

GEK1: Apply the Scientific Method - Intermediate

Research and Technology, GE 202x, Fall 2013

Semester: FALL 2013

REPORT DATE: 2/4/2014

Knowledge of the Scientific Method is assessed in Research and Technology, GE202x, using a pre-test and a post-test that are course requirements. The tests include 9 multiple choice questions (which, when counting sub-questions, include 23 questions in total) pertaining to the scientific method. The pre- and post-tests were created by General Education leadership and the questions on the pre- and post-tests relate directly to the textbook. At present, there is no determined “breakpoint” for this assessment. All sections, 35, of GE202x Fall 2013 are represented in both the pre-test and the post-test. 557 students completed the pre-test, with 394 students completing the post-test.

Research and Technology, GE202x, introduces students to research design and methodology, as well as to disciplinary and interdisciplinary perspectives of the research process. Students learn how to design and implement a research project appropriate for their major disciplines and how to use technology for research and the communication of research results. Students also learn how to critically evaluate the validity, reliability, and limitations of research results. They produce a 15-page written research report and a 5-7 minute oral presentation about their research projects at the conclusion of the semester. Although the course includes students in their freshman, junior, and senior years, students usually take GE202x in their second year, and most students who take the course are enrolled as sophomores.

GE202x is considered an intermediate level course because, as a 2000-level, General Education course, it develops foundational concepts and skills introduced in two prerequisite courses—both at the 1000 level (Communication 1402 and English 1030).

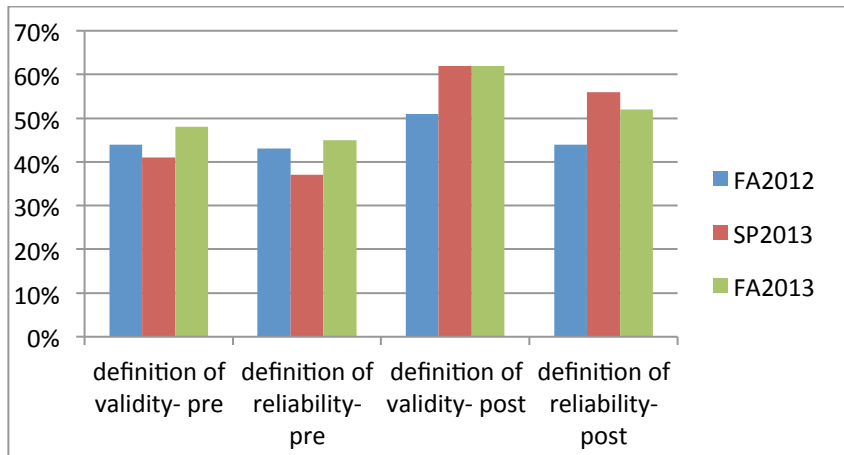
Number of students (Fall 2013): Pre-test: 557; Post-test: 394

Number of sections (Fall 2013): Pre-test: 35; Post-test: 35

Table 1: Longitudinal data regarding key terms “validity” and “reliability”

Semester	definition of validity- pre	definition of reliability- pre	definition of validity- post	definition of reliability- post
FA2012	44%	43%	51%	44%
SP2013	41%	37%	62%	56%
FA2013	48%	45%	62%	52%

Chart 1: Longitudinal data regarding key terms “validity” and “reliability”



Discussion:

Overall, based upon the results of the pre-test and the post-test (see table 2 below), there was an improvement in student understanding of the scientific method from the outset of the Fall 2013 semester to the end of the Fall 2013 semester. Results showed that, in spite of broadly positive results, students continue to struggle with an understanding of the terms “validity” and “reliability.” Specifically, 37% of students incorrectly selected “validity” when answering a question about the definition of “reliability” and 29% of students incorrectly selected “reliability” when answering a question about the definition of “validity.”

More generally, longitudinal data from pre- and post-tests given in the Fall 2012 and Spring 2013 semesters are consistent with the pre- and post-test results from Fall 2013 in that pre-test scores are lower than the post-test scores regarding questions on “validity” and “reliability.” Notably, the higher percentage of correct answers regarding questions on these key terms “validity” and “reliability” in the post-test has improved fairly consistently since Spring 2013. (See table 1.) This may be due to the fact that General Education faculty met in the beginning of the Spring 2013 term and were made aware of the Fall 2012 results showing students’ confusion over the terms “validity” and “reliability”; however, there were no standardized, course-wide curricular changes implemented at that point. Given that, as noted above, some students continue to struggle with understanding the difference between these terms, the next action steps should focus on developing clear strategies for improving student understanding of these terms.

