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Supporting Inquiry by Identifying Gaps in Student Confidence: Development of a Measure of Perceived Competence

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Critical to inquiry-based learning is information literacy. Educators can enhance students' experiences during the inquiry process if they are aware of the skill areas in which students either have or lack confidence. This article describes the development and psychometric properties of the Perceived Competence in Information Skills (PCIS) measure. Educators can use the measure to support student inquiry by identifying and addressing gaps in student confidence. The measure is freely available through Syracuse University's Center for Digital Literacy.

Introduction

Researchers and practitioners have illuminated a number of factors that are necessary for successful inquiry-based learning (IBL) experiences. These include access to information-rich resources in the library media center (Zmuda & Harada, 2008), scaffolding in question development (Harada & Yoshina, 2004), the importance of "guided" inquiry as students construct knowledge (Kuhlthau & Todd, 2006; Kuhlthau, Maniotes, & Caspari, 2007), and a climate in the library media center that supports students' autonomy by providing opportunities for independent decision-making and encouragement of student questions (Arnone, Reynolds, & Marshall, 2009; Todd, 2009). Also critical to the 21st century learner engaged in inquiry-based learning is a set of skills that allows them to confidently tackle a research project. Students must know how to formulate good questions. They need to plan for where they might find information and for how they might share what they learn. These skills plus the ability to "identify, locate, evaluate, and effectively use information" (National Forum on Information Literacy, 2009) are collectively referred to as information literacy.

So that all citizens of the United States recognize the importance of being information literate, President Obama proclaimed October 2009 as National Information Literacy Awareness Month. Yet, the interest in and dialogue about information literacy is global. Countries around the world share their progress on information literacy initiatives in UNESCO's *Information Literacy: An International State-of-the-Art Report* (2007). "Information literacy is really about

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empowering people—empowering individuals, nations and communities" (Abid, as cited in Perrault, 2007, p. 4)

Information literacy is more than just teaching the information skills necessary for inquiry. School librarians attempt to identify aspects of children's attitudes and perceptions that may be serving as barriers to successful inquiry. In today's digital world, the importance of addressing such affective/motivational issues has never been greater. These issues will become more and more pronounced as knowledge continues to advance and accumulate, and as students, particularly those who have experienced little learning success, attempt to understand and manage the information they encounter (Levine, 2005). Research by Kuhlthau (1993), Nahl (1996), and Bilal and Kirby (2002) shows the importance of both cognitive and affective/ motivational aspects of information seeking behavior. Being "confident," for example, was a dimension of interest in recent research by Herring (2009) that explored information literacy attributes of students in year 8. Herring found that student confidence rose as a result of formulating questions that helped guide them in their projects.

In the field of psychology, scholars have made substantial theoretical advancements in intrinsic motivation that can be readily applied in the information literacy domain. One of the most highly recognized and tested theories of motivation is self-determination theory (SDT) (Deci & Ryan, 1985). This theory states that the needs for competence, autonomy, and relatedness underlie human behavior and that, when satisfied, contribute to intrinsic motivation. SDT theory builds on earlier research that proposes humans have a fundamental need for perceived competence, autonomy and social relatedness. This theory has been used in hundreds of studies and applied to educational contexts as well as clinical settings (Deci, Koestner, & Ryan, 1999; Reeve & Deci, 1996; Vansteenkiste, Simons, Lens, Deci, & Sheldon, 2004). Small and Arnone (2000) recommend an *information motivation perspective* to information literacy skills instruction that encourages "self-determination and self-efficacy in knowledge seeking by helping students develop information literacy competence for lifelong learning" (p. 23).

One of the key components of SDT, perceived competence, is relevant to the information-seeking context. Perceptions of competence increase feelings of confidence and self-efficacy (perceptions of ability to reach a goal or perform a task). Understanding how students perceive their own information skills could help library media specialists, classroom teachers, and others who teach these skills to target areas where students lack confidence in order to provide enriched inquiry-based learning experiences and support.

