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Undergraduate Writing in the Sciences: A Case Study

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UNDERGRADUATE WRITING IN THE SCIENCES: A CASE STUDY

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This research project is an attempt to understand the role of writing in undergraduate science education, including the development of writing's current role in scientific education, the present nature of writing in the scientific disciplines, and its value. With this understanding, we feel it is possible to successfully improve the communication skills of undergraduates students in the scientific disciplines, which in turn will benefit both the scientific community and society itself. A case study of undergraduate writing in the sciences was conducted at Utah State University, both to assess the present attitude of faculty toward this subject and to investigate practical approaches to disciplinary writing instruction.

Introduction

In October of 1993, researchers at the George Washington School of Medicine reported that they had successfully created clones of a human embryo (Holberg, 1993). The research group suggested that perhaps this could be a useful advance in fertility treatments for couples having difficulty conceiving. A short time later, a wave of reaction appeared in the popular literature in the form of editorials and articles. A great many of these bewailed the unethical uses of cloning technology and detailed the horrible acts that would come of this research, especially noting the effects that human clones would have on society--one of the most interesting being a proposal that genetically engineered sex-slave clones would soon appear on the market. More than a few of these articles focused on the imminent danger that the production of human clones would pose to the civil rights of the common citizen (Ehrenreich, 1993; Elmer-Dewitt, 1993; Jacoby, 1993; Pope, 1994).

Few would argue that the pace of development of science and technology is growing ever faster; likewise, few would disagree with the assessment that without a solid scientific background, any more than a cursory understanding of issues such as the one presented above is difficult to achieve. The general public tends to display a deeply disturbing lack of scientific literacy, and even well-educated people have difficulties with the esoteric knowledge of disciplines outside their own. Such difficulties undoubtedly

contribute to widespread public ignorance and distrust of both science and the scientific community. With the almost exponential growth of scientific knowledge that is occurring at present, the gaps between the haves and have-nots of scientific literacy is widening at an equal pace. Many have proposed that in this new information-based world, power is becoming less and less rooted in material wealth and resources, and more in knowledge. A distinct disparity in the division of educational "wealth" will create as many problems as economic imbalances have for thousands of years.

The Role of Writing in the Scientific Community

It follows, then, that in bridging the chasm between the general public and the scientific world, education and communication are the key building materials. Education is obviously important for both groups. Anyone who wishes to become a scientists must first learn enough to function in a professional capacity within the scientific community, as well as acquire knowledge of society itself. In order to make well-informed decisions when it comes to social and ethical concerns raised by scientific and technological advancements, those who are not scientists need to have the educational background to at least have a basic understanding of scientific principles and methods.

Communication skills are also vital to bringing these two worlds closer together. The public must be able to communicate desires, concerns, and especially fears to members of the scientific community. This is especially true for public officials who are in positions to make significant decisions regarding those ethical and legal concerns--as well as funding of scientific research and technological development. Scientists need communication skills for two main reasons. First, they must be able to interact effectively with their peers within the scientific community. With large amounts of new

information being published every day, it is often difficult to cross disciplinary lines with any depth of understanding. Each scientific discipline, and even sub-disciplines, can easily become isolated--molecular biologists working with proteins can have difficulty following a fellow researcher's discussion of DNA analysis methods if communication skills are lacking. Second, members of the scientific community need to be able to translate for the general public the information produced by their work. Of course, the demarcations between these two groups are not nearly so clear-cut--scientists are also members of the general public, and the definition of "scientist" is itself subject to considerable variation.

Writing plays an extremely important role in both education and communication--in fact, through writing (and, of course, reading) education and communication become one and the same. Without good writing skills, all of the necessary elements for linking the public and the scientific community become defunct. In order to create and support these cross-bridges, the teaching and practice of such skills are vital. There are several stages where writing skills are both taught and learned--grammar school, secondary education, the university level, and within the context of professional life. We have chosen to focus in this study on undergraduate writing in the sciences at the level of the university.

Undergraduate Writing in the Sciences

Undergraduate exposure to science can generally be divided into two areas. First, science students must learn the material of their major, as well as how to function in a professional capacity within their field. Second, some number of science classes are usually required of all undergraduates in order that non-science students will gain at least

a basic understanding of science. These two components, at the practical level, therefore break down to experiences in disciplinary upper-division courses and general education classes.

