

REPORT ON THE QUALITATIVE ANALYSIS OF A SAMPLE OF SOCIETY OF PHYSICS STUDENTS INTERN JOURNALS

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Executive Summary

The SPS Summer Intern Program

Since the beginning of its summer intern program in 2001, the Society of Physics Students (SPS) has provided internships to 37 undergraduates. SPS internships are designed to create broad-based learning opportunities for undergraduate physics majors in the areas of scientific research and science education outreach/policy work. Successful applicants are placed in organizations and agencies in the Washington, DC, area, such as the National Institute of Standards and Technology (NIST) and the National Aeronautics Space Administration (NASA) for research-based internships, or placed within professional associations such as the American Association of Physics Teachers (AAPT) and the American Astronomical Society (AAS) for science education outreach/policy internships. These organizations and associations utilize the energy and diversity of physics undergraduates to enhance their programs in the advancement of physics and allied sciences, and seek to contribute to students' professional development through meaningful, hands-on engagement in projects relevant to their programs. Participating agencies assign one or more mentors from senior staff to guide interns' work and overall experience.

As part of the SPS Summer Intern Program, students participate in an orientation session and intermittent half-day field trips to broaden their exposure to physics and allied science environments. Sometime during the internship, each student also gives a 20-minute professional presentation on his or her work, accomplishments, and overall internship experience, to the staff scientists of the American Institute of Physics and invited guests. Interns receive a \$3200 stipend, paid housing at George Washington University, and paid transportation to and from Washington, DC, for eight and a half weeks of work over the summer.

The goals of the SPS Summer Intern Program align with SPS' mission to (among others): encourage and assist students interested in physics to develop the knowledge, competence, enthusiasm, and social responsibility that are essential to the advancement of physics; stimulate interest in advance study and research in physics; and develop collegiality among physics students and professionals in physics and allied sciences.

Qualitative Analysis of a Sample of SPS Summer Intern Journals

SPS interns are required to submit a weekly journal as a way of documenting their internship experience. However, reporting expectations are largely undefined and leave interns to decide for themselves what to include, or even how much to write. Interns were simply directed to "submit

a weekly journal entry highlighting your work and/or a particular experience associated with the internship.” Gary White, Director, Society of Physics Students (SPS), Sigma Pi Sigma Director and Assistant Director of Education, American Institute of Physics, requested the services of Ethnography & Evaluation Research to qualitatively analyze a sample of student intern journals in order to determine the usefulness of this type of program assessment in evaluating the SPS Summer Intern Program.

SPS seeks both summative and formative information on their summer intern program from a qualitative content analysis of interns’ journals: summative findings address the intellectual, personal, professional and other types of gains that students take away from their intern experience; formative results concern strengths and weaknesses of the program and allow the program director to make informed policy decisions for the future direction of the SPS Summer Intern Program based upon empirical evidence. Understanding qualitative differences discovered by comparing and contrasting the types of gain students report from their experience either in the science research or science education outreach/policy internships will also aid the program director to assess the quality of both types of internship offered and direct recruitment of faculty and industry partnerships in alignment with program objectives. Identification of any issues related to gender is also an aim of this analysis.

Method

A sample of 20 intern journals was selected from a set of 37. Intern journals were randomly chosen within specific parameters to sample participant characteristics (race/ethnicity, Americans with Disabilities Act status, type of home institution [i.e., 2-year colleges, R1 institutions, public and private colleges and universities], as well as a balance between the two types of internship offered [science research or science education outreach/policy work], and between men and women) so as to provide a view of the broadest range of SPS internship participation possible.

A qualitative analysis of a sample of SPS intern journals was conducted to identify activities, attitudes, and gains that interns recorded in their journal entries while working in an SPS internship. Particular emphasis was placed on exploring evaluation questions important to SPS:

What evidence recorded in interns’ journal demonstrates:

- students’ intellectual, personal and professional gains from the internship experience?
- opportunities to integrate academic knowledge with field applications?
- gains in skills and knowledge that add value to their academic study?
- enhanced preparation in knowledge and skills for advance academic study or entry to the workforce?
- clarification and/or confirmation of participants’ intended career paths?
- knowledge of the physics and allied science community and increased opportunities for professional networking and career development?

