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ABSTRACT

Over the past decade, institutions of higher education have come under increasing demands for accountability. Colleges and universities are expected to document student learning, beyond traditional course grades. The use of assessment as a tool to improve learning relies on the active involvement of faculty in planning, implementing, and refining the assessment process. This paper discusses the role of faculty and provides a case study describing how institutional researchers can help faculty develop valid and reliable instruments to measure student learning outcomes. Faculty used data to refine a general education student outcomes measure for numeracy. The numeracy assessment was administered to 584 students in 27 sections in spring 2001 and later that year to 206 students. The assessment was considered useful for accountability and planning purposes. (Contains 14 references.) (Author/SLD)

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Abstract

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Over the past decade, institutions of higher education have come under increasing demands for accountability. Colleges and universities are expected to document student learning, beyond traditional course grades. The use of assessment as a tool to improve learning relies upon the active involvement of faculty in planning, implementing and refining the assessment process. This paper discusses the role of faculty and provides a case study describing how institutional researchers can help faculty develop valid and reliable instruments to measure student learning outcomes. Faculty use data to refine a general education student outcomes measure for numeracy.

Faculty Involvement in Developing and Measuring Student Learning Outcomes

Framing Issues

Over the past decade, institutions of higher education have come under increasing demands for accountability. One aspect of increased accountability is that colleges and universities are expected to assess and document student learning, beyond traditional course grades. But higher education's core commitment to academic freedom is often in conflict with this movement. How can colleges respond to these new expectations and also maintain the basic tenets of academic freedom?

The use of student outcomes assessment as a tool to improve learning relies upon active faculty involvement in planning, implementing and refining the assessment process. Schneider (1994) contends that, "if the resources now being devoted to assessment of student learning are to make any difference at all in the quality of either student learning or educational programs, assessment initiatives must centrally involve faculty members"(p205). At the community College, faculty ownership is the cornerstone of a successful and comprehensive student outcomes assessment initiative. Administrative and technical support is provided to help faculty define learning outcomes, design measures and analyze assessment results. This approach has resulted in a change in culture that uses assessment and documentation of student learning as one important component in evaluating the effectiveness of the college. This paper presents an overview of the faculty role in the college assessment initiative, describes the support role of the institutional research office, and provides a case study of the process used to refine and improve a faculty-designed measurement tool.

Community College Program to Assess Student Learning

The Community College is located in a large metropolitan area. Enrollment in credit classes in fall 2001 was 24,762. Typical of community colleges nationwide, only one-third of the student population attends school full time, and the average class load is eight credits. Fifty-six percent of the students plan to transfer to a four-year college, and about one-third are taking courses to prepare for a career or update skills. There are 310 full-time and almost 800 part-time faculty members.

The community college program to assess student learning has evolved during the past seven years from an initial planning process to a two-year pilot phase, and finally to a comprehensive college-wide assessment program. The program has gone through several phases of development, implementation and refinement, including the development of student learning outcomes, the design and pilot testing of assessment tools and procedures, and experimentation with a variety of data collection methods. The college's program includes assessment of seven outcomes expected to result from completion of a general education course of study, and seven workplace skills expected to result from completion of career and technical programs. The general education outcome areas are written and oral communication, numeracy, scientific inquiry, information literacy, cultural diversity, arts and humanities, and problem solving/critical thinking. The workplace outcome areas are ethics, interpersonal skills, critical thinking, organization, team work, technology literacy, and personal and professional development.

Data collection is accomplished during an annual Assessment Week held each spring, when assessment measures are administered to a sample of classes. Students beginning programs (completed 0 to 9 hours) are compared to students completing programs (completed 30

or more hours). An annual report is widely disseminated each fall, and assessment results are incorporated into the departmental and college planning process.

A Common Language of Assessment

When developing and implementing a student outcomes assessment initiative, it is important that the key stakeholders in the process use a common language. At the Community College, several operating definitions have been developed and agreed upon by faculty, staff, and administration. These definitions are stated below:

Institutional Effectiveness: A comprehensive evaluation of the degree to which the entire college is accomplishing all aspects of its educational mission.

Student Outcomes Assessment: The measurement and documentation of the degree to which students are attaining specific learning outcomes defined and valued by faculty and the college community.

In addition, the program is based upon the following set of principles believed to create the foundation necessary for a successful assessment program.