For science majors, the esoteric writing style of their discipline needs to be learned at the undergraduate level. Few students have had the necessary training in secondary school; in fact, very few students have decided which area of study they will focus on until arriving at the university. Upon acquiring a university degree, science students will either be in graduate school or a member of the work force--for both positions, they will almost assuredly need to be functioning as a professional.

The value of writing for those who are completing general education science courses rests in the analysis and integration of knowledge. Much of this analysis and integration occurs during the writing process. If a student is unfamiliar with scientific concepts, writing assignments emphasize the organization of thought in order to present information clearly in written form. The student is thus able to reconstruct the newly-learned scientific concepts into a framework more meaningful to him or her. This is especially true in mathematical scientific disciplines, where the very language of mathematics can seem alien to non-science students. Writing serves to translate from foreign mathematical concepts to the familiar English of the everyday world. Of course, this process holds true for the synthesis of all new and unfamiliar concepts, regardless of discipline.

However, there seems to be a problem with the "ideal" learning situation described above. Historically, educators have viewed writing as a discrete skill to be mastered, rather than as a process integral to learning. Consequently, it has not been clear who is responsible for teaching writing. Nor has a consensus been reached regarding

whether the teaching of writing skills--or the use of writing in the classroom--is a necessary part of science education. Interest in this subject led us to formulate this research project.

Research Questions

We determined four research questions which we would undertake to answer for this project. They are:

1. What information about the history and present practices of undergraduate writing in the sciences exists in the literature?
2. What is the current state of undergraduate writing in the sciences at Utah State University; i.e. *is* there actually a problem?
3. What is the attitude of faculty in the College of Science at Utah State University regarding undergraduate writing? Specifically, who do they perceive as most responsible for teaching writing skills to undergraduate science students?
4. If undergraduate writing does need to be improved, what changes in the curriculum, programs, or requirements applying to undergraduates would effectively improve writing skills?

As a result, our project actually has two emphases: investigating both the history and present discussion of writing in the scientific disciplines, and conducting a case study of undergraduate writing in the sciences at Utah State University.

Disciplinary and Curricular Development: A Literature Review

David Russell has written a review about the history of writing in education, *Writing in the Academic Disciplines, 1870-1990: A Curricular History.* Much of the following section is a synopsis of his ideas which are most pertinent to our project. Other sources include: *Writing in Academic Disciplines*, edited by David A. Jolliffe, *Writing to Learn Mathematics and Science*, edited by Paul Connolly and Teresa Vilardi, and *Writing Across the Curriculum*, edited by Susan McLeod and Margot Soven.

The modern university as we know it is a product of the twelfth century. The University of Oxford and the University of Paris were the first official universities. The curriculum initially consisted of the trivium--rhetoric, grammar, and logic--and the quadrivium--geometry, arithmetic, music, and astronomy. Initially, each student studied these liberal arts and sciences at the beginning "collegiate" level. After receiving their beginner's degree, the students could then specialize into different programs: theology, law, medicine, and teaching. This pattern remained basically intact until the industrial revolution of the 18th and 19th century, when an industrial middle-class arose with the industrial revolution. The new factory and market-based society required individuals with new skills, and educational programs changed to provide these trained people to the capitalistic system that so desperately needed them.

Initially, communication was at the heart of a university education, which inherently involved the study of language. The languages of learning were the classical languages. Even into the 20th century, Latin was the language of scholarly scientific works. The more static nature of the classical languages as compared to vernacular languages offered some protection in the curriculum against rapid linguistic change and disciplinary specialization. Students were educated by the recitation method, learning to

read and write through oral discussions, debates, and examinations. Writing was prerequisite to successful oral communication, but not a required part of the students education.

The scientific revolution of the 17th and 18th centuries and the industrialization which followed created entirely new disciplines of study. These new disciplines were technical in nature, making use of newly developed mathematical principles and other quantitative tools such as statistics. The traditional use of the oral examination was no longer deemed necessary. Students needed to master scientific concepts and models in a new language, consisting of increasingly scientific terminology.

