Teaching Information Literacy Skills to Prepare Teachers Who Can Bridge the Research-to-Practice Gap

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This paper explores ways in which academic libraries can partner with colleges of education to prepare teachers who can apply research to their practice. Federal mandates such as No Child Left Behind (2001) and the Individuals with Disabilities Education Act (2004) require teachers to implement evidence-based practices in their classrooms, which presents a challenge to teacher preparation programs and raises important questions about the nature of evidence in education. We believe that information literacy (IL) skills are critical in preparing teachers who can thoughtfully, critically, and ethically implement evidence-based practices. We report the results of a study into the effectiveness of infusing IL throughout the coursework of a teacher preparation program at the University of New Mexico. We describe the collaboration between library and education faculty, the development of an instrument designed to measure IL skills, and results that revealed a statistically significant difference between the pre and posttest scores of teacher preparation cohorts. We conclude that the integration of IL into coursework is a key element for teacher preparation programs.

The No Child Left Behind Act (NCLB) of 2001 and the 2004 reauthorization of the Individuals with Disabilities Act (IDEA) increased expectations for academic achievement for all students.[1] One of the major guiding principles of NCLB and IDEA is scientifically based intervention, also known as evidence-based practice. This principle states, "Highly qualified teachers will use research-based curricula and instructional methods."[2] Under IDEA, this principle extends to the evaluation as well as the instruction of students. Complying with the federal mandates based on this principle presents a significant challenge to teacher preparation programs.[3] We believe colleges of education (COEs) must go beyond an attitude of compliance or noncompliance with these mandates. We must prepare teachers who can design and implement evidence-based practices and who can also thoughtfully and ethically articulate and justify these practices. To achieve this purpose, COEs must improve their students' information literacy (IL) skills. We believe this provides an impetus and opportunity for increased collaboration between COE and University Libraries faculty. This article will describe the ways in which

COE and University Libraries faculty have worked together at the University of New Mexico (UNM). We will report research documenting our progress toward addressing the challenge of preparing teachers who can bridge the research-to-practice gap through the infusion of IL skills throughout the coursework of the Special Education Dual License Teacher Preparation Program.

EVIDENCE-BASED PRACTICE

IDEA identifies two major barriers to improving educational outcomes for students with disabilities. The first is low expectations and the second is "an insufficient focus on applying replicable research on proven methods of teaching and learning for student with disabilities."[4] In the 2004 reauthorization, IDEA was brought into alignment with NCLB by including the same requirements for scientifically based interventions.[5] IDEA (2004) defines "scientifically based research" as research that

1. employs systematic, empirical methods that draw on observation or experiment;
2. involves rigorous data analyses that are adequate to test the stated hypotheses and justify the general conclusions drawn;
3. relies on measurements or observational methods that provide reliable and valid data across evaluators and observers, across multiple measurements and observations, and across studies by the same or different investigators;
4. is evaluated using experimental or quasi-experimental designs in which individuals, entities, programs, or activities are assigned to different conditions and with appropriate controls to evaluate the effects of the condition of interest, with a preference for random-assignment experiments, or other designs to the extent that those designs contain within-condition or across-condition controls;
5. ensures that experimental studies

are presented in sufficient detail and clarity to allow for replication or, at a minimum, offer the opportunity to build systematically on their findings; and

6. has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review.[6]

While teachers need to understand the requirements of federal legislation, they also need to be able to address the question "what is evidence?" in a thoughtful and critical manner. This currently is a major area of debate in the field of education and constitutes a large part of the context within which IL skills must be developed.

EDUCATIONAL RESEARCH

In response to the mandates of NCLB and IDEA, many questions have been raised as to the nature of research and the meaning of evidence-based practice in the discipline of education.[7] There are concerns about special education in particular.[8] One of the major criticisms of the federal definition of evidence-based practices is that the concept is too narrowly defined as only including experimental research. Erickson and Gutierrez state that "within the executive and legislative branches of the federal government a leap of faith has been taken toward belief in the unmixed blessings of hard science-causal analysis by means of experiment as the only way to improve educational research."[9] With regard to special education in particular, Danforth laments that the U.S. Department of Education "has taken a 'hard science' stance on what counts as knowledge, calling for experimental designs that are more common to medical research than to educational inquiry."[10] For example, the National Research Council (NRC) report took up the challenge of what constitutes scientific research within the field of education.[11] The NRC report acknowledged the importance of multiple methods in educational research,

but Lather and Moss are representative of many educational researchers who expressed concern about "the kinds of research that appeared to be ignored or relegated to the margins of the debate as not scientific and about the effects of these choices."[12] Other critics of this report believe that the authors failed to take into account the complexity of educational research.[13] Another criticism is that the report fails to address the challenges represented by research in effective practices for students with exceptionalities.[14]