While instruments have been developed and tested for assessing children's self-efficacy (Bandura, 2006), adults' perceived competence (Deci & Ryan, 1985), and college students' perceptions of competence in information literacy skills (Delta College, 2004), none has been created for assessing adolescents' perceived competence in information literacy skills. Adolescents are at a crucial time of impending transition into high school, when a research and reporting capability comes to be expected of them. The purpose of this paper is to describe the initial work, pilot testing, modification, and development of the *Perceived Competence in Information Skills (PCIS)* diagnostic instrument and to provide free access to this instrument so that information professionals can use it in their schools. Research findings of a large-scale study that used this measure have been reported in *School Libraries Worldwide* (Arnone,

Reynolds, & Marshall, 2009) and in *School Library Media Research* (Arnone & Reynolds, 2009). This article is based on research presented at the American Association of School Librarians National Conference in Charlotte, NC, USA, in November 2009. In this article, the term "school librarians" is used but school library professionals in various areas of the U.S. are referred to as "school library media specialists," "teacher-librarians," and "media specialists."

Methods

The development of the PCIS was completed in five phases:

- Phase 1: Literature / Standards Review and Item Identification
- Phase 2: Expert Reviews and Modification
- Phase 3: Cognitive Testing, Timing, and Feedback with members of target population
- Phase 4: Pilot Study, Statistics, and Refinement
- Phase 5: Main Study, Statistics, and Final Instrument

Phase 1: Literature / Standards Review and Item Identification

The literature in the domain of information literacy was reviewed as well as the 1998 American Association of School Librarians (AASL) standards for Information Literacy. The previous AASL standards were compared with the newer 2009 AASL standards which now include dispositions for learning (Coatney, 2008). This review provided a basis for creating the first table of potential items for the proposed instrument. Each potential item in the table also suggested a possible simulation or task through which a student might demonstrate actual competence. A rubric for cognitive testing of the parallel performance-based simulation instrument was also developed.

However, when funding was acquired for the project, it was for less than originally requested. The study was thus re-scoped to use a reliable and validated knowledge-based instrument to measure *actual* competence in place of developing a costly computer-based simulation measure (The TRAILS assessment, *Tools for Real-time Assessment of Information Literacy Skills*, described in Phase 5 was selected as the knowledge instrument. Working with the TRAILS researchers, the instrument was tailored for 8th grade students.)

Sample items from the table of 42 potential *perceived* competence items included:

I am confident in my ability to:

- Organize a large amount of information so that it makes sense.
- Judge whether I am looking at a reliable web site with high quality information.
- Select the best sources of information to answer my research question.
- Know when a piece of information I find is accurate.
- Judge whether the information I find on the Web is accurate or not.
- Tell the difference between a fact, a point of view, and an opinion when I am looking at a Web page.
- Create an interesting presentation from information I find on my topic.

The principal investigators, experts in information literacy, spent a number of sessions with graduate students to come to agreement that the items adequately represented the content (standards) they were designed to address, thereby establishing initial content validity. Another

task was to reduce redundancy and limit the number of items. Also in Phase 1 a set of directions was developed for students to be reviewed for clarity and comprehensibility by educators in Phase 2. The directions made clear that the Perceived Competence instrument was not a test and would not be graded. We also capitalized keywords related to particular skills to draw students' attention to the main idea associated with each item.

Phase 2: Expert Reviews and Modification

A group of five experienced educators working in New York City school libraries reviewed the refined directions and items developed in Phase 1 in an online questionnaire that provided them with comment fields after each set of directions and for each item. It also provided them with a place for general feedback at the end. They received the following instructions:

> *Prior to each statement in the survey, we have provided the related AASL standard and, in most cases, a related TRAILS knowledge assessment item. Please keep in mind that we are creating a motivation scale and are not attempting to exactly map to standards or to knowledge questions but rather to capture the affective component that may contribute to the acquisition of information skills.*

A sample screen shot used to gather information from the reviewers appears in Figure 1.