In the 19th century, the role of writing in these new disciplines was unclear. However, educators were aware of the increasing deficiency in communication skills, especially writing, among undergraduate students. In fact, in 1872, Harvard president Charles W. Elliot began college-level composition courses in attempt to improve undergraduate student writing. It had been assumed that writing was an elementary skill that needed to be mastered prior to a university education. Following these reforms, the first written requirement for admission to Harvard university was implemented in 1873-4. Following this, Harvard switched from the rhetorical system to a forensic system of education. The Forensic system included discussions and debates as in the rhetorical system, but the debates focused on the written texts of students. With the new emphasis on writing and the increasing diversification and departmentalization of the curriculum, it was extremely difficult to house writing instruction. The increasingly technical nature of the curriculum created something called "the knowledge gap," which meant that English faculty found it difficult to help students with scientific and technical writing. In the late 1890s, Harvard's forensic system began to fade out. The controversy over whether

writing should be taught at the general university level or in discipline specific courses was partly the cause.

Although Harvard was attempting to address the role of writing in college education, other approaches to collegiate education drastically affected writing in the new undergraduate scientific disciplines. The research model of the university, adopted from Germany with its lecture system, tended to phase out comprehensive writing and speaking requirements more than the small private liberal arts colleges. Land grant universities began in the late 19th century. They had a special problem: rapidly rising enrollment and the need for professional specialization.

Different arguments have been proposed to explain the rapid change in the college curriculum that occurred in the late 19th and 20th century. According to David Russell, the major change that occurred in the curriculum during the late 19th and 20th century was a change in higher institutional educational values:

> The new missions of research , graduate teaching, and scientific and professional instruction drew resources away from the central task of the old college: undergraduate teaching in the liberal arts, including rhetoric. The elective curriculum and departmental organization made a specific place for composition courses where there had been none before but no place for college wide writing requirements outside the course structure (Russell, 62).

The shift in values enabled professors to focus on the specialized field of knowledge, while having an "institutionalized" excuse for not taking responsibility to improve undergraduate student writing, especially in scientific elements where research was greatly emphasized.

Disciplinary development also significantly impacted writing instruction at the secondary education level. Secondary education teachers were representatives of the

discipline in which they were trained: biology, chemistry, physics, computer science etc. If future secondary science educators did not receive significant writing instruction in their disciplinary training, writing in the sciences at the secondary education level would tend to become primarily a means of examination, instead of a means of learning.

As urbanization and industrialization increased during the 20th century, fields of specialized knowledge rapidly expanded, requiring the training of many more individuals who could master the new requirements of these expanding fields of knowledge. Universities attempted to solve the challenges of disciplinary specialization by instituting "general education," but the best model for general education of undergraduate students was not clear. It was assumed that the general education requirements of undergraduate students would provide the necessary communication skills, including writing skills, that students needed. David Russell named three models that were proposed in the 20th century for the general education of undergraduate students.

The "social efficiency" model advocated disciplinary development and curricular specialization. Administrators who favored this model claimed that students would learn to write through the cooperation of professors in the various disciplines. However, this assumption did not reach fruition. Russell writes:

> Yet cooperation schemes never confronted the issue of language and discipline because most administrative progressives saw writing as a generalizable skill, independent of disciplinary content and context: thus, the mandated page requirements, the error counting, the papers graded for "content" in one class and "form" in English class. By viewing writing as a discrete skill, administrative progressives were able to quantify and rationalize its instruction, while ignoring its complex relation to disciplinary learning. This mechanistic view of writing condemned cooperation to superficiality, for instructors in the disciplines

> (including English, to an important extent) came to see writing instruction as an additional burden over and above the "real" teaching of the discipline, not as an exciting and integral part of the discipline's activity (146).

The "social efficiency" model generally became the present model of general education. This model presents numerous challenges to writing instruction, especially the challenge of determining who is responsible for helping undergraduate students communicate and write well.

