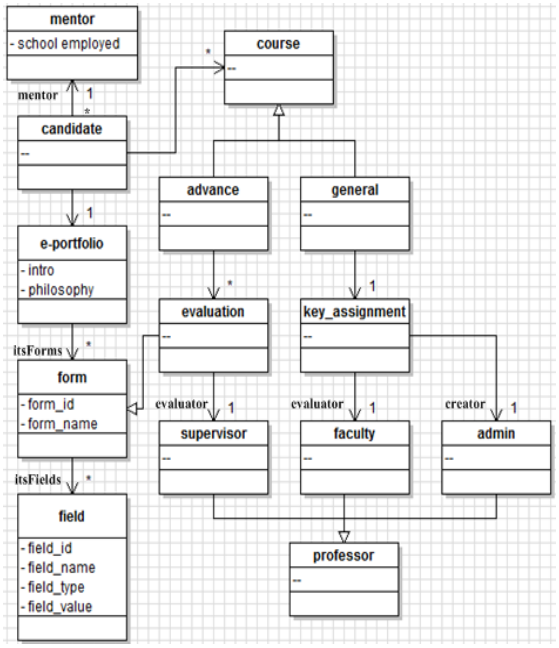

Figure 1: Simplified Class Diagram.

All functional requirements identified above are converted into classes as depicted in Figure 1, a simplified UML class diagram. We designed Administrator, Faculty and University Supervisor as derived classes of Professor class because these user types share several common attributes and behaviors. In addition, some users of the system can play more than one of these roles.

Credential candidates design their e portfolios by completing electronic versions of forms, previously existing as hard copies only, now embedded within our easy to use template. These forms are designed to be instances of the class named Form, which includes many different fields as well as their values.

As mentioned above, faculty and university supervisors are instructors of general and advanced courses. Credential candidates are evaluated by key assignments in general courses and mentor teachers and university supervisors' evaluations in advanced courses as demonstrated in Figure 1.

3.2 Database Design

Our ultimate goal is the design of a sound database with optimized data integrity. Similar to many other web applications, the e-portfolio system is responsible for managing users of the system. The database design process starts with identifying all the necessary information of different users. Another characteristic of our system is that credential candidates are in the center of the connected multiple sub-systems. We used ER Design Tool software to design the database schema (Liu, Vincent, & Murphy, 2006).

One consideration we take into account is how different actors of the system are deeply connected. For example, credential candidates, faculty, administrators, and introductory/general courses are tied together by key assignments. For each introductory or general course, credential candidates are required to submit one key assignment. Key assignments are created and assigned to courses by administrators while faculty members teach the course and grade the key assignments. To design a light and complete schema that reflects all necessary information is a challenge. In addition, the evaluation sub-system has a similar concept of how credential candidates interact with mentor teachers or university supervisors. Figure 2 shows our simplified database schema for the key assignment sub-system.

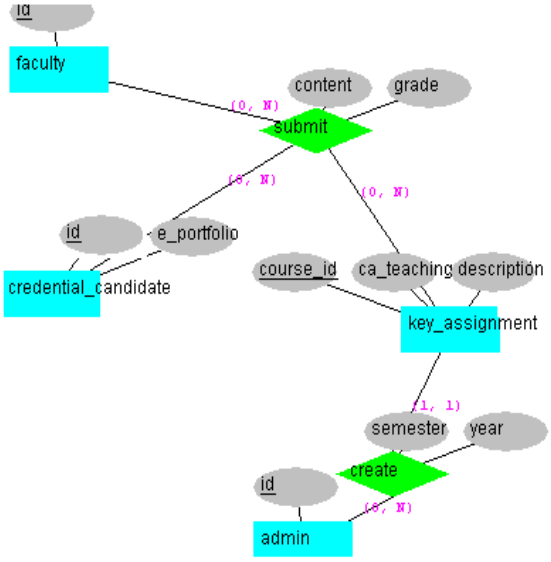

Figure 2: Key Assignment Data Schema.

For The Lesson Plan Creator, we house the content standards data. Each standard is specific to grade levels and content areas such as Math or

English. One content standard may be applicable for more than one grade level and/or content area. Therefore, our job is to eliminate this kind of data redundancy. To achieve that, we include three entities: content standard, grade level and content area to present all the content standards instead of storing each standard separately.