- The college administration makes a long-term commitment.
- The chief academic officer understands and believes in the value of assessment.
- Faculty lead the assessment program and own the results.
- Technical expertise and support are provided.
- Learning outcomes are clearly defined by faculty at the program level.
- Measurement tools align directly with learning outcomes.
- The program has a viable research design.
- Sound methodology is used for data collection and analysis.
- Results are used by faculty to improve learning.
- Assessment is linked to college planning.

Shared Responsibility for Assessment

Assessment testing can be institutionalized yet not faculty-owned. When that happens, testing directors report that the program has not been successful and student participation has been difficult to gain. Faculty must help invent the assessment program; assessment cannot be bought off the shelf by administrators and a few faculty members... If they [faculty] know in advance that what is learned from assessment is theirs to use, to improve the successful academic accomplishments of students, fear and insecurity will be reduced and educational quality increased. (Duvall,1994)

The college assessment process is highly collaborative, with faculty, administration, and institutional research staff working together to develop, sustain and institutionalize the assessment program. Faculty are involved in all aspects of the assessment process. Groups charged with specific oversight responsibilities include the Faculty Senate Student Outcomes Committee and cross-disciplinary faculty clusters for each outcome area. Further, department chairs and individual faculty members at both campus locations participate in the administration of assessments in classrooms. Faculty use the assessment results to help shape decisions within their individual department plans and within their respective disciplines. The Research Office provides the needed administrative and technical support to assist faculty in building and maintaining an effective assessment program. College leadership plays a critical role in supporting assessment, both financially and philosophically, and promoting a culture of assessment at the college.

The Faculty Senate Student Outcomes Committee (SOC) is charged with making decisions and/or recommendations related to all aspects of student outcomes assessment. The SOC helps plan and direct assessment activities, recruits faculty to participate, disseminates

results, and develops strategies to integrate assessment into the planning process. Members of the SOC have participated in regional and national conferences to share their knowledge and approach to assessment. Faculty members from other colleges within the Maricopa District and across the country often seek out faculty and staff to learn more about the assessment program.

Interdisciplinary faculty teams, or "clusters" are in place for the each of the seven general education outcome areas and for workplace skills. These clusters develop the outcomes for each area, identify or develop measures to directly assess the outcomes, review the assessment results, and make recommendations for future changes to the tools or for possible needed program improvements.

For the past two years more than one hundred faculty members have assisted with the administration or scoring of the assessments. In 2001, more than 130 faculty members volunteered and 116 were selected to administer an assessment in 163 class sections. In 2002, 111 faculty administered an assessment measure in 176 sections. Faculty participated in an orientation prior to assessment week, proctored the assessments, informed students about the purpose of the assessments, and provided feedback to the SOC about the process. In addition, selected faculty members have assisted with scoring the assessments in written communication, arts and humanities, information literacy, and oral communication.

In addition, faculty across all disciplines participate in discussions about the use of the results or attend an assessment workshop designed for new faculty. Department chairs promote discussions with faculty and use assessment results when developing their departmental plans and budgets. The entire college community receives information about the results of assessment through a variety of media including print, email, and the college web site.

Support structures are in place to assure that faculty are successful in accomplishing their assessment mission. The Office of Research and Planning (ORP) supports the student learning outcomes initiative by coordinating and facilitating communication between the key stakeholders and by providing considerable technical support. The ORP helps faculty develop assessment tools and scoring rubrics, conducts data analyses, and prepares and disseminates the annual assessment report. The Office of Research's continued support has ensured continuity in the program, has focused assessment efforts, and has promoted the natural evolution of the faculty efforts. Assessment has grown from the initial phase of outcomes development and research design to full implementation and use of results.

The Dean of Instruction provides significant leadership, administrative support, and financial resources necessary to implement the assessment plan. The importance of the role of a college's chief academic officer has been highlighted as an essential component of successful assessment programs. Lopez (1998) states that: "Many institutions have determined that in order for assessment to become an institutional priority, faculty efforts need to be recognized and rewarded, and senior leadership needs to publicly express strong support for those efforts" (p.5).

Numeracy Case Study

Successful Strategies for Involving Faculty

The case study describes the partnership between the faculty and the research office staff in defining student learning outcomes, developing assessment tools and using assessment results. The development of the numeracy outcomes and instrument are discussed in detail. Faculty worked with the research office to substantially improve the numeracy assessment in 1999-2000.

Defining Learning Outcomes

Define College-wide outcome areas

All faculty members had an opportunity to participate in the original definition of general education outcomes categories through a college-wide survey. Faculty identified numeracy as one of the seven general education outcome areas that they viewed as essential for students completing a general program of study at the college.