From the results of the analysis, what can be learned regarding:

- formative information that highlights program strengths or that indicates areas in need of improvement?
- comparison and contrasts of the different types of gains students make from the two kinds of summer experiences offered by SPS internships?
- issues of gender?

To start, an intern’s weekly journal entries were compiled chronologically (from first to last) as an individual document file. The resulting 20 document files varied in length depending upon how much an intern had written, week to week or cumulatively. These files were then imported into *NVivo 7.0*, a computer software program used for qualitative data analysis. In conducting a content analysis, the analyst reads through all of the documents—the text data—searching for information relevant to the evaluation questions. Text segments referencing distinct ideas are tagged by code names. Codes are not preconceived, but empirical: each new code marks a discrete idea not previously raised. All of the code names that are developed are collected in a codebook. When the analyst reads a text passage that relates an idea previously encountered, the same code name is used again to mark the relevant passage. Thus codes and their associated text passages are linked, amassing a data set of code names and their frequency of use across the data set. Once all of the text data is coded in this manner, codes similar in nature are grouped together to define themes; the clustered frequencies, represented as grouped themes or categories, describe both the range and relative weighting of issues in participants’ collective report.

Since no word limit was imposed and parameters concerning what interns should write about were somewhat loose—requesting that they convey “a variety of science, policy and outreach-related activities” and other weekly or special events—journal entries reflect a *freeform* data set. Thus while we may expect commonalities among interns’ journals concerning weekly activities and structured events, what they record in regards to learning gains is notable, as these observations are offered spontaneously, without prompting. Again, because guidelines for interns’ journal entries are rather open-ended, it likely means that at least some gains are *under-reported*.

Findings

Grouping of Observations and Major Parent Categories, and Overview of Findings

Observations were sorted according to textual content into 14 distinct categories. These parent categories divided into two groups: observations on program outcomes and general observations. Broadly, analysis of interns’ journals identified: types of gains derived from participation in the SPS Summer Intern Program; descriptions of general SPS internship elements; and program evaluations.

Overview of observations of program outcomes

Nearly 70% of participants’ observations (67%) described benefits from participating in the SPS Summer Intern Program. They discussed gains in:

- personal growth (20%)
- personal-professional gains (14%)

- increased understanding of how science research and science education outreach/policy work is actually done, and other intellectual gains (13%)
- enhanced understanding of professional work contexts and preparation for advance study and entry to the workforce (9%)
- increased understanding of professional norms and practice and demonstration and development of character traits necessary to professional practice (8%)

Small numbers of participant observations also mentioned gains in: skills (2%), career clarification and confirmation (1%) and enhanced educational experience (<1%).

Overview of general observations

One third of participant's comments (33%) were grouped as general observations. A majority of interns' observations comprising general observations described:

- SPS internship elements (18%)
- Program/internship evaluations (10%)

Small numbers of participants also mentioned: specific ways in which mentors supported their work as interns (1%); how gains were produced (1%); and miscellaneous comments (2%).

Discussion of Parent Category Contents

Observations of program outcomes

Interns' observations of program outcomes show the multiple dimensions of students' growth and learning as a result of their SPS summer internship experience in Washington, DC.

- **Personal growth.** (n=274, 19% res., 22% ed. out./pol.; 22% men, 19% women)

The highest number of all observations reported in interns' journals described gains in personal growth as an outcome of participating in an SPS summer internship (20%). Ninety-five percent of interns wrote about the numerous opportunities to explore Washington, DC, and to take in the wealth of learning the city has to offer. A majority of interns (80%) also included accounts of other personal time spent outside their internship, such as reading, shopping, and going out places in DC. Comments related to interns' personal growth also described the strong collegiality that developed between SPS interns in their time *away* from work. Two-thirds of interns mentioned going places and doing things together with other SPS interns in their time off. These comments related the sense of community that was engendered by living closely together as a group over summer. As well, nearly half of interns specifically noted their SPS summer internship as a wonderful personal experience that helped them as young adults to discover themselves. Several interns offered observations of their internship as providing novel experiences and opportunities to learn about new things. Thus the largest set of benefits discussed by interns in their journal entries encompassed personal gains, such as exploring Washington, DC, other personal time spent outside their internship, including strong collegiality and friendship among the interns as a community, and reflections on ways in which they had grown personally as a result of their summer internship.