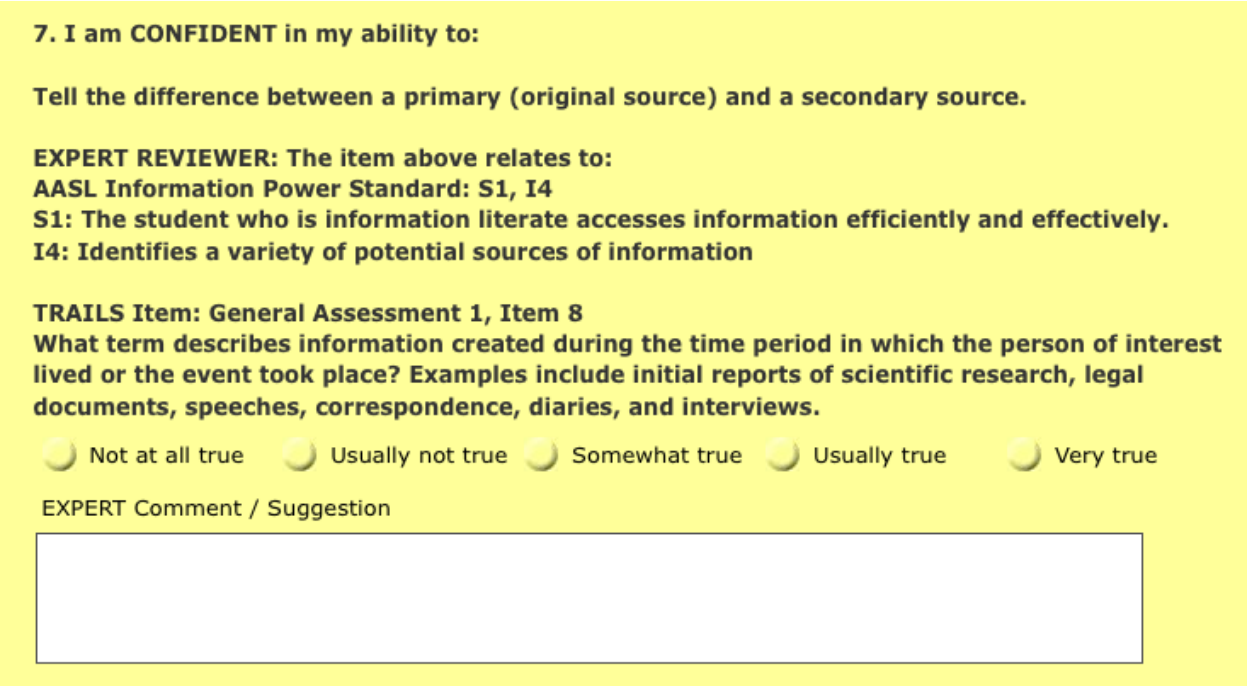

Figure 1: Sample Reviewer Item

The first section includes the statement that a student would see in the actual measure, the middle section refers to information provided to the expert reviewer, the 5-point Likert scale that would be used with students to indicate their level of agreement follows, and an Expert Comment/Suggestion box for reviewers to provide their input. They were requested to look at each aspect of the survey from the wording of the general introduction and directions to specific

details about each item. Next to each affective/motivational item, there was a referent to an AASL standard and to a TRAILS knowledge assessment item that also mapped to the AASL standard. Expert reviewers were requested to indicate whether they were in agreement that the competence item adequately reflected its referent standard. This Phase 2 activity helped to build construct validity, that is, to ensure that the measure with its individual items appeared to be a good representation of the broader construct it represented (perceived competence in information literacy skills).