The Great Books model was supported by humanities departments. Students were to take a philosophical, critical approach to studying texts--"the Great Books"--and through this critical approach of language study, the student would become a broadly educated individual and escape the confinement of disciplinary specialization. The Great Books model abandoned systematic writing instruction, and especially neglected the writing needs of scientific and technical disciplines. The Great Books model appeared to be a wonderful solution to the problem of undergraduate student writing, but Russell makes an interesting point:

> By narrowing the definition of general education to acquaintance with a limited body of texts and their own critical approaches to them, the humanities faculty were able to assume the mantle of the generalist while still pursuing the specialized research and teaching necessary for academic identity and respectability. In this way, the humanities did not need to encounter the discourse of other disciplines, much less teach it, and the effect was to compartmentalize general education and limit the role of writing in it (168).

The Great Books model did not seem to solve the problems created by disciplinary developments and curricular specialization but rather acerbated those problems.

The Deweyan "social perspective" model of education proposed an integrated curriculum in which instruction in communication would be the main objective. John Dewey and his colleagues made significant contributions to writing instruction theory. Fred Newton Scott proposed that "composition (was) a 'growth,' a complex organic activity incapable of being analyzed on the atomistic industrial model or taught through drill and remediation" (Russell, 199). Dewey and his followers believed that writing was a process, instead of a discrete skill that had either been learned or not learned. The fact that the "social perspective" model was centered in education departments was probably a large part of the reason that this model did not became the standard for general education.

University general education requirements did help to meet some of the challenges of disciplinary specialization, but the role of writing in the undergraduate curriculum was still not clearly defined, especially the relationship between writing and learning. The body of scientific knowledge continued to grow at an unprecedented rate throughout the 20th century, and the scientific curriculum was struggling to incorporate this new knowledge. As a result, the pressure to "teach" the material to students understandably left little time for attention to disciplinary writing instruction.

James Britton's book written in the 1970s, *Language and Learning*, argued that language was an essential part of the learning process and that "for students to learn language effectively, the classroom, like the home, must have a climate of trust and shared contexts for purposeful communication" (Russell 277). The value of writing in the learning process was addressed with increasing frequency, and Writing-Across-the-Curriculum (WAC) movements began in higher education in the 1970s. This movement

has and is continuing to attempt to introduce writing instruction into disciplinary-specific courses. The WAC movement is challenging long-standing assumptions about writing. The major assumption challenged by the WAC movement is that writing is a discrete skill that should be mastered before disciplinary-specific instruction can occur. In the WAC movements, writing to learn has tended to be emphasized more than learning to write.

A Case Study: Utah State University

After answering the first of our research questions--namely, what information about writing in the scientific disciplines exists in the literature--the logical next move was to investigate a situation that exists in reality. Having been undergraduates in the Utah State University College of Science, we chose to use U.S.U. as a case study.

Objective of Case Study

The objective of our case study of Utah State University was to determine the attitude of College of Science faculty regarding undergraduate writing. There were three questions in particular to which we desired some response:

1. At present, how well do students write at Utah State?
2. Whose responsibility is it to teach writing to undergraduates in the sciences?
3. How would the writing skills of students in the College of Science best be improved?

These questions reflect the research questions we devised at the start of our investigation.

To answer them, we determined that a survey of all U.S.U. College of Science faculty members would be most appropriate. Eight questions were formulated; five were quantitative in nature and three were qualitative. The actual survey sent to the faculty members is contained in Appendix A.

Methods

Permission to send the questionnaire was obtained from the Dean of the College of Science, and a cover letter with his signature accompanied the survey. An introductory letter explaining the purpose of the questionnaire was also included. Confidentiality was assured to prevent outside concerns from influencing the responses of faculty members. A self-addressed stamped envelope for the return of the survey was sent as well. All accompanying materials sent with the survey are included in Appendix B.

The questionnaire was mailed to every College of Science faculty member, including lecturers and research scientists. All departments were included: Biology, Chemistry and Biochemistry, Computer Science, Mathematics and Statistics, and Physics. The mailing list was provided by the Dean's office of the College of Science. A total of 70 out of 126 surveys mailed were returned.

