

Dropping the Other Shoe: Correspondence between qualitative and quantitative analysis of student reported benefits of undergraduate research experiences.

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Elaine Seymour and her colleagues have composed a draft copy of a report on the first findings of the NSF/ROLE grant (Seymour, Hunter, Laursen, & DeAntoni, in press with Science Education). The manuscript covers the benefits of undergraduate research experiences gleaned from interviews with 76 students at the four research sites. Concurrently, this author created and tested a survey for undergraduates participating in summer research experiences, principally in the sciences, at the same four research sites. The present report attempts to

1. Find items on the 2001 ROLE student survey that correspond to the descriptions of groupings of codes (which I will call categories) found in Seymour's report.
2. Use quantitative methods to test the correspondence between the survey results and the results reported in Seymour's manuscript.
3. By performing this analysis, demonstrate how the qualitative and quantitative halves of the NSF/ROLE grant may be knitted together.

For the sake of brevity, I refer the reader to Seymour, et al.'s report². In particular, please note the tables. I won't repeat the information in the introduction to the manuscript.

In Table 1 of Seymour's report are the parent categories and related codes of benefits gleaned from the student interviews. Tables 2 through 6 break out the details of these codes. These are the codes I refer to in this report.

Category I: Personal/Professional Gains.

Student observations on these gains are elaborated in Table 2. The table shows positive comments concerning a variety of types of confidence. In the table below, I list items from the ROLE 2001 student survey that might correspond to these descriptions. The ROLE 2001 survey was given at the four research sites. There were 249 respondents. Of interest here is that the survey asked students to rate 45 possible benefits of undergraduate research. In addition, the students chose which benefits they thought most important and evaluated their satisfaction with their experience. The general theme of Table 2 is confidence, and the attitude is positive. It seems relevant to inspect one benefit from the survey (#28: self-confidence) and relate self-confidence to both overall satisfaction (because a positive correlation would echo the positive attitude of Table 2) to other benefits in the survey (because they resemble the specific items in Table 2). Positive correlations between these items and self-confidence are an endorsement of the validity of coding in Table 2.

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The comparison of Table 2 items with survey items is found in Correspondence Table 1. I believe the results suggest a reasonable correspondence between the qualitative and quantitative information.

Correspondence Table I

Coded item	Survey item	Analysis
Increased confidence	28: Self-confidence	Table 1 shows positive observations. Therefore a benefit of self-confidence should correlate with overall satisfaction. This correlation is +0.33. ³
In ability to do research	3: Understanding the research process 8: Laboratory techniques	The correlation between Item 3 and self-confidence is +0.32; Item 8 and s-c is +0.38.
In contributing real knowledge to science	20: Sense of contributing to a body of knowledge	Correlation between Item 20 and s-c is +0.39.
Feeling like a scientist (7 items)	Items 3, 8, and 20 (above) as well as 24: Understanding how current research build upon previous studies 25: Opportunities for publication 32: Skill in oral communication 33: Skill in written communication	These items were used as predictors in a multiple regression equation, with self-confidence as the dependent variable. The multiple correlation between the aggregate of items and s-c is +0.60.
(Several of later items in Table 1 have low frequency counts and are not evaluated here)		
Establishing a mentoring relationship with faculty	43: Developing a continuing relationship with a faculty member	Correlation between Item 43 and s-c is +0.43. Item 43 was ranked 6 th most important by students.

³ All reported correlations are statistically significant.

Category II: Thinking and Working Like a Scientist.

The specifics of Category II are presented in Seymour's Table 3. Again we look for items in the ROLE 2001 survey that might offer collaborating support for the results in the table.

Correspondence Table II

Coded Item	Survey Item	Analysis
Thinking and working like a scientist	17: Understanding of how scientists think 18: Understanding of how professionals work on real problems	The correlation between the two survey items is +0.70. The two are highly redundant. The correlation between Item 17 and satisfaction is +0.22.
"...links between theory and practice..."	5: Ability to integrate theory and practice	The correlation between Item 5 and Item 17 is +0.48.
Understanding the nature of scientific knowledge	19: Understanding how knowledge is constructed 20: Contributing to a body of knowledge 24: Understanding of how current research ideas are built upon previous studies	These three items collectively relate to Item 17 with a multiple correlation of +0.63.
Understanding in greater depth; understanding theory/concepts	2: Learning a topic in depth 5: Ability to integrate theory and practice	These two items collectively relate to Item 17 with a multiple correlation of +0.49.
Increased appreciation of the relevance of coursework	23: Ability to see connections to your college coursework	The correlation between Items 23 and 17 = +0.23.
Understanding the process of research; increased patience and perseverance	3: Understanding the research process in your field 30: Tolerance for obstacles faced in the research process 45: Learning to persevere at a task	These items collectively relate to Item 17 with a multiple correlation of +0.56.

