Measuring Technology Proficiency of Students Participating in a Technology Innovation Challenge Grants (TICG) Program: Instrument Validation for Program Evaluation Purposes

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OBJECTIVES OR PURPOSES

The purpose of this study was to examine evidence related to the reliability and validity of scores derived from the Student Technology Proficiency Inventory (STPI), an instrument intended for use with a population known to include high numbers of disadvantaged and ELD students in need of access to technology who had participated in "Unnamed Project," a Technology Innovation Challenge Grants (TICG) Program. It includes evidence about the usefulness of the inferences made from the scores within the context of evaluating the impact of the "Unnamed Project" on the technology proficiency of students. The purpose of the paper session is to present our approach to developing the inventory's items and the results of the validation study.

PERSPECTIVE(S) OR THEORETICAL FRAMEWORK

An Unnamed Unified School District (UUSD), in collaboration with a consortium of community and university partners, aimed to improve high school students' academic achievement in social studies and language arts through the system-wide implementation of "Unnamed Project," an innovative, standards-based and technology-embedded reform program. The Project's principal elements consist of: a) professional development activities, b) curriculum and technology resources, and c) parent involvement activities.

One of the project's major goals related to student achievement reads, "Students will increasingly use educational technology for learning in core academic subjects…. [Those] who have participated in the Technology Innovation program for three years will demonstrate literacy and proficiency in the use of technological systems, operations, communications, research resources, problem-solving and decision-making tools."

As part of the project's logic, it is assumed that parents and students are accessing computers. It is also assumed teachers use of technology will change as a result of the professional development activities and the curriculum and technology resources. These changes in teachers' behaviors are linked to an intermediate outcome that states students will utilize technology as a regular part of the classroom experience. The logic model for the project (available at: http://ns1.californiaschools.net/~ud/goals.htm) shows the overarching goals to be increased student achievement and technology proficiency. Thus, a measure of students' proficiency with technology that yields valid scores for this type of population and that would be practical to administer within the given constraints was needed in order to evaluate program impact.

The project evaluators found it necessary to construct their own instrument to determine student technology proficiency. The y conducted a web search to examine assessments designed to measure technology competence of students based on the National

Educational Technology Standards for Students (NETS-S) published by the International Society for Technology in Education (ISTE, 2000). The search did not generate student technology skills assessments that would meet the needs of this Unnamed Project. However, several district, state, and research websites provided curriculum scope and sequence technology plans, benchmarks, or skills continuums based on the NETS-S. Many of the technology skills and proficiencies expected of teachers were applicable to students. The California Technology Assistance Project (CTAP) Technology Assessment Profile was examined for the types of technology skills required by teachers and some of these questions were adapted for students (http://ctap2.iassessment.org) in constructing our measure.

In a recent search for related literature, ERIC Resources and the online database of proposals to AERA for the 2002 Annual Meeting were consulted (http://edtech.connect.msu.edu/searchaera2002/searchsessions.asp). Again, measures of teacher technology competence were found (e.g., Flowers & Algozzine, 2000; Ropp, 2001). But, as noted by Toyama and Crawford (2002), "while technology proficiency standards for students are becoming increasingly common at the state level… assessing educational technology proficiency in statewide testing programs is still uncommon" (p.21). Furthermore, they found that information regarding the technical quality of instruments was not available for the majority of student technology proficiency instruments they reviewed (p.20). This highlights the need for the current study in which evidence related to the reliability and validity of scores derived from the STPI, the newly constructed instrument, is examined.

METHODS, TECHNIQUES, OR MODES OF INQUIRY

This paper presentation will focus on the quantitative research methodology employed to evaluate the quality of data produced by the Student Technology Proficiency Inventory (STPI) as it relates to evaluating the Program goal of increasing students' technology proficiency. The instrument validation study involved factor analyzing the inventory's items, calculating Cronbach's alpha, a measure of internal consistency reliability, and calculating various correlation coefficients between proficiency scores derived from STPI and indicators hypothesized to relate to technology proficiency.

Validation also involves evidence pertaining to the usefulness of score inferences (AERA/ APA/ NCME, 1999). Like Flowers and Algozzine (2000), we include the results of an experimental study to determine whether the STPI is sensitive to the technology-embedded reform program intervention. To examine the impact of the Program on students' self-reported technology proficiency, comparisons focused on group differences between students who were or were not taught by teachers involved in the Program. In addition, the number of Program teachers who the student had taken during the prior two school years ("treatment exposure level") served as a predictor of STPI scores.

Hierarchical regression analysis was employed where blocks of variables are entered successively and those in prior blocks serve as controls for examining the effects of variables entering in later blocks (see Table 1). .

Table 1. Variable blocks used in hierarchical regression analysis of program impact.