The feedback received from the expert reviewers was valuable in gaining consensus on the specific items and in identifying items that would benefit from additional clarification and/or examples. For example, two reviewers, while agreeing that an item did represent a standard that discussed "formats," suggested the following:

> *Could you include examples of different formats in the explanation before the statements? I think this would make the statements more concrete for the kids.*
>
> *One suggestion is that you might give different examples for the formats such as a pamphlet, powerpoint presentation, etc.*

A number of word changes with rationale were suggested such as:

> *Sadly, I am concerned that some of my students will stumble over the use [of the word] "conflicts." Could you replace that with 'is different from' or 'differ?*

Feedback was also useful in confirming where the expert reviewers (who were experienced educators) felt the questionnaire was solid; the reviewers comments included observations on the tone and quality of the directions and decisions for certain style approaches:

> *The intro seems easy to read and comprehend. It explains what the survey is clearly about. I wondered why the terms are in all caps. As I proceeded through the survey I realized that these terms are used consistently throughout the survey.*
>
> *While I'm no expert in creating surveys, I think the use of capital letters for the keywords … will help those taking it to understand the purpose of the questions.*

The questionnaire was further refined based on the results of the expert reviews in preparation for testing with several students.

Phase 3: Cognitive Testing, Timing, and Feedback with Students

Initially, two students (with an observer) did a test run of the complete survey which not only included the perceived competence instrument but also several others including the knowledge instrument. A number of issues were identified and addressed in the next iteration of the instrument including:

1. Clarifications and several reductions were made to strengthen the overall organization.
2. A matrix was substituted as a way of organizing questions on the PC instrument to reduce the feeling of cognitive overload expressed by the students.
3. A completion status bar was added to give students knowledge of how much of the questionnaire they had already completed.
4. Where the observer had noted additional confusing language, such language was removed or clarified.

The refined questionnaire was then given to three more students in the target age range. The same observer was used as in the first cognitive test. Students completed the survey at the same location and in the same timeframe. Two students were characterized as above average intelligence, with above-average grades, and the third as average with some difficulty with reading skills. Observations were recorded and later summarized for the principal investigator.

As this was meant to be a cognitive test (to determine if the measure was understandable to the target audience), students were able to discuss confusing questions with the administrator/observer and to indicate when they felt frustrated. It was important that weaker readers felt capable of completing the questionnaire. Observation summary notes included the following:

> *The [weaker] reader, student 1 in the table, took her time reading the questions and answering them, though she did it at a consistent pace. Though she sometimes reread the questions (I could tell because she was using the cursor to skim along under the text as she read), she didn't seem to have any major difficulties with them. She often reread the first question on each page, but then, as she got a feel for the 'topic' of the page, she moved through the remaining questions more quickly. This, I think, really points to the soundness of the way [the instrument] was organized this time. As you can see, student 2 moved through the questions very quickly.*

In the end, the weaker reader noted above was the second to complete the questionnaire, not the last to do so. The observer also noted nonverbal behaviors of interest such as a "puzzled look" or "hesitation." After the administration, the observer asked about such things as noticing a hesitation or frustration on particular items. For example, the observer's notes included:

> *After the survey, I asked her if she knew what "biased" means. She admitted that she had heard of it but couldn't remember what it meant. Student 3, when asked, was the only one who knew the meaning of bias.*

The time students spent on each page of the questionnaire was recorded, as was their order of completion. The average time was deemed appropriate for the timeframe within which the questionnaire would be administered to larger groups.

Phase 4: Pilot Study, Statistics, and Refinement

Twelve schools were recruited for the pilot study. A total of nine schools actually participated in the study with 279 students representing a convenience sample. The purpose of the pilot test was to gather reliability and validity data that could be used to further refine the instrument in

the main study. In the pilot study, 15 items that pertained specifically to perceived competence in information skills were used. The pilot study also explored other factors of motivation such as value, enjoyment, feelings of choice, curiosity, and so on, which when taken together, represent the latent variable of intrinsic motivation.

Inter-correlations among the 15 items identified as "perceived competence items" were explored using factor analysis or, more precisely, principal component analysis in which multiple variables are reduced to a single factor. The items loaded onto 2 factors but all items loaded on factor 1 with a discrimination index of at least .50 or greater. Reliability was calculated at 0.90 using Cronbach's alpha. It should be noted that these items were interspersed with other motivational dimensions of information skills (such as autonomy, value and enjoyment). Table 1 on page 54 depicts the principal component matrix.

