2008

Tools for the Assessment of Undergraduate Research Outcomes

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The recent focus on the importance of assessment has resulted in the development of a number of tools to assess student learning outcomes (e.g. Angelo & Cross, 1993). However, most of these tools have focused on what students learn in the classroom. The outcomes of student involvement in research tend to be less well defined, and therefore more difficult to measure, than the outcomes of traditional classroom learning. Nevertheless, some of the existing assessment tools may be appropriate for the assessment of learning through research, and others have recently been developed explicitly for that purpose (e.g. Lopatto, 2004; Tariq, Stefani, Butcher, & Heylings, 1998).

Of the many outcomes listed for psychology majors by the American Psychological Association (APA, 2002), those that seem to be particularly likely to be enhanced by conducting research include understanding research methods, critical thinking, and oral and written communication (assuming that the student writes a paper or gives an oral presentation of the research).

Indirect Measures of Student Learning

Indirect measures are those that do not directly measure what a student has learned, but get at it indirectly, usually through self-report from the students. Indirect measures most commonly take the form of surveys or interviews. Over the last decade, a number of published studies have shown that students do report that they believe they learned a great deal from participating in research (Bauer & Bennett, 2003; Lopatto, 2004; Rueckert & Morgan, 2006; Russell, Hancock, & McCullough, 2007; Seymour, Hunter, Laursen, & DeAntoni, 2004). In particular, Lopatto (2004) has developed a set of learning outcomes, such as gaining an understanding of the research process, skill in interpretation of results, and so forth. He and his colleagues have found that students in a variety of disciplines rate themselves as having improved in these outcomes as a result of their research experience.

Russell et al. (2007) recently reported results from a number of surveys, including one that focused specifically on students in social, behavioral, and economic science. They found a number of positive outcomes in students who engaged in research (compared to students who did not engage in research), including an increase in confidence in research skills, and expectation they would one day obtain a Ph.D. Their survey is available at http://www.sri.com/policy/csted/reports/university/index.html#urosynthesis.

Kruger and Zechmeister (2001) have developed a skills-experience inventory aimed specifically at psychology majors, which is available at http://www-personal.umich.edu/~kruger/skills.html. Their inventory asks students to report whether they have engaged in activities related to a number of skills (e.g. "I have participated in writing of an article for a scientific journal.").

Indirect measures can be used to assess virtually anything, but faculty must keep in mind that they are only measuring what students *think* they have learned, which may or may not reflect true learning. They are most appropriate when the desired outcomes are something subjective, such as a change in student attitudes.

Direct Measures of Student Learning

In contrast to indirect self-report measures of student learning, direct measures get at student learning directly by asking them to actually perform the targeted skill. There have been far fewer reports of the effects of research on student learning that have used these types of measures (but see Bauer, 2001 for a notable exception). This is likely because these measures are more difficult to create. There are a number of existing assessment tools, many of which have documented reliability and validity, that you could easily adapt to assess the outcomes of student research. Which tool you choose to use will depend on what your desired student outcomes are.

Written Research Report

Most student research projects require some sort of written report that the student's advisor grades. These reports can be a valuable assessment source that requires little or no extra work on the part of the faculty advisor. Faculty can use written reports to assess students' ability to write, to analyze and synthesize, to think critically, and to understand research methodology. Of course it is important to assure that faculty evaluate these reports in a well-defined, objective manner. The best way to achieve an objective evaluation is through the use of a rubric. Rubrics are assessment tools that can be used to measure virtually anything, but they are usually used to measure outcomes that can not be easily captured by simpler standardized tests (Moskal, 2000). Rubrics usually take the form of a grid that includes a list of outcomes or criteria, and standards that describe successful performance at multiple levels. They can be holistic, which means they give one description of successful performance overall, or they can be analytic, which means they break performance down in to a number of factors, each with its own set of criteria. Analytic rubrics are more common and are probably better suited to assess research reports. Rubrics are usually shared with students in advance, so they will know what professors expect of them.

Several web sites, some of which are listed at the end of this chapter, include more details on how to develop good rubrics, as well as examples of existing rubrics. It is usually easiest for faculty to use existing rubrics, or to modify them slightly, so they do not have to reinvent the wheel. Many are for written papers in general, but there are a few that psychologists have developed that specifically focus on psychological research. At Northeastern Illinois University psychology faculty have developed a rubric for scoring our students' required capstone papers (most of which are research reports). You can find it at http://www.neiu.edu/~lruecker/capstone.doc. Gotfried and Vosmik are currently in the process of developing a more detailed APA-style paper rubric. They will eventually make it available on the Office of Teaching Resources in Psychology web site (http://teachpsych.org/otrp/). Tariq, Stefani, Butcher, and Heylings (1998) have created a detailed rubric for the assessment of projects, including research projects. Their rubric is somewhat unusual in that it assesses the entire research process. It includes things like "plan of action" and "initiative", in addition to criteria for scoring the final written report.