Educational research takes place in contexts where the kinds of controls that exist in the hard sciences are not possible. Classrooms and schools represent dynamic contexts that are constantly changing on a minute-to-minute, hour-to-hour, and day-to-day basis as a result of the complex interactions between the human beings in these environments. This requires the use of multiple methods of educational research, including both qualitative and quantitative methodologies. Research in special education brings its own challenges as a result of the variation within and between exceptionalities and the lack of consistency in how exceptionalities are defined and diagnosed in different states and school districts. Further complications in the field of special education include the ethical and legal considerations in following the requirements of the Individualized Education Program. As a result, leading researchers on special education have proposed "that research and development on effective practices in special education exists on a continuum, with each methodology matched to questions arising from different points of the continuum."[15] These methodologies must include correlational, single-subject, and qualitative designs in addition to experimental designs.

The term *scientifically based* is used interchangeably with *evidence-based* in the educational literature to describe educational practices based on research. We will use *evidence-based* throughout this article. As noted above, the reauthorization of IDEA 2004 proposed that the lack of progress for

students with disabilities resulted from teachers not using "proven methods of teaching and learning for students with disabilities."[16] The challenge to teacher preparation programs is to make sure we address the requirements of federal legislation regarding evidence-based practices while recognizing the unique challenges of deciding what constitutes evidence in complex educational contexts. It is hard to imagine how teachers can begin to address issues surrounding evidence-based practices if they do not develop competencies in IL that are both general and discipline specific. We believe that this needs to take place within the context of their teacher preparation programs.

INFORMATION LITERACY

Rockman defined IL as "the ability to find, evaluate, analyze, integrate, communicate, and use information to solve problems, create new ideas, make informed decisions, and turn data into meaning."[17] These are critical skills if teachers are to implement evidence-based practices in classrooms in ways that benefit their students. Though the academic library has taught research skills for decades, much of what librarians taught was the skills for finding and sometimes evaluating information, leaving the rest of the IL process to the student and the classroom faculty.[18] It wasn't until 1989 that the ALA Presidential Committee on Information Literacy declared IL "a survival skill in the information age" and recommended that librarians, teachers, and academic and government education agencies incorporate IL into research and practice.[19] As a result, the Association of College and Research Libraries (ACRL) developed IL standards and performance indicators for use by faculty and librarians when implementing programs. ACRL stated that an information literate individual is able to

- determine the extent of information needed;
- access the needed information effectively and efficiently;

- evaluate information and its sources critically;
- incorporate selected information into one's knowledge base;
- use information effectively to accomplish a specific purpose; and
- understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally.[20]

These standards clearly address the competencies needed by teachers to thoughtfully and critically address the federal requirement to develop and implement evidence-based practices in their classrooms. We believe that one of the barriers to applying educational research is a lack of IL skills in a world where the complexity and amount of information available has grown exponentially over the past two decades.

Teacher education programs have collaborated with academic libraries for more than a century, with mixed results. O'Hanlon reviewed "selected writings relevant to the continuing struggle to establish library instruction programs for future teachers."[21] In studies and surveys published between 1898 and 1987, she found that the literature focused on the library skills needed by teachers, complaints that they lack these skills, and models and methods for providing library skills to teachers-in-training. She concluded, "Librarians have attempted to convince educators of the value of bibliographic instruction for teacher trainees for more than eighty years, without much success."[22] Fifteen years later, Johnson and O'English saw some progress, with examples of successful collaboration between faculty and librarians.[23] Most of the publications in their annotated bibliography describe programs and projects; discuss the role of librarians, teachers, and administrators and their collaboration; and advocate for the benefits of IL.

