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Increasing Pre-service Teacher Science Test Success with a Tutorial CD

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Abstract: Pre-service teachers often perform poorly on high-stakes state certification exams. Noting that there were a few particular items and concepts that seemed to be the most problematical, the authors developed a n HTML and flash-based tutorial CD that contained supplementary video and reference materials designed to assist the prospective teacher in preparing for the exam. Research subjects were studied for their preparation for self-regulated learning, as well as language environment, content background, and other factors. Data from scores on the teacher certification exam was correlated with CD use and demographics to identify the effectiveness of the CD tool as an aid for various categories of learners, including non-native speakers of English.

Pre-service Teacher Preparation and Success in Certification Exams

Pre-service teachers in Texas receive their license to teach via a program of study in number of ways. There are university-based programs, which combine university coursework, school clinical practice partnerships, and pre-qualifying exams as part of their program – the system that is in place at many universities, including the University of Texas at El Paso (UTEP). There are also a number of alternative preparation programs, including ones associated with Texas' 20 Regional Education Service Centers, and alternative private programs. What all of the programs have in common is the requirement that a teacher pass at least content and eventually a pedagogy exam before receiving a teaching certificate in the state. At UTEP, the students seeking Early Childhood to fourth grade (EC-4) or Middle Grades (4-8) certifications have been having a problem passing the science objectives of the content pre-qualifying and certification exams. To address this issue, an initiative has been developed to explore ways to use technology to provide support mechanisms for students preparing for their pre-qualifying and certification exams. One mechanism has been the development of a hybrid, HTML-based Compact Disc (CD) that contains flash video tutorials and study materials that walk the user through many of the more problematical science objectives – and provide additional support through web-based materials and interactive discussions. The research team has begun the development of this CD-support tool, and is studying its effectiveness in assisting students to improve their science content scores. This paper reports on the progress of the development of the tool to date, with data on the CD design, measurement instruments, and particular strategies for supporting the high level of non-native speakers of English that are a factor in the pre-service teacher population in the Texas-Mexico border region.

The Population

The City of El Paso, Texas is a bustling urban area of 600,000 people, more than 70% of whom are Mexican in origin. Across the river from El Paso sits the Mexican City of Juárez, a city of more than 1.2 million people; El Paso/Juárez represents the largest metropolitan area along the 2,000 mile U.S./Mexico border. Almost a quarter of El Paso's population is foreign born, and over 50 percent of El Paso's households speak Spanish as the language of preference.

The population of the El Paso metropolitan area is 84% Hispanic (UTEP CIERP, 2005). According to the 2000 Census data, this border region is one of the lowest socio-economic urban areas in the United States. Furthermore, just nine percent of the residents of the community have a college degree. 2004-2005 data shows a campus that is 72% Hispanic, with approximately 1,800 of UTEP's 20,000 undergraduate students pursuing degrees or certification plans the College of Education. In fall 2004, 1,500 students were Mexican citizens. El Paso is no longer unique in having a significant Hispanic population – the National Center for

Education Statistics notes that The Hispanic population in the United States is growing more than any other population and is projected to be the largest minority group in the country by 2005 (NCES, 2003). Most students in modern universities have a personal computer and an Internet connection available to them, so providing a CD-based tutorial tool that the students can use away from their classrooms is a logical way to support their preparation for high-stakes tests (Lehnart, A., Simon, M., & Graziano, M., 2001).

At UTEP, the College of Education focuses on the preparation of future educators in a program that is collaboratively designed and managed. University faculty, public school personnel, and family/community members work together to design, implement, and evaluate educator preparation programs that aim to serve the needs of the diverse student population of the border region. Working together with these partners, the College of Education graduates more than 500 teachers each year; many of these novice teachers are the first in their families to attend college. Education students at UTEP represent a promising pool of potential teachers, ready for opportunities to become highly qualified teachers and leaders for the next generation of children and youth, especially those from culturally and linguistically underrepresented populations.

Science Education in Diverse Contexts

In science and mathematics, the critical need for preparing high quality teachers with solid understanding of learning theory, extensive pedagogical skills and a full range of content knowledge is magnified by national scrutiny in relation to U.S. public schools. Recent international reports, for example, found that U.S. education had a “splintered vision”; standards in science and mathematics education are not only unfocused, but frequently aim at the lowest common denominator (Schmidt et al., 1997). Compared to teachers in 50 other countries, U.S. science teachers are expected to address a wide range of subjects, yet they seldom have the time to teach them in depth. As a result, pupils often take a piecemeal approach to learning content information as the boring memorization of facts that are seemingly irrelevant to their everyday lives. Moreover, the research indicates that the performance of U.S. fourth-graders in both mathematics and science was lower in 2003 than in 1995 relative to the 14 other countries that also participated in these international studies (IEA, 2005).