Phase 4 provided valuable information that was used to modify the final instrument. It helped to further clarify questions and to reduce cognitive load on the student as evidenced by time spent on survey completion. Further, some of the items factored at .5 were deemed unsatisfactory. A description of changes to the final instrument is discussed in Phase 5.

Phase 5: Main Study, Validity and Reliability of Final Instrument

The main study data collection was conducted in the Spring of 2008, between March and May, with a large convenience sample of U.S. 8th grade students and their school librarians. The study schools were recruited during January and February 2008 from open invitations posted to the mailing list of the American Association of School Librarians Forum (AASL Forum) and to the listserv of Tools for Real-Time Assessment of Information Literacy Skills (TRAILS-9). Interested individuals completed an initial online interest questionnaire which provided information about the study and collected demographic and contact information. A small gift of $200 to be used in the school library media center was provided as an incentive for participation in the full study.

Library media specialist participation in the study both as administrators and participants was an important aspect of the study. Loertscher and Todd (2003) are among the many researchers and practitioners who are encouraging evidence-based practice by school library professionals. It is accomplished through action-based research in which the school librarian collects data in order to improve instruction or some aspect of the library media program. For this reason, as a further incentive to participation, the researchers also offered to share school-level datasets and a results profile report to each participant school presenting school-level anonymized aggregate findings from the three student surveys sessions that occurred over a two-month period.

Participants.

Eighty schools initially agreed to participate in response to the listserv solicitations, but some determined the schedule of participation would be too demanding (given 3 survey sittings). Ultimately, 47 schools fully participated in all three sessions of the survey data collection. The 47 schools included 46 school librarians. There was some attrition in students at each location across the three survey sittings, which is reflected in some of the varying numbers (Ns) for the descriptive statistics below. The N for Survey Sitting 1 was 1264. The N for Survey 2 was 1180.

The N for Survey 3 was 1028. Furthermore, not all students answered each question. For example, not all students knew their parents' education levels and thus that question reflected a lower response rate (n = 933). An average of 27 adolescents (average age of 13) participated from each school. Twenty U.S. states were represented in the sample.

Table 1. Principal Component Matrix

I am CONFIDENT in my ability to do well at these activities:	Components 1	2
Identifying the best sources of information for SCHOOL research projects and assignments.	0.66	-0.29
READING and UNDERSTANDING LITERATURE (fiction and non-fiction) in different formats such as print and electronic. This activity applies to both in school and out of school.	0.65	-0.23
Creating interesting presentations in appropriate formats for sharing the results of your SCHOOL research projects and assignments. Examples of different formats are writing reports, creating a song, designing a Web site, creating a PowerPoint presentation, making a pamphlet, and so on.	0.69	-0.28
Identifying the best sources of information to answer your own questions about your own PERSONAL interests.	0.69	-0.40
EVALUATING THE TRUTH of information that you find in books, web sites, magazines, and in media. This activity applies to both in school and out of school.	0.64	-0.27
WORKING EFFECTIVELY IN GROUPS for SCHOOL research projects and assignments. Working effectively in groups includes things like listening to others' ideas, contributing your own ideas, being able to settle problems when they occur, and collaborating with each other using technology.	0.56	-0.20
Formulating smaller (more specific) questions that help me narrow down my big (broad) research topic.	0.63	-0.04
Locating information on my research topic in sources like books, databases, encyclopedias, and websites.	0.71	-0.14
Locating information inside a source once I find it such as using the index, table of contents, etc.	0.63	0.04
Using information responsibly, such as properly giving credit for sources I use and preparing a bibliography for a research paper.	0.66	0.34
Writing a research paper in my own words, adding my own ideas to new things I learn.	0.70	0.25
Thinking back on my research process and product, and identifying ways I can improve how I do things the next time.	0.67	0.35
Organizing the information that I find during research, to best communicate and present the results.	0.70	0.06
Telling the difference between a primary (original source) and a secondary source.	0.52	0.50
Recognizing if information I find is biased or slanted toward a particular point of view.	0.55	0.47

Extraction Method: Principal Component Analysis.