What factors contributed to the progress noted by Johnson and O'English? Carr provides some evidence in her digest examining the relevance of IL to teachers.[24] She points to the ALA Presidential Committee on Information Literacy's call for "restruc-

turing of the learning process" to include IL and the follow-up progress report from the National Forum on Information Literacy. The Committee recommended, "Teacher education and performance expectations should be modified to include information literacy concerns."[25] Carr also points to "guidelines and position statements on what information-literate teachers need to know" developed in 1992 by ACRL's Education and Behavioral Sciences Section and in 1995 by the American Association of School Librarians.[26]

Despite this increased attention, only a handful of research studies provide evidence of program or student success. Visscher merely describes the library skills she presented to a class of students in a special education class.[27] Librarians and education faculty at California State University, Long Beach, developed a set of seven online lessons that illustrate IL processes and offer videos that provide case studies for preservice teachers with the goal of incorporating the skills into their professional practice.[28] The author claims that students who took the online lessons gained information competence, but provides no examples or evidence.[29] Franklin and Toifel administered pre- and posttests to undergraduate and graduate education students to test the effectiveness of their library instruction program; they found a statistically significant improvement in general knowledge of the library as well as specific knowledge of the online catalog and education indexes.[30] Note that these reflect the time period and are narrow information-finding skills rather than broader IL skills. Templeton and Warner collaborated to integrate IL into a teacher education course using a constructivist theoretical framework.[31] Over the course of eight semesters, they surveyed faculty and students and analyzed documents to develop a qualitative case study. They found that the partnership between faculty and librarian and the student project enhanced teacher candidates' IL and teaching skills. Librarians Witt and Dickinson describe their collaboration with education faculty to teach IL skills to pre-service teachers.[32] After the

students become teachers, it is their hope that they will in turn teach IL skills to their students. They administered a pretest and indicated that they planned to assess the results once the program had completed its cycle by comparing the results with a posttest, but neither researcher continues to work at the university involved in the study, so a follow-up assessment is unlikely. Asselin and Lee describe the IL project they integrated into a Canadian teacher education program.[33] The collaboration between library school faculty, education faculty, school librarians, library associations, and a curriculum theorist led to the development of an IL lesson plan. A comparison of projects completed by preservice teachers before and after the lesson found that they recognized IL more as a process, that they linked resource-based learning and IL to critical thinking, and that they could teach these processes to students from the youngest ages in partnership with the school librarian. Also in Canada, Branch gave a pre– and posttest to preservice teachers to assess how their understanding of IL changed after participation in a class on resource-based teaching.[34] She found that the preservice teachers' definition of IL expanded, but that few respondents made the connection between their own IL skills and teaching those skills to their students.

There is even less published research linking the requirements of evidence-based practice in the context of education, NCLB, and IDEA. The studies that have been published examine why teachers choose not to use evidence-based practice. Boardman et al. conducted focus group interviews with special education elementary reading teachers and found that they were skeptical of research claims, especially when programs were pushed by the school district.[35] Teachers felt that research studies were often not relevant to their student populations, and even when they were the teachers faced barriers of time, access, and inadequate training and support. Teachers felt that in many cases experience was superior to research. In the United Kingdom, Williams and Coles surveyed and interviewed teachers on their ability to find, evaluate, and use educational research literature.[36] Despite the fact that teachers value the idea of using research (especially if they themselves are involved in research projects), low confidence in their IL skills, lack of time, and limited access to resources resulted in low rates of use of research as evidence in actual practice. Landrum et al. echoed these findings, hypothesizing that teachers do not find published research useable.[37] They found that teachers preferred reading research that had been reformatted into a teacher-friendly recommendation rather than an academic text. Landrum et al. propose that researchers supplement the dissemination of their findings with an easily understandable version.

We believe that the solution to this teacher skepticism, low confidence in their IL skills, and aversion to academic articles is best addressed by teaching teachers to find, evaluate, and apply research to their discipline independently and critically. These skills will not only enable teachers to develop and implement evidence-based practices, but also evaluate the credibility of claims made by sellers of intervention programs that purport to be evidence-based. As can be seen from this review, there is a paucity of research into the role of IL in teacher education, and special education in particular. This article will begin to address this deficit by reporting the preliminary results of our longitudinal study into the effectiveness of infusing IL skills throughout the coursework of the Special Education Dual License Program.

DEVELOPING A COLLABORATIVE INFORMATION LITERACY PROGRAM

University Libraries

The role of the UNM Libraries is to bring knowledge to students and faculty by providing access to scholarly resources and offering services that help students and faculty find, evaluate, and use these resources. One of the library's programs is Information Literacy and Instruction Services, whose role is to bring IL to students. In a typical year, faculty in UMN's COE bring more than fifty classes to the library. The vast majority of these classes are standalone sessions in which the students learn finding and evaluation skills that help them complete an assignment. The class visits are based on students' needs and continue on the basis of personal relationships that have developed between teaching faculty and librarians. The number of courses that come to the library has increased because of positive word-of-mouth, but for the most part are not formally integrated into the curriculum. As a result, librarians believed that the relationship between the library and the COE could be strengthened and services to students improved.