Write Specific Student Learning Outcomes

Cross-disciplinary faculty clusters developed more specific student learning outcomes statements for each of the seven categories defined by the college community. Faculty members representing three general education disciplines (mathematics, chemistry and biology) participated in defining numeracy learning outcomes. Selecting a representative group of faculty insured that input was balanced and not discipline specific. The research office provided guidance by showing examples of good outcome statements and guiding the group to write outcomes that are specific enough to be measured and independent of one another. Faculty were encouraged to define the desired learning outcomes for a student completing a general education. The competencies reflect completion of a core of general education courses. Student learning outcomes for each outcome area are detailed at the assessment web site:

Numeracy Outcomes:

1. Select known models or develop appropriate models that organize the data into:
    a. tables or spreadsheets
    b. graphical representations
    c. symbolic/equation format
2. Obtain correct mathematical results and state those results with qualifiers.
3. Use the results to:
    a. determine whether they are realistic in terms of the original situation
    b. determine whether the mathematical model/representation of data was appropriate
    c. describe a trend in a table, graph, or formula and make predictions based on trends; or draw qualitative conclusions in written form.

Validate, Review and Refine

Over time reinitiating the dialog about desired learning outcomes keeps assessment meaningful. For example, new faculty are asked during an orientation workshop to complete a matrix indicating whether they address the general education outcomes in their course objectives. Examination of the alignment of outcomes to courses will be conducted by departments and will be used to validate or refine the outcome statements.

Developing Assessment Tools

Identify/Develop Tools Aligned to Outcomes

After the outcomes were written, faculty clusters met to determine the most appropriate assessment tools. The research office provided support during this process by conducting searches for possible appropriate tools, reviewing items, and helping faculty align items to outcomes. Finding commercially-available instruments that matched the faculty defined outcomes was problematic. Therefore, only the problem solving cluster used an existing standardized instrument. For several other areas, instruments or item banks were modified with permission of the developer. Faculty designed their own numeracy instrument. The need to develop customized assessment tools is supported by John Muffo (2001). As he explains, "In doing assessment, then, one size cannot fit all...Blindly copying somebody else's assessment tools when they have different missions is just plain wrong and might do serious damage in the end" (p.63). Similarly, written communication, oral communication, and arts and humanities clusters developed their own assessment activities and rubrics to evaluate them.

Faculty were provided guidance in developing the assessment activities and instruments. For example, faculty generated items or activities for each outcome using some common guidelines for test construction. Creative thinking was encouraged and alternative methods for

data collection were explored. Faculty made the primary decisions relating to the development of the instruments, and the research office provided feedback and offered suggestions and technical support. The first iteration of the numeracy instrument was designed in 1997 to measure four numeracy student learning outcomes. Students were asked to perform graphing tasks and answer multiple-choice questions concerning calculating ratios, converting measurements and using algebraic equations.

Pilot Test and Administer Assessments

The numeracy assessment has been administered to students over the past six years during the annual assessment week. The SOC committee and the research office collaborate on designing data collection strategies, and the research office provides the logistical support for sample selection and data collection. Faculty have tried several strategies for collecting data and piloting instruments. For the first four years, eligible students were invited and offered incentives to attend an assessment event outside of the classroom, resulting in a small self-selected sample. Therefore, during the 2000-01 school year, the faculty decided to move assessment into the classroom to increase student participation.

SOC members have primary responsibility for recruiting faculty members from all disciplines to participate in the assessment process by volunteering a section. Faculty ownership has resulted in a high level of faculty participation. Assessments were assigned across departments from a pool of more than 200 volunteered sections. As a result, in Spring 2001, 584 students in 27 sections took the numeracy assessment during a scheduled class period. In order to ensure that the general education program, and not a particular department, was being assessed, measures that relate to particular disciplines were not administered in those disciplines (e.g., the numeracy assessment was not administered in mathematics classes). Faculty attended

an orientation and followed standard administration procedures. Faculty continue to help shape the assessment process by providing feedback, at the end of each assessment cycle.

Analyze Results and Refine Tools

A cross-sectional research design was chosen for the assessment program, since longitudinal studies were not practical due to the transient student population. Beginning students who have completed zero to nine hours (pre-group) are compared to completing students who have completed a core of at least 30 hours of general education coursework distributed across the core curricular areas (post-group). Statistical tests were used to compare the total scores and the scale scores for the learning outcomes to determine if there are significant differences between the two groups of students. Demographic characteristics of participating, and non-participating students are also compared by cohort and overall.