Upon return of the questionnaires, responses were separated according to department. The responses to each question were tallied both on a master sheet and a departmental tally sheet. Once all raw data was accumulated, it was determined that the most

appropriate method of statistical analysis would be to figure percent of faculty response to each category. For example, question 3 asks, "How well do undergraduates write at Utah State?" A rating scale of 1-9 was given, with 1 being very poor, 5 being adequately, and 9 being excellent. We decided that a rating of 1-3 would be tallied as "poorly", 4-6 as "adequately", and 7-9 as "well." The number of faculty responding within that range were divided by the total number of responses for that question, arriving at a "percent of faculty response." Questions 6 and 7 were analyzed similarly. For question 5, which reads, "Please identify what you feel to be the most serious problems with undergraduate writing," a simple number of faculty indicating a certain skill was figured. Questions 1, 2, 4, and 8 were not included in the analysis due to the qualitative nature of the responses.

Statistical analyses were also conducted by departmental grouping. Biology and Geology were grouped together as being in general more descriptive and less mathematical than Chemistry and Biochemistry, Physics, Computer Science, and Mathematics and Statistics. The purpose of this was to see if any significant differences by disciplinary grouping were apparent.

Results

The results of the quantitative questions are included in Tables 1 and 2. For ease of discussion, we will follow the order of the actual questionnaire (Appendix A).

1) What is the average number of writing assignments per class you give to your students?

Due to the varying nature of responses, and the ambiguous term "writing assignment," it

was not possible to accurately quantify the results of this question. Some faculty members felt that essay tests qualified as writing assignments; others only listed term papers. Also, responses pertaining to graduate-level classes were given.

2) Please describe the writing assignments you give, if any.

The purpose of this question was to understand the response to Question 1. These answers indicated to us that faculty had widely varying interpretations of the term "writing assignment."

3) On a scale of 1 to 9, how well do undergraduate students write a) at Utah State and b) in your discipline?

The responses to this question were analyzed as described above. The percentages of faculty response were as follows: For Utah State, 36.1% felt that undergraduates write poorly; 62.3% adequately; and 1.6% well. In the faculty member's discipline, 39.3% poorly, 55.7 % adequately, and 4.9% well.

4) How would you define "adequate writing skills" in general and in your discipline?

The purpose of this question was to justify the quantifying of Question 3 results. The responses to this question were consistent enough to allow a general description of factors listed. For general skills, good organization, correct usage of grammar, clarity of expression, well-constructed sentences, good vocabulary, logical flow of thoughts, and ability to answer a specific question were listed often. Disciplinary skills listed were: ability to summarize research findings, correct citation and use of scientific literature, incorporation of quantitative data, appropriate utilization of scientific terminology, and understanding of concepts.

5) Please identify what you feel to be the most serious problems with undergraduate writing.

This question was quantified as described in the discussion of methods. Following are the number of responses indicating a significant problem: Organization, 52; grammar, 48: format/structure, 44; mechanics, 44; content, 37; syntax, 33; style, 28.

6) At present, whose responsibility is it to teach undergraduate students the writing skills they need.

The majority of faculty felt that high school, core writing classes, and the student were significantly responsible for the acquisition of writing skills. Most felt that the department and graduate school were not very responsible for teaching writing skills to undergraduates. There was a mixed response to the responsibility of general education. Actual percentages are listed in Table 1.

7a) Do you feel the writing skills of undergraduate students in your department need to be improved?

The vast majority of faculty responded affirmatively--96.9% yes, 3.1% no.

7b) If yes, which of the following would be effective methods for improving undergraduate student writing in the College of Science?

Three choices were indicated as being very effective: More writing-intensive classes within the department, more writing-intensive classes within general education, and higher university/departmental admissions requirements. Peer writing tutors who are science students were felt to be moderately to very effective. A College of Science writing center was seen as moderately to not effective. More required English classes and

non-science peer writing tutors met with mixed response. Actual percentages are found in Table 1.

8) If you were given the opportunity and funding to develop your own curriculum and/or writing program, what would you do?

The majority of faculty did not respond to this question. Although responses did vary widely, many indicated that they would not care to accept the responsibility. Other responses included developing writing-intensive classes, required satisfactory performance on a standard writing test, establishing a center for help with revision, and reducing time requirements for faculty giving writing assignments.

Table 2 lists results divided by discipline. Biology and Geology (BG) were grouped together, and Physics, Chemistry and Biochemistry, Mathematics and Statistics, and Computer Science were placed in the same group (PCMC). Only Questions 3 and 7 showed significant differences in faculty response. On Question 3, the majority of the PCMC group responded that undergraduates at U.S.U. write adequately, while the majority of the BG group felt that undergraduates at U.S.U. write poorly. The same results were seen when inquired of the writing skills of undergraduates in the particular disciplines.