Actions:

- (1) Revise curriculum to include new strategies for helping students clarify the relevance of the terms “validity” and “reliability” (e.g. in-class assignment asking students to distinguish between “validity” and “reliability” to be followed by in-class discussion for immediate feedback.) This will include GE202x faculty meeting to formalize lessons that will improve student understanding of these terms.
- (2) As GE202x is an intermediate level course, the question of whether or not an additional pre-requisite is needed for this course will be considered. Specifically, it is a question of adding a science requirement, such as BIO1000, to the list of pre-requisites.

- (3) Changes will be made to the assessment process to track individual student responses to determine individual knowledge levels starting in Spring 2014.

Table 2: FALL 2013 Pre- and Post-Test Results

	557 #students 35 #sections		394 #students 35 #sections	
	<u>Pre-Test</u>		<u>Post-Test</u>	
Question	% correct	Most common incorrect answer	% correct	Most common incorrect answer
Definition of research	92%	N/A	96%	N/A
Definition of validity	48%	36% responded with reliability	62%	29% responded with reliability
Reliability in a research instrument	45%	37% responded with definition of validity	52%	37% responded with definition of validity
Definition of scientific method	61%	N/A	68%	N/A
Understanding of scientific method	70%	N/A	79%	N/A
Application of terms Q1	93%		95%	
Application of terms Q2	85%		86%	
Application of terms Q3	74%		78%	
Application of terms Q4	78%		84%	
Application of terms Q5	76%		84%	
Quantitative vs Qualitative Q1	68%		69%	
Quantitative vs Qualitative Q2	79%		74%	
Quantitative vs Qualitative Q4	67%		69%	
Quantitative vs Qualitative Q5	48%		53%	
Quantitative vs Qualitative Q6	54%		55%	
Quantitative vs Qualitative Q7	74%		77%	
Quantitative vs Qualitative Q8	68%		69%	
Quantitative vs Qualitative Q9	34%		41%	
Quantitative vs Qualitative Q10	63%		60%	
Quantitative vs Qualitative Q11	68%		73%	
Quantitative vs Qualitative Q12	78%		78%	
Definition of IRB	36%	N/A	51%	N/A
Variables	76%	N/A	82%	N/A

N/A: other answers had similar scores

Pre- and Post-test Questions Assessing K1 in GE202x:

1. _____ is the systematic process of collecting, analyzing, and interpreting information (data) in order to increase our understanding of a phenomenon.
 - a. A problem statement
 - b. A hypothesis
 - c. Research
 - d. A theory

2. _____ is the extent to which an instrument measures what it is supposed to measure
 - a. Reliability
 - b. Rejectability
 - c. Transparency
 - d. Scientism
 - e. Validity

3. A test is said to be reliable if it:
 - a. Measures what it is supposed to measure
 - b. When researchers agree with the answers
 - c. Consistency when measuring results when the entity hasn't changed
 - d. If the council of science votes to approve it into the laws of science

4. The _____ method is a systematic, cyclical approach to "search for knowledge."
 - a. Cluster Sampling
 - b. Guestimation
 - c. Scientific
 - d. Information gathering
 - e. All of the above
 - f. None of the above

5. Which of the following is NOT an essential part of the scientific method?
 - a. Make conclusions
 - b. Identify a problem
 - c. Gather data
 - d. Creating new theories
 - e. Form a hypothesis

6. Read the following and identify the appropriate response to the questions below.
 - a. You are watching a student carrying their textbook under their arm while they are texting on their smart phone
 - i. What is an observation?
 - ii. What is the theory?
 - iii. What is the hypothesis?
 - b. The textbook begins to slip
 - i. What is an observation?
 - ii. What is the theory?

- iii. What is the hypothesis?
 - c. You think that the textbook is going to drop
 - i. What is an observation?
 - ii. What is the theory?
 - iii. What is the hypothesis?
 - d. The textbook falls to the ground
 - i. What is an observation?
 - ii. What is the theory?
 - iii. What is the hypothesis?
 - e. You explain to someone that textbooks fall to the ground because of the Law of Gravitation
 - i. What is an observation?
 - ii. What is the theory?
 - iii. What is the hypothesis?
7. Identify as either Qualitative (A) or Quantitative Research (B)
- a. Measures amounts of one or more variable of interest
 - b. Aims to describe complexities and nuances of a particular phenomenon
 - c. n/a
 - d. Build theories
 - e. Focuses with known variables
 - f. Holistic with unknown variables
 - g. Numeric data
 - h. Textual and/or image-based data
 - i. Deductive Reasoning
 - j. Inductive Reasoning
 - k. Statistical Analysis
 - l. Statistical Analysis
 - m. Narratives
8. Before beginning a research study, you usually obtain approval from the _____
- a. Council of Scientific Review
 - b. Institutional Review Board
 - c. Principals of Scientific Review
 - d. Federal Oversight of Science Board
9. A _____ variable is potentially influenced by something else
- a. Independent Variable
 - b. Dependent Variable
 - c. Binomial Variable
 - d. Waft-Index Variable