A goal of UTEP’s teacher preparation program is that future teachers/learners develop the skills and knowledge needed to work effectively with all children, including English Language Learners (ELLs) and recent immigrants in culturally, linguistically diverse communities/schools. Extensive experiences in K-12 schools and classrooms are presently required of all pre-service teachers who spend 650 hours over two semesters in Professional Development School (PDS) classrooms, and are grouped in cohorts in their university classes and field experiences. In any given semester, approximately 500 pre-service interns are assigned to field experiences in high-need partner schools, many of which have predominantly Hispanic student populations.

Identified Need in Science Education

In 2005, the College of Education had 745 students that went through their initial certification exam process. Of these 745 participants, 77 percent were female and 22 percent were male. In addition, 76 percent of these students were Hispanic, 14 percent were White and 2 percent were African-American. Students seeking certification in the middle school areas form a small percentage of this group (15 percent). In 2005, there were 110 student seeking certification in one of the following middle school specializations: Generalist 4-8, Bilingual generalist 4-8, Mathematics/Science 4-8. On average, students in middle school specializations do not pass their content exams on the first attempt and generally require two to three attempts prior to passing. In addition, the overall average score for the first attempt at these exams is markedly lower than other specialization areas (235 v 248). In relation to these statistics, middle grades students have particular difficulty with the tested domains related to science content. By extending the study to include both EC-4 and 4-8 levels, the researchers hope to positively impact the preparation of pre-service teachers in the area of science education and thereby positively impact the results in science for the students they will serve in schools.

The Procedure

Early in their penultimate semester, each student in the UTEP teacher preparation program seeking teacher certification as either the EC-4 generalist, EC-4 Bilingual Education Generalist, 4-8 Generalist, 4-8 Science specialist, and 4-8 science-math specialist certifications will be provided the science objectives tutorial CD along with a brief explanation and demonstration of its use. At that time they will be administered the MSLQ. During the same semester students take their pre-qualifying exam, a university-developed version of the teacher certification exam for their area that utilizes released questions from previous state certification exams. If student subjects receive an adequate score on their pre-qualifying exam, they are eligible to take the state certification exam in their content area. Scores from the pre-qualifying exams and the certification exams, and in particular the achievement on the specific science objectives addressed by the CD will be correlated to the individual subjects' use of the CD, MSLQ results, and their self-reported social language environment category. Data on student performance in science objectives on these tests is also available for previous years. The research team will then explore correlations among these factors via multivariate analysis of variance (MANOVA) utilizing the Statistical Package for the Social Sciences (SPSS).

Web-connected "hybrid" CDs

The Compact Disc (CD) format has become a common method of delivering content in digital form. It is almost universally accessible and web-based data CDs are well supported by modern computer operating systems (Immink, 1998). The research team is using a CD with HTML-based interface, along with Flash video and MP3-based audio as its form of tutorial media distribution because of these tools' cross-platform compatibility and ability to connect to online resources via embedded hyperlinks. A data CD that is able to connect to the Internet (if an online connection has already been established) is popularly referred to as a "hybrid" CD (not to be confused with a similar term for CDs that have been created to play on both Apple and Windows computer systems). Minimum recommended requirements for the CD user are a computer with a high-color video display, an audio system and speakers, a CD-player, a modern operating system (Windows 2000 or above, Macintosh 9 or above, Linux with KDE or Gnu), a modern browser (Netscape 6 or above, Internet Explorer 5 or above, or the equivalent, such as Mozilla), and the Flash 7 plugin. An appropriate Windows version of the Mozilla Firefox browser that does not require installation (Portable Firefox) is included on the CD.