- **Personal-professional gains.** (n=197, 14% res., 15% ed. out./pol.; 15% men, 14% women)

Ranking second in number of intern observations on program outcomes, a smaller percentage of all observations (14%) described personal-professional gains—personal gains associated with their professional work experience. Participants’ comments in this category emphasized the benefit of collegiality built upon close interaction with interns and supervisors at their work. Gains in professional collegiality with other interns were reported by 60% of interns. These comments show the positive relationships that developed between interns working together, helping one another, learning from one another, and the sense of community professional collaboration engendered. Sixty percent of interns also mentioned opportunities for closer interactions with their supervisors. Nearly half mentioned ways in which supervisors mentored them and supported their learning during their internship, sharing knowledge and experience, modeling professional practice, and offering good guidance. Participating in and the development of a broader *group collegiality* were also noted in 55% of interns’ journals. In these entries, interns related larger group activities both as part of their work, i.e., organized tours, science education outreach events or attending events on Capitol Hill, as well as more relaxed social interactions with SPS program staff. While a majority of interns (55%) noted how happy and excited they were to get good results and were relieved and satisfied to find their work activities successful, only a handful of interns’ (four) went further, expressing gains in confidence due to their learning and sense of accomplishment. Interns’ personal-professional gains demonstrate positive affective benefits associated with authentic professional work experience. These gains support professional socialization and students’ identity development as young professionals.

- **Thinking and working like a professional.** (n=171, 14% res., 10% ed. out./pol.; 10% men, 14% women)

Close in number of observations to the personal-professional gains category, 13% of intern comments collected in “thinking and working like a professional” described intellectual benefits derived from the SPS Summer Intern Program. Overall, interns noted several types of intellectual gains. A majority of interns (80%) described *applied* learning gains in terms of their active engagement in authentic work (i.e., “learning by doing”)—gains in understanding how the profession works in hands-on practice. Some interns (eight) went further and mentioned their results fitting theoretical models, demonstrating a higher-level intellectual gain from their experience. Four interns discussed another high-level intellectual gain: participating in the design of their research or participating in lesson planning and development for science education outreach activities. Sixty-five percent of interns also described gains in new knowledge, as well as increased understanding of connections within and between the sciences. These gains highlight interns’ intellectual growth. By providing the opportunity to integrate academic knowledge with field applications, interns increased their understanding of how work is actually done, in applied practice, increased their knowledge, and increased their conceptual understanding of connections between and within the sciences.

- **Enhanced understanding of professional work contexts and preparation for advance study and entry to the workforce.** (n=122, 7% res., 12% ed. out./pol.; 9% men, 9% women)

To meet the objective of developing collegiality among physics students and professionals in physics and allied sciences, the SPS Summer Intern Program has specifically structured the program to provide opportunities for interns to interact with professionals in varied fields and work contexts. Nine percent of intern observations recounted ways in which participation in the SPS Intern Program enhanced their understanding of professional work contexts and their preparation for advance study and entry to the workforce. Attending congressional hearings and sessions with law- and policy makers, as well as intern-organized tours of their work sites, enhanced understanding of professional life and practice. As part of relating the activities of their internship, 65% of interns discussed opportunities to meet with, talk with, and learn from politicians, science researchers, and science education outreach and policy practitioners in authentic professional contexts. These observations demonstrate the ways in which the half-day field trips to attend various congressional hearings and tours of government research labs broadened interns' exposure to physics and allied science environments (reported by 55% of interns). Talking with their supervisors and other professionals, learning about what professionals do in their work, gaining a closer view of professionals balancing work life and personal life, and making connections with important people in the field were program outcomes recorded in SPS intern journal entries concerning ways in which participation had broadened and extended their understanding of and preparation for future professional opportunities, advance study and entry to the workforce.