The data source for Table 1 is the pre-screening participant recruitment survey for the 47 librarian participants. Each library media specialist and student guardian was requested to complete a consent form for participation, providing permission and assuring participant anonymity and privacy.

As part of the full study, students' actual knowledge of information skills was measured; this variable lends to the predictive validity of the PCIS scale. The knowledge measure was provided to the authors by researchers from Kent State University who developed and validated the 30-item TRAILS test, *Tool for Real-time Assessment of Information Literacy Skills* (Schloman and Gedeon, 2007). The TRAILS test was developed for 9th graders. Since subjects were 8th graders, the TRAILS' developers worked with the researchers to identify items from the original test that skewed lower on the item difficulty index. It was used in the pilot with 20 of the 30 items from the general assessments. The decision to reduce the number of items in the pilot was made to lessen the cognitive load on students who were also completing other questionnaires. Based on the post-pilot item analysis, items that skewed as too difficult or too easy were replaced, 5 more items from the TRAILS item pool were added to increase reliability, and the revised version was implemented in the main study. The Cronbach's alpha reliability coefficient in the final 25-item version was acceptable at .81.

Revised PCIS Measure

Further modifications were made to the pilot instrument in preparation for the main study. Rather than interspersing confidence items among the other motivational factors as was the case in the pilot study, all perceived competence items were compiled into one scale and were sequenced into logical sections such as developing questions, identifying resources, etc. Further, several more indicators of information skills for different information-seeking activities were added to reflect a broader range of the construct than the pilot measure achieved.

To reduce the potential cognitive load, the length of some items was reduced and the stem of the items modified. For example, items on the pilot test that were written as "I am confident in my ability to do well in the activities listed below: formulating smaller (more specific) questions that help me narrow down my research topic" etc., were changed to "I am confident in my ability to: formulate smaller (more specific) questions that help me narrow down my research topic." Several items were eliminated and placed into a separate scale that measured dispositions, so all questions in the new index focused on singular information skills. The final instrument was 17 items shown in the Component Matrix in Table 3 on page 57. The factor analysis for the final study resulted in all items loading on 1 factor and an increased reliability coefficient of .93.

While factor analysis may be considered one aspect of construct validity, correlations were conducted between this new measure and a widely validated existing general measure of perceived competence in learning applied to the domain of research ability. The 4-item instrument was from the family of questionnaires used in Self-Determination Theory Research by Edward Deci and associates at the University of Rochester and beyond. In other studies reliability has always been high at .90 and above. In the pilot study, the Deci instrument also had high internal consistency (Cronbach's alpha = .90). The directions and items were as follows:

Please respond to each of the following items in terms of how true it is for you with respect to using your information skills to do research.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I feel confident in my ability to use information skills to do research.
2. I am capable of using information skills to do research.
3. I am able to achieve my goals when doing research.
4. I feel able to meet the challenge of using information skills to do research.

Using Pearson Product Moment Correlation, the new, more specific perceived competence measure for information literacy was correlated with the Deci instrument ($r = .74$, $p<.001$). Establishing a significant relationship between the new instrument and another validated measure addressing a similar construct contributes to the argument for construct validity. See Table 2.

Table 2. Pearson Correlation Coefficients

	PCIS	DeciPCR	IL Knowledge
PCIS	1		
N	1259		
DeciPCR	.74**	1	
N	1258	1261	
IL Knowledge	.41**	.33**	1
N	1204	1203	1204

**. Correlation is significant at the 0.01 level (2-tailed).

The perceived competence in information literacy skills measure was also correlated with an actual knowledge measure of information literacy, the TRAILS assessment as mentioned earlier. The correlation between the perceived and actual competence measures in the pilot test was ($r = .41$, $p< .01$).