Special Education Dual License Program

UNM's Special Education Dual License Program is an undergraduate teacher preparation program that is housed in the Department of Educational Specialties in the COE. Dual License students graduate with a dual major in Special Education and Elementary Education. Graduates are eligible for licensure in Special Education PreK–12 (all categories) and General Education K–8. Students in the Dual License Program complete a four-semester sequence of coursework and field experiences. The junior year of coursework and fieldwork is referred to as the Pre-Residency Year (PRY), and the senior year of coursework and fieldwork is referred to as the Residency Year (RY). During the RY, students complete a full year of student teaching in special education, general education, and inclusive classroom settings. More detailed information on the Dual License Program can be found elsewhere.[38] The Dual License Program received continuing accreditation in 2007 by the New Mexico Public Education Department and the National Council for the Accreditation of Teacher Education.

University Libraries/Special Education Dual License Collaboration

With the goal of increasing collaboration between UNM Libraries and the COE, librarians approached the dean of the COE in the spring of 2005 with a proposal to incorporate IL into one or more COE programs. As a result, the associate dean of the COE approached the library and Educational Specialties faculty in the summer of 2005 about meeting to consider ways in which the COE could graduate students who had strong IL skills. The teaching faculty decided that IL skills were increasingly critical for COE students because of the new federal mandates from NCLB and IDEA, and the librarians were interested in integrating IL skills into the curriculum. Our goal was to work together to design a curriculum that directly connected IL skills to evidence-based practices in the classroom setting. We found that our views of teacher education, evidence-based practice, and IL coalesced to create a fruitful collaboration. Faculty decided to design a collaborative program to integrate IL competencies into coursework in the Special Education Dual License Program. Faculty from the library and the Dual License Program committed to a program and agreed to evaluate its outcomes. Dual License and library faculty met regularly in the fall of 2005 to collaboratively plan ways to integrate IL instruction across the existing Dual License curriculum and courses. Implementation began in January 2006. University Libraries and Dual License faculty continue to meet regularly each semester to plan instruction, evaluation, and dissemination of the project.

Integration of Information Literacy

IL content is integrated into the Dual License Program beginning with the second semester of coursework (see table 1). Library and Dual License faculty mapped IL competencies onto the Dual License course sequence. Faculty then discussed how instruction would

be provided and how student achievement of the competencies would be evaluated using formative and summative assessments. Table 2 provides some examples of the integration of IL across coursework.

METHOD

Purpose

The purpose of our study was to assess the effectiveness of infusing IL skills throughout the coursework of an undergraduate teacher preparation program.

Subjects

All participants were participating in the Special Education Dual License Program. Two groups of students were included in this preliminary analysis. The experimental group included students beginning the program in August 2005 and graduating in May 2007. This group consisted of twenty-four students for the pretest and twenty students for the posttest because four students were

completing the program part-time. The control group consisted of eleven students who began the program in August 2004 and graduated in May 2006—it should be noted that the students who took the test were volunteers from a larger class of twenty-two. Both groups followed the same program of studies and the same instructors. The only difference between the curricula of the two groups was the integration of IL instruction into the coursework for the 2005–07 group. Demographic information on gender, age, and ethnicity for these groups is shown in table 3.

Procedure

We developed an instrument designed to measure IL skills specifically for this project. We named it the "UNM Education Information Literacy Test."[39] The questions were all drawn from a databank of previously validated and administered questions that Teresa Neely collected for her dissertation.[40] She had organized the questions by ACRL IL standards, so it was a simple matter for her to pull questions that matched

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Table 1. Special Education Dual License Coursework Sequence

Semester	Course
Prerequisites	SPCD 201 Education of the Exceptional Person SPCD 204 Introduction to Special Education
Fall 1	SPCD 420 Introduction to Mental Retardation SPCD 481 Assistive Technology LLSS 443 Children's Literature EDUC 353 Teaching Science/Elementary EDUC 361 Teaching Math/Elementary
Spring 1	SPCD 303 Methods in Special Education* SPCD 495 Field Experience* EDUC 331 Teaching Reading/Elementary EDUC 333 Teaching Language Arts/Elementary
Fall 2	SPCD 319 Classroom Organization and Management* LLSS 435 Teaching Students with Reading Problems* EDUC 321 Teaching Social Studies/Elementary* SPCD 304 Student Teaching EDUC 400 Student Teaching
Spring 2	SPCD 313 Curriculum in Special Education* SPCD 464 Assessment* EDUC 493 Professional Seminar* SPCD 462 Student Teaching EDUC 400 Student Teaching

* Information literacy content is integrated into these courses.