- **Becoming a professional.** (n=103, 9% res., 5% ed. out./pol.; 8% men, 8% women)

Intern comments collected in the “becoming a professional” category conveyed (in almost equal measures) increased understanding of the nature of professional work and the demonstration and development of attitudes and behaviors viewed as character traits necessary for professional work in the field. Authentic, applied experiences showed interns the realities of working in science research and the difficulties of conducting science education outreach activities in practice: 65% of interns noted that the work can be slow, that there are difficulties and mistakes, that carrying out science activities with and teaching school-aged children is easier said than done. Comments related to understanding the nature of the work were balanced by a set of intern observations denoting demonstration and development of attributes important to professional practice. Half of interns expressed strong enthusiasm for and excitement at the prospect of their internship and the opportunity to work with respected professionals. Smaller numbers of interns also described the development of a range of attitudes necessary for professional practice, such as gains in tolerance, patience and perseverance, increased willingness to think creatively and to work through problems independently, being extra diligent, taking greater care, or putting in extra effort. As with the above categories, these types of gains are evidence that interns' are developing as young professionals and that program participation encourages their professional socialization. These outcomes are viewed as important to students “becoming professionals” and to ensuring the future professional workforce.

Small numbers of participant observations also mentioned gains in: skills (2%), career clarification and confirmation (1%) and enhanced educational experience (<1%).

In summary, nearly 70% of interns' observations described program outcomes encompassing a broad range and variety of personal, intellectual and professional benefits. Interns' observations of program outcomes related gains in: personal growth, personal-professional gains directly related to their engagement at their internship; increased understanding of how science research and science education outreach/policy work is actually done, and other intellectual gains; enhanced understanding of professional work contexts and preparation for advance study and entry to the workforce; and increased understanding of the nature of professional work, norms and practice and the development and demonstration of character traits deemed important to working professionally in the field. Small numbers of interns also reported gains in skills, career clarification and confirmation, or enhanced educational experience. Collectively, interns report program outcomes demonstrating multiple dimensions of students' learning from SPS Summer Intern Program participation.

General observations

Following a majority of observations reporting program outcomes, a remaining 33% of intern observations were grouped as general observations. The majority of comments in this category described general elements comprising internship experiences, followed by intern program evaluations.

- **SPS internship elements.** (n=250, 18% res., 18% ed. out./pol.; 20% men, 17% women)

Comments comprising the category of "SPS internship elements" were 18% of all intern observations. These observations highlight the structural elements of the SPS Summer Intern Program and inform understanding of the role of structural elements in supporting interns' success and in achieving program objectives. From their accounts, it is clear that interns were participating in authentic work in which they had the opportunity to integrate academic knowledge with field applications (95% of interns offered clear descriptions of their active engagement in their projects and 75% of interns provided clear accounts demonstrating conceptual and practical understanding of their work objectives and assigned responsibilities). All interns reported group SPS field trips and opportunities to see a variety of physics and allied science work environments. Nearly half mentioned attending congressional hearings. Descriptions of engaging in authentic work, group SPS field trips and structured opportunities for interns to see a variety of work contexts, interns' clear understanding of project objectives and work responsibilities, and other structured activities (i.e., the SPS orientation session, safety trainings, or other informational meetings) show that the SPS program structure is successful in supporting interns' learning and in meeting stated program objectives.

- **Program/internship evaluations.** (n=141, 9% res., 12% ed. out./pol.; 9% men, 9% women)

The majority (nearly 90%) of interns' evaluative observations were highly positive: 90% of interns described how much they were enjoying their internship; 75% of interns described what a great summer they were having and how "time was flying by." Interns' positive evaluations reflect and corroborate program outcomes reported from their SPS intern experience. Very few of interns' evaluative observations were of a mixed nature, and even fewer were negative.

Small numbers of participants also mentioned: specific ways in which mentors supported their work as interns (1%); how gains were produced (1%); and miscellaneous comments (2%).

In summary, just over a third of all intern observations were grouped as general observations. The majority described SPS structural program elements supporting intern learning and highly positive program evaluations. Very small numbers of comments and actual numbers of interns reported: structural elements provided by their supervisors, intern views on how their learning was enabled, and other miscellaneous observations.

Analyses of Internship Type and Gender

Overall, percentages of observations by type of internship and by gender were well balanced. This is also true for actual numbers of interns citing a particular observation. Observations made by participants in science research vs. science education outreach/policy internships and by men and women were similar in nature and in number. Indeed, there is remarkable alignment in the balance of observations recorded by science research vs. science education outreach/policy interns and between men's and women's observations in every category across the data set. From analyses of the data set, it is evident that the many benefits which interns described as outcomes of program participation were reported equally by science research interns as by science education outreach/policy interns and by men as by women.