On average, the BG faculty members were more optimistic about the effectiveness of the proposed programs to improve undergraduate writing. The most startling differences were in the use of science writing peer tutors and the use of more writing-intensive classes within the department. Many more BG faculty felt that these two programs would be effective. The actual percentages are listed in Table 2.

Discussion of Survey Results

We acknowledge that our methods allowed for a certain amount of bias in our results. Two possible biases are particularly in need of discussion. First, we had little control over the sample we received. Seventy of 126 surveys were returned. It is possible that only those who have particularly strong feelings about this issue in one way or another were motivated to answer the questionnaire. Likewise, faculty who only have a research position--with no exposure to this subject--might feel that they had no "stake" in undergraduate writing, and therefore might not have returned our questionnaire. This would introduce sampling bias into our data.

Also, upon reflection a certain amount of subjective language was included on the questionnaire. Some terms, such as "writing assignment," were not specifically defined, which could lead to ambiguity in responses. The qualitative questions--numbers 2, 4, and 8--did as a result produce a wide variation in response. Although we are able to indicate the nature of some responses, we feel that we simply do not have background in qualitative research methods to analyze them in any more specific way.

Another problem with our research methods was the failure to concretely define our method of analysis prior to sending the survey to faculty. As a result, the decision regarding how to quantify the results was not made until after the surveys were returned. It is likely that unnecessary bias in our results exists due to this lack of foresight.

However, we do feel that these results offer valuable insight into the attitude of faculty in the College of Science at Utah State University. We feel that although our

results may not be sufficient to justify a reform approach, they do warrant further investigation into the role and implementation of undergraduate writing in the sciences--both at U.S.U. and at other higher institutions of learning.

Conclusions

In conclusion, the faculty does agree that undergraduate writing at Utah State, both in general and in the scientific disciplines, needs to be improved. There is not a clear consensus regarding whose responsibility it is to teach undergraduates the writing skills they need once they are in the university. Interestingly, the historical basis for this confusion was clearly brought out in our literature review in that with the advent of the research university, less attention was paid to the teaching of undergraduate communication skills in the sciences, especially writing. Generally, science faculty do not feel that it is the responsibility of the discipline, either at the undergraduate or graduate level, to teach these skills. However, most faculty do agree that secondary education and the student him- or herself bears the majority of responsibility for the acquisition of writing skills. This observation validates the observation in the literature review that scientific faculty view writing as a discrete skill to be mastered prior to entrance into disciplinary training, instead of an "organic," growing process that occurs over a long period of time. Although we do not feel that it is our place to propose actual reform measures, we do feel that we have suggested some of the possible approaches to improving undergraduate student writing. Three solutions did seem to elicit significant

faculty support. More writing-intensive classes within general education and within the department were generally viewed favorably. Peer writing tutors who are science majors were also felt to be a possibly effective approach. By far, the most favored response for improving the level of writing at U.S.U. was to be more stringent in allowing students to enter the university or the department.

The grouping together of disciplines was done to challenge the assumption that all science faculty might respond in a similar manner. We thought that biology and geology would view writing differently than the disciplines heavily based upon mathematics. In general, this was not borne out except for the perceived student writing ability at U.S.U. and in approaches to improving student writing.

Obviously, these findings are extremely preliminary, and do not even attempt to address practical issues such as funding, facility, teaching resources, administration etc. Perhaps our results will be of value to those who wish to pursue the actual implementation of writing skill improvement programs. We feel that our results certainly do warrant further investigation into this topic.

To bring this report back to a full circle, it seems apparent to us that science writing skills are of vital importance in today's world. The growing gap between the scientific community and the general public needs to be bridged. In order to meet the upcoming challenges raised by living in a science and technology-based society, communication--especially writing--is absolutely essential. Although there are a number of areas where these skills can and should be learned, the university, and especially the undergraduate science classroom, is one place where the process of building the necessary bridges takes

place. It is only once this responsibility is accepted that effective improvement in the relationship between science and society can occur.