Table 2. Sample Activities to Meet ACRL Information Literacy Competency Standards

ALA Competency	Semester	Instructor Activity	Librarian Activity	Student Activity	Assessment
Standard 1: The information-literate student determines the nature and extent of the information needed.					
1.2.c. Identifies the value and differences of potential resources in a variety of formats (e.g., multimedia, database, website, data set, audiovisual, book)	Spring 1	Provide structured log	Library tour Provide three-part exercise (reference, book stacks, journals)	Log ten hours in library Three-part exercise (reference, book stacks, journals)	Log with reflections Worksheets
Standard 2: The information-literate student accesses needed information effectively and efficiently.					
2.4.b. Identifies gaps in the information retrieved and determines if the search strategy should be revised	Spring 1 and Fall 2		Teach session on locating articles and advanced search strategies	Complete ERIC/ Education Research Complete on a specific topic	Research presentation
Standard 3: The information-literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.					
3.2.c. Recognizes prejudice, deception, or manipulation	Spring 2	Co-teach session on how to evaluate evidence in a research article and other sources	Co-teach session on how to evaluate evidence in a research article and other sources	Evaluates research articles through guided and independent group practice	Research presentation
Standard 4: The information-literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.					
4.3.b. Uses a range of information technology applications in creating the product or performance	Fall 2 and Spring 2	Model effective presentations Provide instruction on how to prepare presentations and use software	Model effective presentations	Prepare research presentation for Undergraduate Symposium	Research presentation
Standard 5: The information-literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.					
5.1.d. Demonstrates an understanding of intellectual property, copyright, and fair use of copyrighted material	Fall 2	Model fair use of copyrighted materials	Provide instruction on fair use of copyrighted materials	Citation of sources in all assignments	All class assignments

the curriculum map we had created. We met and discussed the questions that would best assess the skills we were planning to teach and the behaviors we expected might change. The "UNM Education Information Literacy Test" asks for demographic information and is composed of thirty-one items: twenty-one multiple-choice questions testing knowledge of standards and ten

eliciting self-reporting of behavior.

In table 2, we share examples of how ACRL IL competencies were integrated into the curriculum of the Special Education Dual License Program. As a companion to table 2, the following items drawn from the "UNM Education Information Literacy Test" provide examples of how we assessed whether students had mastered a spe-

cific competency. Knowledge questions tested awareness of concepts or skills. Correct answers are in italics. Question 4, for example, covered performance indicator outcome 1.2.c, which states that a student "identifies the value and differences of potential resources in a variety of formats (e.g., multimedia, database, website, data set, audiovisual, book)."

Table 3. Demographics

	Pretest		**Posttest**		**Control Group**	
	n		n		n	
Gender	21	Female	18	Female	10	Female
	3	Male	2	Male	1	Male
Age	1	Below 21	0	Below 21	0	Below 21
	13	Age 21–30	13	Age 21–30	3	Age 21–30
	4	Age 31–40	4	Age 31–40	4	Age 31–40
	4	Age 41–50	1	Age 41–50	3	Age 41–50
	2	Age above 50	2	Age above 50	0	Age above 50
	0	Decline to state	0	Decline to state	1	Decline to state
Ethnicity	0	American Indian/Alaska Native	1	American Indian/Alaska Native	0	American Indian/Alaska Native
	0	Asian/Pacific Islander	0	Asian/Pacific Islander	0	Asian/Pacific Islander
	0	Black/African American	0	Black/African American	0	Black/African American
	2	Hispanic/Latino	3	Hispanic/Latino	3	Hispanic/Latino
	17	White or Caucasian	13	White or Caucasian	6	White or Caucasian
	5	Other	3	Other	2	Other

4. Typically a library's online catalog contains

    (a) information about books
    (b) information about government documents
    (c) information about videos and other nonprint items in the library
    (d) the complete text of all the journal articles in the library
    (e) answers a, b, and c
    (f) I don't know

Question 19 measured performance indicator 3.2.c, which asks that a student "recognizes prejudice, deception, or manipulation":

19. Which criteria should you use to evaluate whether or not a particular source is valuable for your research?

    (a) expert author, reliable information, up-to-date, objective
    (b) famous author, high Internet search engine ranking, short, up-to-date
    (c) famous author, up-to-date, easy to find, large quantity of information
    (d) easy to read, Internet availability, visual aids (diagrams, photos), objective

    (e) I don't know

Question 27 measured performance indicator 5.1.2, which requires that a student "demonstrates an understanding of intellectual property, copyright, and fair use of copyrighted material":

27. One of the limitations to copyright law is the doctrine of fair use. This provision allows for the "fair" reproduction of a particular work for purposes such as criticism, comment, news reporting, teaching, scholarship, and research.