Block 1 (Demographic):
- Male (1=Yes, 0=No)
- Grade Level (9, 10, 11, 12)
- Ethnicity (indicators for 4 groups)

Block 2 (Academic Achievement/Aspirations):
- Self-Reported Grades
- Having Plans to Attend College (1=Yes, 0=No)

Block 3 (Computer-specific):
- Having Home Computer (1=Yes, 0=No)
- Took Technology Class (1=Yes, 0=No)
- Belief in Importance of Computers (1=Yes, 0=No)

Block 4 (Program Treatment):
- Experimental Group (1= Teacher Participated in Program, 0= No Teachers Participated in Program)
  - or -
- Exposure Level (# of Teachers who Participated in Program; 0-5)

DATA SOURCES OR EVIDENCE

Selection of Teachers/Classes. UUSD serves more than 11,000 urban secondary students in Unnamed ethnically and linguistically diverse community. The sample of students who responded to the instrument attended one of six sites where teachers had the opportunity to participate in the Project. For each school site, a list of the language arts and social studies teachers was made. A stratified sampling process resulted in the random selection of six teachers (one from each site) for each of the following 4 groups: LA Project teacher, SS Project teacher, LA non-Project teacher, and SS non-Project teacher (where LA= language arts, SS= social studies). Each teacher was paid a $100 stipend for administering the surveys to two of their classes.

Description of Instrument Being Investigated. The Student Technology Proficiency Inventory items were contained within a paper-and-pencil survey that also asked students to report gender, typical course grades, grade level, ethnic background, whether they have a computer in their home, whether they received a free computer, whether they have taken a technology class at school, and whether they plan to go to college. They also indicate which, if any, of the Project teachers they have taken classes from, whether their teachers encourage the use of the computer for school assignments, whether they have cooperated with a group of students to create a class project using computer technology, and whether they believe that knowing how to use the computer will be important for them in their future. The 21 technology proficiency items concern (a) basic operations and concepts; (b) social, ethical and human issues; (c) communication tools; (d) productivity tools; (e) research tools; and (f) problem-solving and decision making tools (with 5, 3, 3, 5, 2, and 3 items, respectively). (Recall that the purpose of this study was to investigate the quality of this data source.)

Description of Sample. A total of 929 high school students responded to the STPI. The percentage of females was slightly higher than that of the males (54% vs. 46%). The grade level distribution was 42% freshmen, 33% sophomores, 17% juniors, and 8% seniors. The ethnic distribution was 30% African American, 28% Asian, 4% Caucasian, 26% Hispanic, 7% Multiethnic (or a qualified response), and 5% "other." Eighty-two percent of the students reported having a computer in their home. Equal numbers of students (50% vs. 50%) indicated that they had taken a technology class at their school as that they had not. Ninety-three percent indicated that they plan to go to college.

Description of "Experimental" and "Comparison" Groups. Ninety-six percent of the students completed the question on the survey which allowed classification into the "experimental" vs. "comparison" group. For the purpose of this part of the evaluation study, being treated was operationally defined as having taken one or more classes during either or both the current or past school year (2000-2002) from one (or more) teachers who was associated with the "Unnamed Project." The comparison group consisted of the 23% of the sample who were students at the same sites but who did not have a Project teacher within the last 2 years. To gauge whether the experimental and comparison groups varied in systematic ways that might threaten the internal validity of the experimental study, a series of t-tests for independent groups and chi square tests of association were conducted. The two groups were found to differ with respect to gender, grade level, ethnicity, having taken a technology class, and plans for college but to not differ with respect to having a computer at home, their beliefs about the importance of computer skills for their future, and typical course grades. (In gauging program effects, an effort is made to control for group differences by employing hierarchical multiple regression.)

Description of Treatment Exposure Level. As an approximation to the amount of exposure the student had to teachers associated with the Project, a variable was constructed by counting the number of Project teachers at the site from which the student indicated she or he had taken classes. Nearly half (47%) of the "experimental" group had just one, 35% had two, and 18% had three or more Project teachers.

RESULTS AND/OR CONCLUSIONS/ POINT OF VIEW

To determine the reasonableness of combining responses to a specific set of items (namely, numbers 4-24) into a single score intended to reflect students' technology proficiency, the items were initially subjected to a factor analysis. Although 4 factors were extracted (using the eigenvalue greater than 1 criteria), the first was nearly four times as large as second. Also, the factors that emerged did not align well with the conceptual areas articulated in content standards (ISTE, 2000) on which they were based.

This is not surprising or problematic considering our intent to construct a quickly administered measure where the number of items written to address each area was necessarily limited. Our concern was that no clear competing second factor be present that might weaken the internal consistency of scores derived from combining all items together.

A measure of score reliability, Cronbach's alpha, was .86 for the scale comprised of items 4-24 which were completed by 835 students.

Preliminary evidence of content validity relies upon knowing that the item writer is a professor of educational technology who relied upon the NETS-S (a standards framework that is highly regarded).