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Table 1: Faculty Survey Results

Question	Faculty Response		
	Poorly	**Adequately**	**Well**
How well do undergraduates at U.S.U. write?	36.1 %	62.3%	1.6%
How well do undergraduates in your discipline write?	39.3%	55.7%	4.9%

What do you feel are the most serious problems with undergraduate writing?	**Number of Responses**
Organization	52
Grammar	48
Format/Structure	44
Mechanics	44
Content	37
Syntax	33
Style	28

At present, whose responsibility is it to teach undergraduates the writing skills they need?	**Not very responsible**	**Moderately responsible**	**Significantly responsible**
High School	4.5%	9.1%	86.4%
Core Writing	7.5%	14.9%	77.6%
General Ed	22.7%	36.4%	40.9%
Department	44.6%	27.7%	27.7%
Grad School	55.4%	24.6%	20.0%
The Student	9.7%	11.3%	79.0%

Do you feel the writing skills of undergraduates in your discipline need to be improved?	**Yes**	**No**
	96.9%	3.1%

Which of the following would be effective methods for improving the writing skills of undergraduates in the College of Science?	**Not effective**	**Moderately effective**	**Very effective**
More required English classes	40.4%	26.9%	32.7%
Peer writing tutors--non'science students	36.5%	38.5%	25.0%
Peer writing tutors--science students	20.4%	37.0%	42.6%
More writing-intensive classes within the department	25.0%	26.7%	48.3%
More writing-intensive classes within General Education	13.3%	28.3%	58.3%
A College of Science writing center	40.0%	40.0%	20.0%
Higher university or departmental admissions requirements	17.5%	15.8%	66.7%

Table 2: Faculty Survey Results--Departmental Comparison

Question		Faculty Response by Department Biology & Geology / Chemistry, Physics, Mathematics and Statistics, & Computer Science		
		Poorly	**Adequately**	**Well**
How well do undergraduates at U.S.U. write?	*	56.0 / 24.3%	44.0 / 72.7%	0.0 / 3.0%
How well do undergraduates in your discipline write?	*	52.0 / 31.4%	44.0 / 62.9%	4.0 / 5.7%
What do you feel are the most serious problems with undergraduate writing?		**Number of Responses**		
Organization		21 / 31		
Grammar		23 / 25		
Format/Structure		16 / 28		
Mechanics		21 / 23		
Content		16 / 21		
Syntax		15 / 18		
Style		12 / 16		
At present, whose responsibility is it to teach undergraduates the writing skills they need?		**Not very responsible**	**Moderately responsible**	**Significantly responsible**
High School		4.0 / 5.6%	4.0 / 13.9%	92.0 / 80.5%
Core Writing		8.0 / 7.1%	16.0 / 14.3%	76.0 / 78.6%
General Ed		19.2 / 25.7%	42.3 / 33.3%	38.5 / 41.0%
Department		40.0 / 47.5%	28.0 / 27.5%	32.0 / 25.0%
Grad School		50.0 / 59.0%	27.0 / 23.1%	23.0/ 17.9%
The Student	*	4.3 / 12.8%	8.7 / 12.8%	90.0 / 74.4%
Do you feel the writing skills of undergraduates in your discipline need to be improved?		**Yes**	**No**	
		100.0 / 94.7%	0.0 / 5.3%	
Which of the following would be effective methods for improving the writing skills of undergraduates in the College of Science?		**Not effective**	**Moderately effective**	**Very effective**
More required English classes		42.9 / 38.7%	19.0 / 32.3%	38.1 / 29.0%
Peer writing tutors--non-science students	*	31.8 / 41.4%	36.4 / 41.4%	31.8 / 17.2%
Peer writing tutors--science students	*	9.1 / 30.0%	31.8 / 40.0%	59.1 / 30.0%
More writing-intensive classes within the department	*	18.5 / 30.3%	18.5 / 33.3%	63.0 / 36.4%
More writing-intensive classes within General Education	*	7.7 / 17.6%	23.1 / 32.4%	69.2 / 50.0%
A College of Science writing center		45.4 / 34.4%	27.3 / 50.0%	27.3 / 15.6%
Higher university or departmental admissions requirements		23.1 / 12.9%	11.5 / 19.4%	65.4 / 67.7%

* denotes a significant difference in departmental responses

Appendix A

Undergraduate Writing in the Sciences

Name of discipline: _____

1. What is the average number of writing assignments per class you give to your students?

2. Please describe the writing assignments you give, if any.

3. On a scale of 1 to 9, with 9 being excellently, 5 being adequately, and 1 being very poorly, how well do undergraduate students write?