    If you were preparing an assignment for class, which of the following could you legally do? Please select all that apply.

    (a) For your research paper on Tupac Shakur, directly quote, without citing a source, a paragraph from an article titled "The Miseducation of Hip-hop," published in the journal *Black Issues in Higher Education*
    (b) Use a video clip from *The Oprah Winfrey Show* as part of a class presentation on talk shows
    (c) Use an audio clip of "I Want to Hold Your Hand" by the Beatles as part of a class

    presentation on relationships
    (d) Use music from the Rolling Stones or Sean "P. Diddy" Combs as background music during a presentation
    (e) Report on and summarize an article on childhood obesity from *Early Child Development and Care* in a speech for your Intro to Special Education class
    (f) Make a copy of a book chapter placed on reserve in the library by your professor and take it home to read

The behavior questions asked students if or how often they performed specific tasks or activities. Question 1, for example, measured performance indicator 2.4.b, which asks if a student "identifies gaps in the information retrieved and determines if the search strategy should be revised":

1. After you have done your initial research for a paper, how often do you do the following?

    (a) Understand all of the information
    (b) Discuss findings with friends and colleagues
    (c) Make an outline
    (d) Review the original research

questions to determine if additional information is needed

(e) Discard irrelevant or useless information

(f) Revise outline based on research findings

(g) Look at materials under each outline heading and synthesize major points and concepts

Students indicated in a table whether they engage in each activity on a Likert scale of very frequently, frequently, occasionally, infrequently, or never. Question 26 asked about performance indicator 4.3.a, which states that a student "uses a range of information technology applications in creating the product or performance":

26. If given the opportunity, which of the following would you feel comfortable using? Please select all that apply.

    (a) Written research project
    (b) Visual projects

(c) Presentation using Power-Point or other presentation software

(d) Presentation using nontechnical methods (flip charts, posters, etc.)

(e) Webpages/website

(f) Dramatic performance (singing/dancing/recitations/musical interpretation)

(g) CD

(h) DVD or VHS

(i) Other:

The test was administered to the experimental group at the beginning of the first semester of prestudent teaching and again eighteen months later at the completion of student teaching and the Dual License Program. It was administered to the control group only at the completion of student teaching. Unfortunately, we were not able to give the control group a pretest because we began the research while they were in the middle of their course work. The test took 20–30 minutes to complete.

RESULTS

We compared scores between the experimental pretest group, the experimental posttest group, and the control group. The highest possible score was 28 because of several multiple-choice questions had more than one correct answer. On both the pretest and the posttest, the minimum score was 12 and the maximum score was 24, but the mean increased from 17.0 to 18.9 and the median increased from 16.0 to 19.5. In the control group, the minimum score was 14 and the maximum was 24 with a mean of 18.3 and a median of 19.0. The box-and-whisker plot (see figure 1) illustrates the differences, indicating the lowest performance by the pretest group and the highest by the posttest group, with the control group in between.