Overall, if we consider the survey item "understanding how scientists think" to be the survey's closest equivalent to "thinking and working like a scientist", then we may use it in a multiple regression of "understanding how scientists think" as predicted by the

specific items listed above in the second column. This analysis yields a multiple correlation of +0.72. The quantitative data corresponds to the qualitative data.

Category III: Gains in Skills.

The specifics of this category are presented in Seymour's Table 4. These skills (communication and technical) do not form as coherent a concept as the previous categories do. There is no single item in the ROLE 2001 survey that can serve as an umbrella term here. Therefore, I present some information about corresponding items and their relation to satisfaction. The strong tendency for students to make positive observations in the qualitative data should correspond to a positive correlation between skill learning and satisfaction in the survey.

Correspondence Table III

Coded Item	Survey Item	Analysis
Communication (oral)	26: Opportunities for poster or oral presentations 32: Your skill in oral communication	The combination of all the items in Column 2 predicted overall satisfaction with a multiple correlation of +0.31.
Communication (written)	25: Opportunities for publication 33: Your skill in written communication	
Lab skills	8: Laboratory techniques	
Work organization	No items	
Computer	13: Computer skills	
Reading comprehension	22: Ability to read and understand primary literature	
Collaborative working	31: Ability to collaborate with other researchers 42: Becoming part of a learning community	
How to get information	21: Ability to locate and identify the relevant literature	

Because no single item on the survey encompasses the general concept of "skills", I explored ways in which the survey items listed in Column 2 above might be organized. One intriguing organization stems from setting "Becoming part of a learning community" as a dependent variable and adding the other items are predictors in a multiple regression equation. The result is that the other items have a multiple correlation of +0.70 with

“learning community”. Collaboration, oral communication and written communication are all independent predictors of the gains reported for “learning community”.

Category IV: Clarify Career/Graduate School Intentions.

Student observations on this topic are elaborated in Seymour’s Table 5 (p. 32). There are several items on the survey that are relevant. They are:

Correspondence Table 4

37: Clarification of a career path
38: Enhancement of your professional or academic credentials
41: Understanding the personal demands of a career in your discipline
44: Opportunities for networking (e.g., contacts in career or in graduate school)

The four variables as a set of predictors correlate with satisfaction, $R = +0.29$. The “clarification of a career path”, which roughly corresponds to Seymour’s construct, is predicted by the three other variables ($R = +0.48$), indicating that they are linked to clarification of a career path.

Category V: Enhanced career/graduate school preparation.

The ROLE 2001 survey does distinguish well between Category IV and Category V. The results above may have some bearing on both categories.

Category VI: Changes in Attitude to Learning and Working as a Researcher.

This category includes “learning to work independently.” There was one item on the ROLE 2001 survey that asked about independence: Item 36: Learning to work independently. This item was not significantly correlated with satisfaction.

Category VII: Other Benefits.

This category includes getting paid, access to good lab equipment, etc. The ROLE 2001 survey has no items that correspond.

Conclusion

This analysis uses the categories and sub-categories reported in Seymour’s manuscript as the basis for reporting quantitative analysis on analogous items for the ROLE 2001 survey. The conclusions may be summarized as follows:

1. Where the categories are based on positive observations, thus indicating satisfaction with the research experience, the analogous survey items correlate directly with satisfaction.

2. Where the category and its sub-categories can be compared to a survey item echoing the parent category and separate items echoing the sub-categories, the sub-category items predict (correlate with) the parent item with significant, often large positive correlations.
3. Generally, the quantitative survey corresponds to the codes resulting from the student interviews to an encouraging degree. There is a network of quantitative relations that correspond to Seymour's codes. The two methodologies of the ROLE grant cross-validate. The two shoes walk together.