Conclusions and Recommendations

Often when important research is concluded, the development and testing of project instruments that measure students' knowledge and skills is not fully explained, nor are those instruments given widespread accessibility for the people who can use them the most---information professionals. This article described the development, testing, modification, and wide-scale implementation of the *Perceived Competence in Information Skills (PCIS)* instrument, an

Table 3. Component Matrix

I am CONFIDENT in my ability to…	Component 1
Formulate smaller (more specific) questions that help me narrow down my big (broad) research topic.	0.68
Know when a topic is too broad or too narrow for a research paper.	0.70
Understand the relationship of one concept (e.g. solar system) to another (e.g., planets).	0.70
Identify a good starting point for researching a topic I don't know much about.	0.70
Choose the best sources of information for my particular research topic.	0.71
Tell the difference between a primary and a secondary resource.	0.61
Locate information on my research topic in sources like books, databases, encyclopedias, and Web sites.	0.73
Understand the meaning of terms like keyword, bibliography, and footnote.	0.71
Locate information inside a source once I find it such as using the index, table of contents, etc.	0.71
Determine whether the information I find is appropriate for my information need.	0.74
Use technology tools to help organize new information I find.	0.64
Evaluate the truth of information that I find in books, web sites, magazines, and in media.	0.72
Know when it is important that information be up-to-date.	0.69
Recognize if information I find is biased or slanted toward a particular point of view.	0.70
Give proper credit for sources I use when preparing a bibliography for a research paper.	0.70
Write a research paper in my own words, adding my own ideas to new things I learn.	0.68
Know when it is appropriate to use images created by someone else on my Web site.	0.66

Extraction Method: Principal Component Analysis.

instrument that targets eighth grade students at a critical time in their development prior to entering high school. Access to a freely available validated and reliable instrument that assesses eighth grade students' perceptions of their information skills competence benefits library media specialists, classroom teachers, and others who teach information literacy skills in the following ways:

- Provides a unique instrument that assesses students' perceived competence in information skills that is significantly correlated with actual competence;
- Provides the ability to assess perceived competence in information skills at a critical educational point in time, just before students transition to high school;
- Identifies students with high perceived competence, allowing educators to provide reinforcement to strengthen those perceptions and increase confidence in students' ability to perform information skills tasks;
- Identifies students with low perceived competence, allowing educators to provide additional training and support for students to master information skills before they enter high school.

Students will also benefit if they know that the PCIS is used as a diagnostic instrument as opposed to being another test given at the beginning of the year. Test anxiety is reduced because students know this is not a test but rather a way for the school librarian to better plan for student needs.

At Syracuse University's Center for Digital Literacy (CDL) website, school librarians can download archived reports and measures resulting from this study. They will also be able to create an account for their class, set up ID numbers for their students, and administer a secure online questionnaire of the PCIS and other final project diagnostics. The beta version is currently available (see Figure 2). Librarians will receive instant feedback on their students' performance via downloadable reports on their class's performance in rich text format (.rtf). The summary report includes class means, median, frequency distributions, range, and the class roster of scores automatically generated and inserted into the report. Other options include a downloadable Excel file with the raw data from student survey responses should practitioners wish to do further analyses. The CDL site and measures are currently set up for practitioners working with their individual classes, and not for large-scale research studies. The latter is a goal for the future. The PCIS is available at http://digital-literacy.syr.edu.

School librarians can administer the measures as a pre- and post-survey, for self-evaluation of their performance as instructors across the school year, to determine whether their students' affect towards information skills and the library setting is enhanced through their pedagogy.

It is recommended that the PCIS instrument for measuring students' perceived competence in information skills be implemented by teachers of information skills early in the school year so that results can be considered when planning inquiry-based learning experiences. Easy access to the PCIS measure, it is hoped, will encourage evidence-based practice which Todd (2008), Loertscher and Todd (2003), and many others consider crucial to the school media field.

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