Critical Thinking

Although there is no one definition of critical thinking everyone agrees upon, most psychologists and educators assume that it includes the ability to analyze, synthesize, and evaluate claims. More specifically, in relation to psychological research, critical thinking could involve the ability to formulate hypotheses, conceive of alternatives, and develop plans for experiments (Ennis, 1993). Several standardized tests of general critical thinking ability have been used in a number of contexts (for a review, see U.S. Dept. of Education, 2000). Among the most commonly cited are the Watson-Glaser Critical Thinking Appraisal (Watson & Glaser, 1994) and the California Critical Thinking Skills Test (CCTST; Facione, Facione, Blohm, Howard, & Giancarlo, 1998; http://www.insightassessment.com/test-cctst.html).

The Watson-Glaser is a multiple-choice test that tests critical thinking in five categories: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. It has two forms (A and B) that faculty can use as pretest and posttest. The current price for the Watson-Glaser is $284 for a packet of 25 tests. (For examples of questions, see http://www.harcourtassessment.com).

The CCTST is also a multiple-choice test. Its subtests are inductive reasoning, deductive reasoning, analysis, inference, and evaluation. The current price for the CCTST is $180 for a packet of 25 tests.

In addition, Lawson (1999) has developed a test specifically for critical thinking about psychology. It involves open-ended questions about the validity of various claims. Although they answer key gives specific correct answers, scoring is somewhat subjective.

Statistical Reasoning

The most comprehensive resource for tests of statistical reasoning is the NSF-funded Assessment Resource Tools for Improving Statistical Thinking (ARTIST) project (delMas, Ooms, Garfield, & Chance, 2006). This web site (https://app.gen.umn.edu/artist) includes over 1000 test items on a variety of statistical topics that users can search and download for their own use. The test items consist of both multiple choice and open-ended questions. It also includes 11 unit tests on specific topics and the Comprehensive Assessment of Outcomes in Statistics that instructors and students can access after requesting an access code. The web site also includes links to other statistical reasoning assessment tools.

Other Assessment Tools

Halonen, Bosack, Clay, & McCarthy (2003) have developed a rubric that gives specific criteria for five levels, ranging from "beginner" to "professional graduate and beyond," for a number of skills related to scientific inquiry in psychology. The comprehensive nature of this rubric makes it best suited for portfolio-type assessment of an entire curriculum. The Association of College and Research Libraries (2003) has created a detailed information literacy rubric. There are a number of oral presentation rubrics, and a few scientific poster rubrics, available online. Some are listed in Table 1.

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Table 1

Internet Resources for Rubrics

	Description	URL
Rubrics in general	Michigan State University Online Instructional Resources. Links to many sites with instructions for creating rubrics, tutorials, and examples of rubrics.	http://www1.provost.msu.edu/facdev/instructionalresources/Assessment/rubrics.asp
	MidLink Magazine Teacher Tools at North Carolina State University. A number of examples of rubrics and templates. Mainly focuses on K-12 but could be modified for college students.	http://www.ncsu.edu/midlink/ho.html
	Texas Center for Educational Technology. Links to general information, technology-related rubrics, rubric software.	http://www.tcet.unt.edu/START/instruct/general/rubrics.htm
Oral presentation rubrics	Center for Transportation Research and Education at Iowa State University. Ten criteria with four levels of achievement. Could be used for any type of presentation.	http://www.ctre.iastate.edu/educweb/oralpres.pdf
	MidLink Magazine Teacher Tools at North Carolina State University. Six criteria with four levels of achievement. Focuses on student presentations in any field.	http://www.ncsu.edu/midlink/rub.pres.html
	Northwest Regional Education Laboratory. Assesses verbal and nonverbal effectiveness, appropriateness, and responsiveness.	http://www.nwrel.org/assessment/pdfRubrics/oralassess.PDF
	Texas Center for Educational Technology. Assesses nonverbal skills, vocal skills, and content.	http://www.tcet.unt.edu/START/instruct/general/oral.htm
Poster rubrics	Genesis mission at NASA. Can be used for any scientific poster.	http://genesismission.jpl.nasa.gov/educate/scimodule/data/interaction_synthesis/SAPoster_Rubric.pdf
	C. L. Hansvick's checklist for psychology posters at Pacific Lutheran University.	http://www.plu.edu/~hansvicl/teaching_posterchk.pdf