Learning Probabilility and Statistics
International Study Group for Research on
Newsletter of the
Quantitative literacy project and reasoning under uncertainty project required.

In a study of these materials on student learning outcomes, we evaluated the impact of the project on student learning and reasoning skills. The results showed that students who participated in the project demonstrated improved understanding and reasoning skills compared to those who did not participate. This finding supports the idea that projects that focus on developing critical thinking and reasoning skills can be effective tools for improving student learning outcomes.

The Need for Common Assessment Methods

The Common Assessment Methods (CAM) project, led by the California Mathematics Collaborative (CMC), was designed to develop a universal set of assessment tools that could be used across different grade levels and subject areas. The CAM project used a combination of formative and summative assessment methods to provide a comprehensive picture of student learning. This approach allowed for a more accurate understanding of student progress and helped teachers to identify areas where additional support was needed.

Another example of a common assessment practice is the use of rubrics. Rubrics are tools that provide a clear and specific set of criteria for evaluating student work. This helps to ensure that assessment is fair and consistent across different evaluators.

In conclusion, the use of common assessment methods can be a powerful tool for improving student learning outcomes. By providing a clear and consistent framework for evaluating student progress, teachers can better understand where students are succeeding and where they need additional support. This can help to improve the overall effectiveness of educational programs and ensure that all students have the opportunity to succeed.

SOURCES:


development of new tests and methods. However, the tests and assessment methods constructed reflect the specific program content rather than more general conceptual understanding and higher order reasoning skills.

In his forthcoming chapter on research on learning probability and statistics, Shaughnessy (in press) describes the need for some standard, reliable tools to assess students' conceptions of probability and statistics. If he lists the development of assessment instruments as the first item on his "wish list" for future research in this area. Although a variety of items and tasks have been used by researchers or evaluators in the past, it is difficult to assemble these items and tasks into a test because of their different purposes and formats (e.g., paper and pencil, clinical interview). Shaughnessy stresses the need for new instruments which incorporate and build on the ideas of previous research but which have greater applicability. Ideally, these instruments will help us determine if the new standards for learning probability and statistics (as described in the NCTM report) are being achieved.

Research Related to Assessing Statistical Understanding

A review of research by Jolliffe (1990) organizes the relevant literature in the categories of classification schemes for assessment tasks, newer methods of assessment, attitude scales, and studies of understanding. After my own literature review, I have modified these categories into five groups of studies relevant to the assessment of statistical understanding. These are: 1) students' attitudes and anxiety towards learning statistics, 2) students' computational skills in using probability and statistics, 3) students' misconceptions of probability and statistics, 4) conceptual frameworks for assessing statistical learning, and 5) methods of assessing mathematical learning and problem solving. Each is described below.

Student Attitudes and Anxiety. The Statistics Attitude Survey (SAS) scale (Roberts & Saxe, 1982), the Attitudes Toward Statistics test (ATS) (Wise, 1985), and the Statistical Anxiety Rating Scale (STARS) (Cruise, Cash, & Bolton, 1985) are Likert-type scales written for college students in statistics courses. The SAS was designed to assess various components of statistical attitudes, such as students' perceptions of their own statistical competence and the usefulness of statistical analysis. The ATS was developed specifically to measure attitude changes during statistics courses and is designed to be given as a pre- and post-test. Two scores are calculated: attitudes towards the course and attitudes toward the field of statistics. The STARS measures students' attitudes towards six areas: worth of statistics, interpretation anxiety, test/class anxiety, computation self-concept, fear of asking for help, and fear of statistics teachers. None of the three instruments assess student understanding of and beliefs about what the field of statistics is, what it means to "do" statistics and solve statistical problems. Instead, they deal with the more specialized attitudes and anxiety faced by college students.

Students' Computational Skills. Tests written to accompany commercial textbooks are the most common form of assessment for measuring students' ability to perform statistical calculations. Items on standardized tests and the National Assessment of Educational Progress (NAEP) tend to be of this type. One example from the NAEP asks students to calculate the mean, median and mode for a set of data consisting of inches of snowfall (Brown & Silver, 1989). Although these items typically test whether or not students can use formulas and come up with a single, correct answer, they do not assess whether or not students understand the concepts and can use them to analyze and interpret data. For example, students may be able to correctly calculate the median and mean but not know when one is a better average to use than another. This type of skill is best assessed in classes through assignments and quizzes, and does not need to be on a general test of statistical understanding and reasoning.

Students' Conceptions and Misconceptions about Probability and Statistics. The only test written and used on a large scale to assess students understanding of probability concepts was developed and administered by Green (1983) to 3000 students in Great Britain. Some of these items and other items appearing in the research literature have been found to be useful in detecting misconceptions and helping researchers to understand how student think about probability and statistics. See for example the work of Falk, delMas, Garfield, Jolliffe, Konold, Pollatsek, Shaughnessy, and Well. Research reviews by Garfield and Ahlgren (1989) and Shaughnessy (in press) refer to many of these studies. Items used are often open-ended and many have been used in clinical interviews to probe students' beliefs. Many have been used with adults or college students and involve a substantial amount of reading. Although these items are good at detecting student conceptions and misconceptions, many need to be revised and adapted for high school students.

Frameworks for developing assessment tasks. There have been at least two attempts to design frameworks for developing tasks for assessing statistical learning. Chervany, et al., (1977) used a model of the problem solving process to develop a three stage model of assessment (comprehension, planning and execution, and evaluation and interpretation). These three stages contain 10 different steps in statistical reasoning which can be used to guide item development. Although this framework was designed to evaluate innovative college courses and was successfully used to design tests for a college level course (Garfield, 1981) it does not appear to have been used in other studies. Nitko and Lane (1990) also designed a framework for generating assessment tasks that provide a richer description of students' thinking and reasoning than just giving them problems to work out. This framework was developed for college and graduate level statistics courses and can be used to assess relationships among knowledge and whether or not important principles and concepts are understood by students. Three interrelated categories are used to classify statistical activities: problem solving, modeling, and statistical argument. Although developed for students at a level higher than secondary school, these models are useful in providing frameworks for organizing statistical knowledge and skills.

Assessment of mathematical learning and problem solving. There are 13 standards for evaluation included in the NCTM curriculum standards. These standards describe the assessment of students' mathematical knowledge, conceptual understanding, procedural knowledge, problem solving, reasoning, and mathematical disposition. Assessment is viewed as the process of understanding the meaning which students give to mathematics; it should be dynamic and involve a variety of approaches (Webb & Romberg, 1988). Recently, more attention has been given to assessment of higher order mathematical thinking (Kulm, 1990). Educators are encouraged to move away from using single number summaries to represent
Another proposal I am working on is a study of the proportional project as one of the key factors of the curriculum.

In conclusion, my proposal will focus on some aspect of the curriculum and

the development and validation of an instrument to measure student attitudes towards assessment and consequential behaviors of teachers and students.

These are some of the references cited in my literature review:

Have a good summer, and be sure to send me papers, comments, and suggestions for our next newsletter, due in your mailbox in next September.

Please let me know:

Well, that's all I have so far on assessment. If you know of other relevant papers, please let me know.