Though the sample was small, one-way analysis of variance (ANOVA) revealed a statistically significant relationship between mean student scores depending on whether they had taken part in the pretest, the posttest, or the control group ($F = 3.31$, $p < .05$). We reject the null hypothesis that there is no relationship between the scores of the pretest, the posttest, and the control group. To explore the relationship between each pair of variables, we conducted Gabriel's post hoc pairwise test. The comparison of means for each pair of variables revealed a statistically significant difference between the scores of students taking the pretest and the posttest ($p < .05$), but not between the scores of students in the control group as compared to either the pretest ($p = .30$) or the posttest ($p = .95$). We reject the null hypothesis that there is no relationship between the scores of the pretest and the posttest, but at this time we fail to reject the hypothesis that there is no relationship between the scores of the control group and of either the pretest or the posttest. We believe that there is a possibility that the scores of the control group were inflated because the students who volunteered to take the test were more likely to be higher achievers, though there is no way to know until we add additional cases to the control group. Because we were
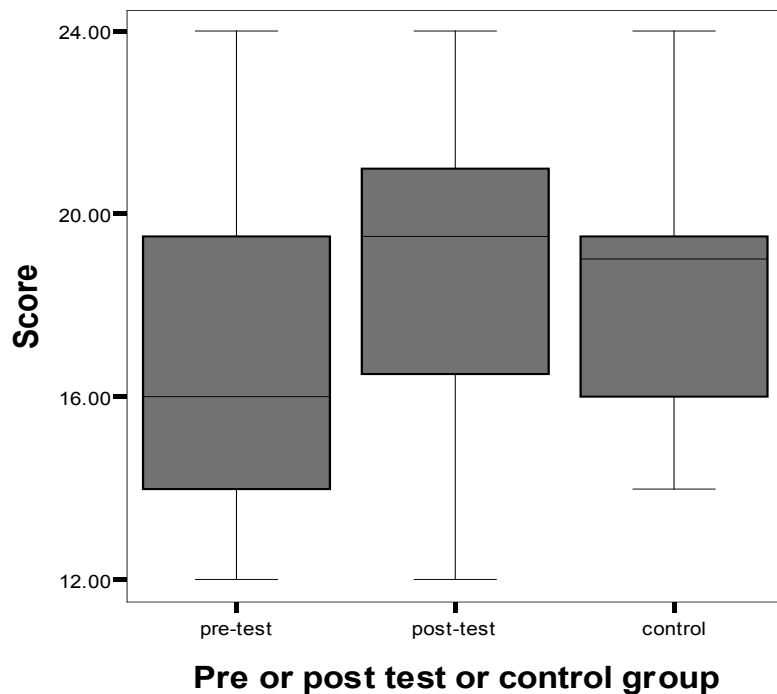
Figure 1. Box and whisker plot comparing pretest, posttest, and control group scores

unable to give a pretest to the control group, we cannot draw any further conclusions about the control group. However, given that there was a significant relationship between the score on the pretest and the posttest groups, we interpret the results with caution to mean that our instruction made a difference in student's knowledge of IL.

Because of numbers that are too low to test for statistical significance, several areas warrant further investigation as we add more experimental and control groups. Both the experimental group and the control group were mostly white women in their twenties. A preliminary analysis indicates that there may be differences in performance by age (on the pretest) and ethnicity (on the pretest and posttest). In addition, we asked students about prior experience with library instruction. The library has a robust IL program integrated into a required freshman English course, so it was no surprise to find that all but two students had experienced library instruction before enrolling in the Special Education Dual License Program. What we did find interesting was the preliminary indication that students who had taken the English course at the university might have outperformed students on the pretest who had taken an equivalent course at the local community college or another institution.

Ten of the questions on the "UNM Education Information Literacy Test" involved self-reporting of behavior. Preliminary analyses indicate that there may be differences in behavior between the pretest, posttest, and control groups. For example, with regard to sources of information, the posttest group was significantly more likely to use manuscripts and conference proceedings as a source of information and less likely to use encyclopedias than the pretest or control group. In the area of presentation formats, the only statistically significant finding was that the posttest group reported more experience with website formats and more comfort with using Web-based formats.

We did collect informal qualitative data on our collaboration as part of the ongoing evaluation of instruction in the Special Education Dual License Program overall. The students in the experimental group were asked whether the integration of IL was a valuable part of their preparation. All but one student reported that the IL instruction was really beneficial and should be included in the future. The one student who did not feel it was valuable indicated that she already knew the information. We plan to add a formal qualitative component to the "UNM Education Information Literacy Test" for future groups specifically addressing ways in which IL affects their ability to meet the needs of their students.

DISCUSSION

Our preliminary study demonstrates that collaboration between library and COE faculty has the potential to increase the IL skills of teacher candidates. We believe that increasing IL knowledge and skills is a key component in effectively preparing teachers to develop, implement, and critically evaluate evidence-based practices in their classrooms.

Limitation

There are limitations to this study, and our preliminary results must be interpreted with caution. Though our analysis did reveal statistically significant improvement in IL knowledge from the pretest to the posttest, we did not give the control group a pretest, and we were not able to demonstrate a significant difference between the posttest and the control group. As noted above, the control group consisted of volunteers—this will not be the case as we continue our study. In addition, the room conditions in which the pretest and posttest were given were not constant. The faculty member who administered the posttest indicated that the air conditioning was not working in the classroom and the students were very hot and uncomfortable, leading the students to rush the test. Once we add more cases to the experimental and control groups and we give a pretest to the control group, we anticipate that

we will be able to demonstrate a significant difference between the groups receiving IL instruction and the groups who do not.