Exploratory data analysis and psychometric analyses of the instruments have been performed for the past five academic years and the results were used to refine the assessment tools. The research office has facilitated the evaluation and refinement of faculty-designed instruments over time. Test items were reviewed for form and content. Items were analyzed to identify under-performing items or items that had unusual psychometric characteristics, e.g., extremely high percentage correct or negative discriminations between the highest scoring group of students and the lowest scoring group of students. Item discrimination allows for selection based on items where high-scoring examinees have a high probability of answering correctly and low scoring examinees have a low probability of answering correctly, i.e., those knowing the material and those who do not. (Crocker & Algina, 1986). Reliability analysis and factor analysis have also been conducted to explore and improve the alignment of items to outcomes.

1999-2000 Numeracy Findings

Data Collection and Measurement

Students were asked to complete both the Numeracy assessment as well as the Scientific Inquiry assessment; they were given 90 minutes to complete both tests. The Numeracy assessment instrument included eleven multiple-choice items, four questions with a fill-in-the-blank format and three graphing tasks.

Assessment Results

Seventy-four students took the numeracy assessment; 30 students classified in the Pre-group and 44 students in the Post-group. No significant differences were observed between the two groups overall, and there were no significant differences in the mean scores by outcome. The mean proportion correct was 69.3% overall.

Analysis of the 1999-2000 Numeracy Instrument

A complete review of the instrument was conducted in 2001 based on data from 1999-2000. Significant revisions were made to the instrument at that time in an effort to improve its validity and reliability. Analysis of the 1999-2000 data indicated four major areas for improvement to the instrument to be made by the numeracy cluster. The reliability of the instrument was relatively low (.74). Item analysis showed that several items needed to be revised because they did not discriminate well. Further, the number of items per outcome was not sufficient to draw inferences. Scores from small numbers of items associated with any particular curricular objective on a test tend to be relatively unreliable. (Thissen & Wainer, 2001). In addition, the portion of the test that was hand-scored needed to be revised to facilitate reliable scoring.

The numeracy cluster members worked over several months to refine the instrument prior to administration in spring 2001. Faculty changed a hand-scored graphing problem and a fill-in-the-blank problem to multiple choice items that could be administered to a large population. To be classified as a multiple choice item (at least three choices), the typical pattern is to have four or five effective or functioning choices or options, to reduce the probability of guessing the correct answer. (Thorndike, 1999) The number of items per outcome was increased to better define each scale, and items that poorly differentiated between outcomes were revised. Faculty reviewed the instrument relative to content-related validity and construct validity. Editing can not guarantee a good item but can contribute to improved item performance, since as many as 40% of the items may fail to perform as intended when first tried. (Haladyna, 1994)

Working with faculty to revise instruments was most successful with small sub-groups for intensive technical work sessions. Refining instruments takes time. Faculty time is maximized by prioritizing and organizing tasks. Progress is incremental and several iterations of the survey were needed to improve its usefulness. Comments from faculty were reviewed prior to adoption of a revised instrument. Outside review by a measurement consultant was an integral part of the most recent modifications. Suggestions to improve instruments were provided to faculty. Further, worksheets showing the alignment of items and outcomes, and indicating the most difficult, easiest and the items with poor discrimination were provided to faculty to simplify their work. Meeting time was kept short and productive and, when necessary, items were shared via email so that faculty could respond to revisions in a timely fashion. In order to start the discussion, the research office prepared some sample items for review by faculty. Faculty then began to generate their own items and modify them for use. Setting up meetings on a regular

basis, documenting accomplishments and monitoring progress was important to keep the momentum going.

An item analysis was conducted and outlying data were presented to the faculty to review for change. Definitions of the item analysis output were provided, and items were categorized by their relative difficulty and the extent to which they discriminated between the highest and lowest performing students. Options that were presented for revision included changing the stem of the item, changing any of the responses, or developing a new item. In some cases the wording was revised because it was unclear, a graph was revised, and rarely the item was removed entirely. In one case, the group decided to retain an item even though most students scored correctly in order to encourage students to finish the assessment. External review also provided faculty with several suggestions for improvement such as: clarify directions by adding overall instructions to sets of questions, standardize the number of distractors for each item, rotate the correct answer position between items to increase the probability of selecting a distracter.

2000-2001 Numeracy Data

Two hundred and six students qualified for the pre/post analysis of numeracy in 2001. The demographic characteristics of the students who participated in the general education assessment cohorts are similar to students who did not participate, and to the overall student population.

Numeracy scores were statistically significantly higher for the post-group overall and by subscale.