For additional evidence of validity, we looked to see whether higher scores were found among students (a) who had higher school grades, (b) at higher grade levels, (c) with computers in their homes, (d) who had taken a technology class at their school, (e) who planned to go to college, and (f) who believed that knowing how to use the computer would be important for their future. Weak correlations, but statistically significant and in the predicted direction ($p<.001$), were found between the total number of technology skills the student self-reported and all the indicators listed above (r's= .25, .20, .27, .32, .24, and .27, respectively), lending support for the validity of scores derived from the instrument.

Results of the experimental study, investigating the usefulness of the STPI for program evaluation purposes, suggest that students in the treatment group (i.e., whose teachers participated in the Project) did report significantly more technology proficiency skills than the students in the comparison group after controlling for demographic, academic achievement/ aspiration, and computer-specific background variables. The impact of the Program was also evident when treatment exposure level was used. Though statistically significant, however, the change in the proportion of variance for the outcome (self-reported proficiency level) was only 1%. It should be recognized that this estimate of program impact is conservative in that we control for computer-specific variables that the program could, in fact, have impacted (e.g., the acquisition of a home computer, the decision to take a computer class, beliefs in the importance of having computer skills). The regression results for the model outlined above with Program treatment dichotomously indicated is shown in Table 2 below.

Table 2. Hierarchical regression results.

		Change Statistics				
Predictor Variable Sets	R	R Square Change	F Change	df1	df2	Sig. F Change
Block 1: Demographics	.283	.080	10.900	6	751	<.001
Block 2: Academic Achievement/ Aspirations	.398	.078	34.751	2	749	<.001
Block 3: Computer-Specific	.530	.123	42.595	3	746	<.001
Block 5: Treated (vs. Not Treated)	.540	.010	10.376	1	745	.001

Taken together, the results of this instrument validation study provide evidence that this quickly administered, checklist-type survey instrument can be usefully employed as a means of measure of self-reported technology proficiency among high school student populations consisting of high numbers of disadvantaged and limited English-speaking students.

Although the validity evidence is moderate, there are three limitations that suggest the estimates could be stronger if some modifications were introduced. First, the majority of the experimental group received a "low dosage" of treatment since the sample largely consisted of freshmen and sophomores who had very few Program teachers' classes. As noted earlier, the Program goal was intended to be measured on students who had participated in the Program sites for 3 years. (i.e., Juniors and Seniors). Second, the instrument simply asked for students to indicate whether they did or did not know how to do the stated skill. The scale was negatively skewed (i.e., approaching a "ceiling effect") with the majority of students indicating they could do more than half of the listed skills. Thus, future studies should pilot a response format that could yield greater variability in proficiency scores. For example, respondents could be instructed to choose among response options like those used by Ropp (2002) where points represent "1"=Not at all; "2"= Minimally (need help); "3"= Confidently (knowledgeable and fluent); and "4"= Able to teach others. Third, the extent to which the Program impacted each teacher has yet to be factored into the model. In the future we plan to refine the treatment exposure measure to include more specific information as to the teacher's level of participation in the project activities. Thus, teachers may contribute differential amounts to the overall exposure level of the student to the Project and this could be reflected by weighting each teacher accordingly prior to totaling the number of UD teachers the student had. Consideration should also be given to piloting more items within each of the strands based on the ISTE standards to allow for the possibility of forming reliable and valid subscale scores.

EDUCATIONAL OR SCIENTIFIC IMPORTANCE OF THE STUDY

The Technology Innovation Challenge Grants (TICG) Program is a national competitive grant program that supports innovative demonstration projects that adapt proven practices, expand effective models, or develop new applications of technology that integrate technology into the teaching and learning process. TICG projects explore new and innovative approaches to using technology to help students meet challenging standards and use technology effectively. Thus, an evaluation, such as this, of a TICG Program is crucial in order to document the district's reform process, assess the consortium's progress toward meeting goals and objectives while subsequently providing ongoing evaluative information for program refinement.

This study contributes to our knowledge of how an assessment of student technology proficiency may be developed and validated for use within the context of a TICG program evaluation. Moreover, the results of the study suggest that significant progress has been made toward developing a valid measure for this purpose. The study's significance can be appreciated in light of the current status of large-scale technology proficiency assessments as reported by Toyama and Crawford (2002). They suggest that technology proficiency assessment is "still in a very early stage" and that there is a "scarcity of technical quality evidence" which is needed in order that fair and valid decisions are reached (p. 21). This study provides such evidence while heeding their advice that "test developers need to evaluate OTL [opportunity to learn] and determine the extent to which the instruments are sensitive to the instruction that students receive in school versus outside of school" (p. 21). Toyama and Crawford explain why there will be increasing demand for high quality technology proficiency assessment and encourage their development (p. 22). The need to address "the lack of appropriate student outcome measures that can capture the impact of technology use in a broad set of technology-using classrooms" was underscored in a 2002 AERA symposium according to the proposal, "Evaluating Technology Impacts: Assessing Student Technology Outcomes," that was accepted by Division H (Hamilton, Hinojosa, Quellmalz, Crawford, Toyama, and Zalles, 2001).

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