This sample was also too small to analyze subgroups. Future analysis should reveal if the differences between ethnic groups and age groups were truly significant and determine if prior instruction experience had any effect. We plan to continue administering pretests and posttests to subsequent Special Education Dual License students as well as to other elementary and special education students as controls until we have enough cases to determine a strong relationship between our instruction and student performance.

We recognize that further analysis is needed to explore response patterns to specific questions and the implications this may have for instruction. For example, some questions had high levels of correct responses for all three groups, indicating that the students knew this information and we did not need to teach these competencies. Further analysis is needed to investigate anomalies, such as when the pretest group outperformed the posttest group on individual questions. The test construction will need to be reevaluated and adjusted as we continue to evaluate our findings.

Implications and Future Directions

This study is part of an ongoing research study. In addition to giving a pretest to the control group, we plan to add more control and experimental groups to the database for further statistical analysis. We also will add a formal qualitative component to assess the participants' perceptions of the value of the integration of IL for their practice, specifically their ability to implement evidence-based practices. In the long term, we hope to follow up with students once they are teachers to explore the relationship between IL skills and their practice in the classroom; specifically examining the teacher's ability to critically evaluate and implement evidence-based practices for their students.

We believe that this research is of critical importance in the fields of librarianship and education as a whole and special education in particular. It is imperative that COEs prepare teachers who have the IL skills to help ready them to meet the mandates of federal legislation such as NCLB and IDEA as well as the confidence to thoughtfully and critically apply evidence-based practices in their classrooms. Historically there has been a gap between theory taught in teacher preparation programs and the reality our students find in their classrooms and schools. We agree with Walsh that teachers "are generally taught little about discerning good research from bad."[41] Our teachers must have the IL skills to be reflective practitioners, and in the current climate, being articulate and knowledgeable about evidence-based practices is essential. We believe that collaboration between library and education faculty is a crucial component for teacher education programs because IL skills cannot be developed apart from the context in which teachers will be applying these skills. A comprehensive approach covering all ACRL IL standards is important because educators need to understand not just how to find information but also how to evaluate and apply this evidence appropriately and ethically. Future research is needed to focus on the outcome of these collaborative programs on teacher practice after graduation.

We noticed unanticipated positive effects from the integration of IL into the Dual License coursework that were not part of the study. The integration of IL raised the expectations and level of challenge in the coursework for our students. For example, although our program had previously required class presentations, we had not required presentations be rigorously evidence-based and presented to a university-wide audience. All twenty students in the Dual License Program experimental group were required to present a research poster or presentation at the juried Undergraduate Research and Creativity Symposium (URCS) in April 2007. Only one other student from all the other COE teacher preparation programs

presented at this symposium in 2007. Similarly, participation in the URCS was voluntary for the control group, and only one student presented at the symposium in April 2006. Presenting at the URCS gave our students confidence in their research abilities and experience in presenting as a professional. For the faculty, these presentations provided an authentic assessment of the mastery of IL competencies.

Another unanticipated benefit of our study was that the teaching and clinical faculty noticed improved student performance in all areas and increased retention of students in the experimental group. Every student in this group completed student teaching and coursework successfully, and no students had to be placed on a performance contract. This is very unusual; typically up to four students do not complete the program successfully or need to be placed on performance contracts to address student teaching issues. We believe that emphasizing the importance of research and evidence led the students to appreciate the importance of taking their profession seriously. We will need to collect more data to evaluate whether or not this was a one-year aberration that had no relationship to the current study.

The ultimate goal of any teacher preparation program is to prepare professional educators who can design, implement, and critically evaluate instructional practices that improve educational outcomes for students and their families in our schools and communities. We believe that the integration of IL into teacher preparation coursework is a key element in bridging the gap between research and evidence-based practice. We believe our approach also offers one proactive positive solution that can help teacher preparation programs to comply with requirements from NCLB and IDEA while giving teachers the skills to thoughtfully and critically evaluate these mandates and their effect on classroom practice. This study described and evaluated our collaborative approach to improving the ability of teachers to implement evidence-based best practices in a way

that is both consistent with federal requirements and takes into account the unique challenges faced by educators, in particular special educators. We hope that our collaboration will be an inspiration and model for other teacher preparation programs and academic libraries throughout the nation.

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