   At Utah State 1 2 3 4 5 6 7 8 9

   In your discipline 1 2 3 4 5 6 7 8 9

4. How would you define "adequate writing skills"?

   In general _____

   In your discipline _____

5. Please identify what you feel to be the most serious problems with undergraduate writing: (mark all that apply; rank if necessary)

   ____Content
   ____Format/Structure
   ____Grammar
   ____Syntax
   ____Organization
   ____Mechanics i.e. punctuation, spelling, capitalization
   ____Style

6. At present, whose responsibility is it to teach undergraduate students the writing skills they need? Please rate on a scale of 1 to 9, with 9 being significantly responsible and 1 being not responsible.

1 2 3 4 5 6 7 8 9	High school
1 2 3 4 5 6 7 8 9	Core writing communication classes--101, 200 or 201 etc.
1 2 3 4 5 6 7 8 9	General Education
1 2 3 4 5 6 7 8 9	Departmental classes
1 2 3 4 5 6 7 8 9	Graduate/professional school (students will learn what they need in their field during graduate studies)
1 2 3 4 5 6 7 8 9	The student

7. Do you feel the writing skills of undergraduate students in your department need to be improved?

yes no

If yes, which of the following would be effective methods for improving undergraduate student writing in the College of Science? Please rate from 1 to 9, with 9 being very effective and 1 being not effective. Elaborate if necessary.

1 2 3 4 5 6 7 8 9	More required English classes
1 2 3 4 5 6 7 8 9	Peer writing tutors--non-science students
1 2 3 4 5 6 7 8 9	Peer writing tutors--science students
1 2 3 4 5 6 7 8 9	More writing-intensive classes within department
1 2 3 4 5 6 7 8 9	More writing-intensive courses within General Education
1 2 3 4 5 6 7 8 9	A College of Science writing center
1 2 3 4 5 6 7 8 9	Higher university or departmental admissions requirements

Other:_____

_____

_____

8. If you were given the opportunity and funding to develop your own curriculum and/or writing program, what would you do?

Please attach any additional comments you may have. Thank you!

Appendix B

March 31, 1995

Dear Faculty Member:

As part of our Honors senior thesis project, we are conducting a survey of the College of Science faculty. We are undergraduate students who will be graduating this June from the College of Science. We have worked as Rhetoric Associates (writing tutors) for past two years, assisting students in variety of courses from the Colleges of Natural Resources, Science, and HASS.

Our project focuses on the development of writing skills at the undergraduate level in scientific disciplines. As faculty, your input will be helpful in assessing the level of writing, common problems and difficulties associated with undergraduate writing, and the attitude of professors toward writing instruction. With the information you provide, we will be able to investigate undergraduate writing, its relationship to general education, and possible models for improving the undergraduate scientific writing experience. If you are a research instead of teaching faculty member, please indicate this on your questionnaire. We are still interested in your response; answer from your personal experience with undergraduate students.

The questionnaire is confidential; your name is not requested. Please be open and detailed in your response, and feel free to attach any additional materials you feel would be helpful. An envelope is provided for returning the form to us. We would appreciate a prompt return of the questionnaire, as the school year is drawing to a close.

We will be presenting our project on Scholar's Day, May 16. Please attend if you are interested! Thank you for your support.

Sincerely,

Susan Browning
Jon Obray

March 31, 1995

Dear Faculty Member:

Susan Browning and Jon Obray are undergraduate students in the College of Science. Their senior thesis project involves undergraduate writing in the sciences. I have given permission to submit a questionaire to the College of Science faculty. This questionaire is not meant to be a tool for individual faculty evaluation, but rather as an attempt to understand how to improve in preparing undergraduate students for success following graduation from undergraduate studies.

Thank You,

Dean James A. MacMahon