The Motivated Strategies for Learning Questionnaire (MSLQ)

Paul Pintrich and his colleagues developed the Motivated Strategies for Learning Questionnaire (MSLQ) in the late 1980s and popularized its use in the study of motivation in the early 1990s. The MSLQ is a paper and pencil questionnaire tool for measuring of students' motivation and use of cognitive and self-regulatory strategies. It measures several motivational constructs, including self-efficacy, intrinsic value of learning, and test anxiety, along with students' cognitive strategy use and self-regulation (Wigfield, Zusho, & De Groot, 2005). It has been adapted to online forms, including shortened and full versions available in web-based forms. One of the premiere tools for studying preparation for learning, especially self-regulated learning, the MSLQ has spawned a number of similar instruments over the years. It was validated for use in 1993, and has become an established tool in the study of motivation since then (Pintrich P., Smith D., Garcia T., McKeachie W., 1991; Pintrich P., Smith D., Garcia T., McKeachie W. 1991). The MSLQ is being administered to all participants in the study in this study to identify student learning strategies, habits, and preparation for self-regulated learning – noting that the use of a CD tutorial would likely be more likely among students with a higher degree of self-regulation.

The CD Satisfaction and Language Environment Survey

The CD satisfaction and language environment survey is being administered to each participant at the end of the study. It collects demographic information about the subjects (gender, age, etc.) and also asks the subject to self-report their social language environment, using the questions listed below:

- My family and/or friends are monolingual English speakers - English is the only language they normally use.
 - My family and/or friends are Spanish speakers - Spanish is the only language they normally use.
 - My family and/or friends are multilingual English-Spanish speakers - They use both English and Spanish on a regular and roughly comparable basis.
 - My family and/or friends are multilingual English-Spanish speakers - They use both English and Spanish but they tend to speak more English than Spanish.
 - My family and/or friends are multilingual English-Spanish speakers - They use both English and Spanish but they tend to speak more Spanish than English.
 - My family and/or friends are multilingual - They use both English and other languages (besides Spanish) regularly.

The subjects are also asked to identify any problems they had with the use of the CD or its interface, and the amount of times they used it. Finally, they are asked to document which tutorials they completed, and which, if any, they did not complete. The data collected will be correlated with student MSLQ categories and scores on pre-qualifying and certification exams.

The Study

The major function of the research component will be to collect data and information in order to improve student learning in the area of science through the certification process. The comparison of the students utilizing the resources available on the CD versus those students not utilizing the resources on the CD is the comparative basis for the study. The use of the Internet can not be randomly assigned or monitored outside of the context of the CD distribution. The effectiveness of this teaching and learning resource will be tested in part through this evaluation. In order to resolve these issues, evaluation strategies will be used that are associated with summative evaluations. In any assessment program, the uses of multiple methods and data sources are recommended in order to ensure the validity and reliability of the data and the findings (Isaac, 1971).

Data Analysis Process

This research study may be defined as the design, collection, and interpretation of data and information in order to understand the value of an instructional methodology (Isaac, 1971). To measure the increases in student learning in science and technology, specific educational objectives will be tested and the results analyzed. The educational objectives reflect the core skills that students need to achieve in the area of science need to complete as stated by the state and national science standards. Students participating in the research study will be enrolled in one of UTEP's early childhood or middle grades teacher preparation programs. These programs include the EC-4 generalist, EC-4 Bilingual Education Generalist, 4-8 Generalist, 4-8 Science specialist, and 4-8 science-math specialist certification areas. Each evaluation instrument will be administered twice to each participant over the course of the intervention.

The quantitative findings will be analyzed utilizing a multivariate analysis of variance (MANOVA) analysis which by definition is useful for assessing differences across the dependent variables. It also allows the researcher the opportunity to look for significant effects from the independent variables on the dependent variables. Finally, it can be useful to determine the interaction effects from within subjects and within groups. Each one-way MANOVA will measure one main effect. For each of the focus areas, there will be a one-factor MANOVA test that will measure the differences in test scores over time. The dependent variable will be the student sample sizes and the independent variable will be the scores of each test

over time. As the sample is further analyzed, a second independent variable may be utilized. The resulting two-factor MANOVAs can be further analyzed using the interactions and effects of the independent variable of test score by the separate independent variables of collected demographic information. This will be done in order to measure the differences across the sample in test scores over time for each additional independent variable.

The populations will be from similar demographic and geographic locations in the city of El Paso in the state of Texas. Possible analysis strategies include using a one-factor repeated measure MANOVA with a within-subjects design will be used across the sample and each student (subject) will serve as her/his own control. A two-factor repeated measure MANOVA can also be used to test the interaction effect between test score and the demographic that are self reported as part of the survey instruments. The alpha level will be set for the comparison analysis at .05.

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