Conclusions

Findings from the qualitative analysis of a sample of intern journals exploring the efficacy of this type of program assessment as a tool for program evaluation document strong impacts on participants' personal, professional and intellectual development and provide empirical evidence that the SPS program structure is well aligned with and supports the achievement of its program objectives. Overwhelmingly positive program evaluations are testament to interns' excellent experiences with the SPS Summer Intern Program.

Observations recorded in intern journals support the conclusion that SPS is meeting program objectives aimed at encouraging and assisting students interested in physics to develop knowledge, competence, enthusiasm and social responsibility, interest in advance study and research in physics, and collegiality among physics students and professionals in physics and allied sciences. Evidence of many of the learning gains associated with program participation, i.e., personal growth, personal-professional development, gains in intellectual understanding of how a profession operates in practice, exposure to varied work contexts and possibilities (and gaining connections to them) as well as demonstrated attitudes and behaviors necessary to students' continuing on in the profession, are benefits that coincide with research documenting the beneficial outcomes of similar intensive, mentored learning experiences.

The largest set of benefits discussed by interns in their journal entries reflected personal gains they took away from their experience. In a recent report presenting outcomes from a Carleton College off-campus field research program in marine biology, personal growth also ranked first among outcomes (Hunter, 2006). Personal gains are important because they speak to the goals of educating students as well-rounded human beings and of helping students to develop as young adults capable of participating in and negotiating a complex world. Indeed, providing a holistic education that meets the needs of the "whole" student is a longstanding tenet of education that is

still viewed as a central purpose of colleges and universities today (Dewey, 1933, 1938; Shor, 1987; Giroux, 1988; Freire, 1990; Boyer Report, 1998; Baxter Magolda, 1999, 2001, 2004). From SPS interns' journal entries, it is clear that living in and exploring Washington, DC, as well as living closely among a group of peers, strongly contributed to students' personal growth.

Gains categories comprised of observations related to participants' personal growth, personal-professional gains, "thinking and working like a professional," "enhanced preparation" "becoming a professional,"—and, in much smaller numbers, skills and career clarification—match those described by Seymour, et al. (2004) and Hunter, Laursen & Seymour (2006) in their study to establish the benefits to students of undergraduate research (UR) experiences, as well as other recent research studies of UR (Ward, Bennett and Bauer, 2002; Zydney, et al., 2002; Bauer and Bennett, 2003; Lopatto, 2004; Russell, 2005). Gains cited across these categories all document the depth of participants' engagement in their learning, and, again, reflect participants' holistic learning. Importantly, these learning gains demonstrate program benefits that are consistent with national science education policy objectives and are promoted by relevant national funding organizations and institutions of higher education (Boyer Commission, 2002; NSF, 2000, 2003a; NRC, 1999, 2000, 2003a, 2003b).

Collectively, intern observations on personal growth, personal-professional gains, increased understanding of how work is actually done, increases in knowledge, enhanced understanding of and preparation for advance study and workforce entry, increased understanding of the difficulties encountered in professional work and the demonstration and development of character traits and attitudes necessary to professional practice document powerful program outcomes. Highly positive program evaluations of interns' intensive, experiential learning opportunities in which they had the opportunity to integrate academic knowledge with field applications complement interns' gains observations. Findings from the qualitative analysis of a sample of SPS intern journals demonstrate a breadth of important personal, intellectual and professional outcomes resulting from participation in the SPS Summer Intern Program.

Qualitative analysis of interns' journals shows their efficacy as a tool for program assessment. However, as previously stated, open-ended guidelines for interns' journal entries likely means that at least some gains are under-reported. Although intern journals are clearly useful as a program assessment tool, there is a weakness in that they do not collect the same information from every participant consistently, i.e., as a survey would. Too, analyzing this qualitative data for the purposes of program evaluation is costly and time intensive.

A strong benefit of having conducted this qualitative analysis is that SPS now has a framework upon which a grounded survey instrument that can query all participants about all gains, or other issues, may be built. Indeed, qualitative research typically precedes survey development. Thus, having identified the range and type of benefits interns report from program participation, SPS is now in a good position to move forward in developing a survey instrument that will allow SPS to consistently and accurately gather data to aid in evaluating program outcomes. Development of such an instrument, might, in fact, serve as the basis of a future SPS summer intern opportunity.