Analysis of the 2001 Numeracy Instrument

Changes that the numeracy cluster made significantly improved the usefulness of the numeracy instrument. Psychometric analysis of the instrument was conducted using 584 surveys. An internal consistency reliability was computed for the numeracy instrument.

# Items	Alpha	Mean P
26	85	68

This reliability (coefficient alpha = .85, S.E.M. = 2.0) indicates that there is a high level of consistency for the assessment (measuring a common construct). Generally, reliabilities of .80 to .90 are considered very good for a non-standardized test. Item analysis indicated items discriminated fairly well between the lowest group scoring student group (lowest 27% of the scores) and the highest scoring student group (highest 27% of the scores).

The next cycle of improvement will examine the alignment of the items to the outcomes or constructs being measured. Construct validity is the most valuable yet the most difficult way of assessing an instrument, because it is difficult to understand, to measure and to report, often determined only after years of experience with the instrument, frequently seen as "gestalt" of how well an instrument performs over a number of years. (Litwin, 1995). Although the subscales were improved by adding items, faculty will need to further examine questions based on the results of a factor analysis. Faculty will be challenged to improve the psychometric properties and strengthen the reliability of the scales without unnecessarily adding new items. One of the new rules in measurement asserts, under some conditions that a shorter test can be more reliable than longer tests. (Embretson & Hershberger, 1999).

Using Assessment Results

Publish and Widely Disseminate Results

Assessment results are published annually in reports prepared by the research office. Results are also presented in a wide variety of venues. The faculty SOC members present findings within the college community. Presentations are made to the department chairs and administrators and at faculty department meetings. A summarized version of the report are available to the public through the research web site. Results are also presented to new faculty during their orientation. The research office prepares presentation materials and offers support to faculty efforts. Numeracy results were presented to other faculty by a cluster member who was very effective in describing the process of developing the instrument and helped facilitate discussion about the measurement of general education outcomes.

Engage in Systematic Discussion of Results

As results are disseminated campus-wide a venue for discussion is created. Within departments the faculty are engaged in discussion of results as they apply to their own disciplines. The SOC committee has prioritized use of results as a major initiative for the committee and presented a plan to facilitate the discussion of results across the campus.

Develop Appropriate Strategies

Over the past year, a major priority of the Student Outcomes Committee has been ensuring the wide dissemination and use of assessment results. Results from the 2001 assessments showed a pattern that was consistent across several of the general education outcome areas. Students had the most difficulty, and consistently scored lower, on outcomes that required the application or evaluation of information or knowledge (i.e., critical thinking).

Individual faculty members, as well as several departments at the college, have developed curricular and instructional changes in response to these findings.

The SOC developed a formal recommendation about use of results which was approved by the Faculty Senate. The recommendations include raising awareness of assessment results, supporting both departmental and college-wide initiatives, and building a culture that uses assessment results. The SOC recommended working collaboratively with the Center for Teaching and Learning, the college's faculty development center, to systematically incorporate use of assessment results into faculty development programs and activities. For example, the CTL can facilitate interdisciplinary faculty discussions to explore ways of incorporating outcomes into coursework, and can sponsor external experts to work with faculty on improving integration of critical thinking into the curriculum.

The Higher Learning Commission characterizes an institution as being in a mature stage of assessment when, "Faculty, as a whole, demonstrate effective assessment practices and routinely link assessment results to decision making and program improvement" (The Higher Learning Commission, 2001, p19.)

Implications for Institutional Research

In order to be successful, student outcomes assessment initiatives must be developed and implemented with respect for the tenets of academic freedom. Faculty will not support externally imposed assessment programs, nor will they make use of the results. At the Community College, the principle that "faculty lead the assessment program and own the results" has provided the foundation for the success of the assessment program. But faculty cannot be expected to be responsible for the considerable operational and technical aspects of assessment. This support can be provided through a close collaboration between a college's

research staff, the faculty, and the administration. Such a collaborative effort takes time, commitment and tenacity. Trust and respect among the stakeholders must be fostered. A collaborative approach to student outcomes assessment is not necessarily the most *efficient* way to assess student learning, but these presenters believe it to be the most *effective*.

The use of faculty-developed outcome measures that can be applied across curricular areas contributes to a culture of assessment. The institutional researcher provides a critical supportive role in helping faculty develop valid and reliable instruments. This paper provides a specific example of how institutional researchers can support faculty-driven outcomes assessment efforts and ensure the use of good measurement principles. The case study demonstrates the collaborative and iterative nature of instrument development and the successful involvement of faculty in the process.

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