3.3 Interface Design

During the user interface phase, there are two main aspects of the system that are taken into account. First, the front end interface is required to follow our institutional university web-site template. Second, we design an easy-to-use web application. Our main users, credential candidates, are graduate students who are simultaneously teaching full-time. Their time constraints and limited computer background must be considered. Therefore, having a user-friendly and well guided interface is very important. In addition, when creating lesson plans that align content standards with objectives and goals to initiate a search of peer-reviewed journal articles, it is more important to construct an intuitive and simple interface than an overly attractive one, rich in superfluous features.

One of the core features of our Lesson Plan Creator is its 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; finding an appropriate standard is a tedious and time consuming task. Candidates can search for the most appropriate content standard by entering pertinent information from other fields. For example, a user can choose mathematics, grade 2, and subtraction, to locate the related content standards (refer to figure 3).

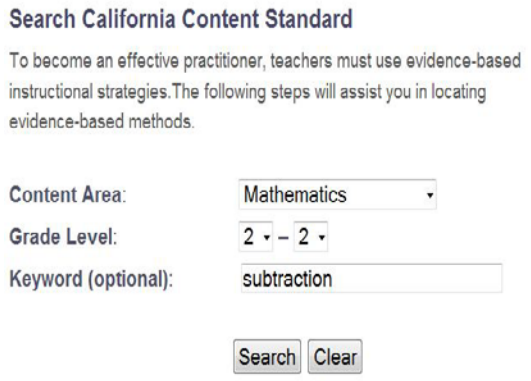

Figure 3: User Interface for CACS Search Page.

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 figure 4). 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.

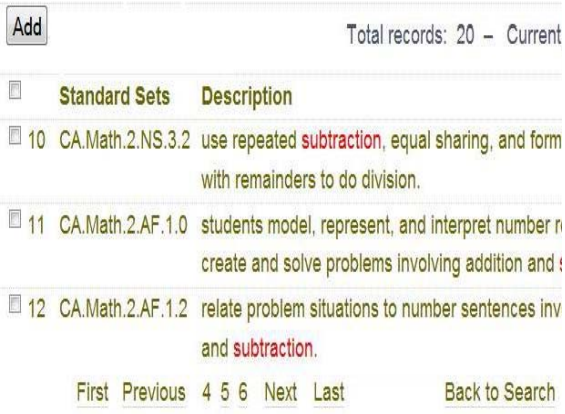

Figure 4: User Interface for CACS Result List.

3.4 System Architecture

This web-based application employs 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. The business logic tier represents application components that make computational and procedural decisions based on calls from the user interface. The data access layer represents parts of the application that organizes, stores and retrieves data, sometimes from multiple data sources. This approach allows us to write reusable and flexible programming code that can be easily extended for new features (Weaver et al., 2003).

J2EE - Java 2 Platform Enterprise Edition was chosen as a platform not only because of the capability for creating flexible and reusable components. It also contains the various reliable and readily available libraries needed to quickly implement a web application, include role based authentication and control security (Core J2EE Patterns – Data Access Object, 2003) and an abstracted database access API (Securing J2EE

Applications, 2002). HTML and JavaServer Pages are used to implement the user interface. Javascript is included for the interface enhancement. We are writing the business logic layer using Servlet and Java classes. We apply Object Oriented Design to break this layer into smaller components. We also choose Tomcat as our servlet container because it is available at no cost, and it is widely used and endorsed by Sun (Murach, & Steelman, 2008).

For the database layer, we use MySQL for data storage and retrieval. MySQL is popular among web developers, not only because it is inexpensive and lightweight when compared with Oracle Database or Microsoft SQL Server, but also because it runs fast and can run on most modern operating systems, while other products can only run on specific systems (Murach, & Steelman, 2008). MySQL is well suited for web applications which have a small or medium sized user base such as our system. In addition, we chose Java DataBase Connectivity (JDBC) drivers for linking the application layer and database layer. JDBC is supported by J2EE which is an enhanced version of ODBC driver.

4 CONCLUSIONS

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 argues 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. In addition, we continually keep the field abreast of new promising and effective strategies for teaching. We currently have funding for one mathematics and one special education graduate student to begin reading and extracting methodologies from peer-reviewed mathematics education journals.

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.

ACKNOWLEDGEMENTS

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