

ChemPals: A Collaborative Approach to Mentoring in the Sciences

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Abstract

The goal of this proposal is to initiate a local electronic outreach program called “ChemPals,” an email “penpal” program that initiates contact between local eleven to thirteen year-old girls and science professionals. The strength of the program stems from the collaborative interactions of chemistry and education faculty, forming the foundation for a state-of-the-art-mentoring program using today's technologies. Capitalizing on the pervasiveness of email communication in school, home and industry, this program seeks to encourage more talented girls to explore opportunities in science. It will target false self-perceptions that these girls may possess by encouraging positive feedback from an adult scientist, thereby increasing the likelihood that these girls will choose science majors upon entering college. Matched pairs will maintain email contact, periodically engage in video conferencing with program-maintained equipment, and participate in an annual "reunion" science exploration day at Lehigh University. This program will be initiated by Lehigh students at the local level, and because of the power of internet communications, has endless possibilities for expansion to the national level.

Total Amount Requested: \$18,900 for 1 year

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PROPOSAL DESCRIPTION

Women in Science : Remaining Challenges

It cannot be disputed that hands-on research is an important part of undergraduate education in science. The involvement of undergraduate students in the research process, from experimental design, scientific literature exploration, real problem solving, data interpretation and the discovery process itself are enriching to a young scientist's training. Many colleges and universities, including Lehigh, now have very successful undergraduate research programs already in place. What we believe is lacking from undergraduate science programs is more young women choosing majors in the physical and engineering sciences. Having developed a successful strategy for bringing upper (junior and senior) and lower (freshmen) undergraduates into the laboratory research experience, we now see the need to attract more women to science before they reach the undergraduate level.

Many current undergraduate science curricula are quite rigorous, and require that students adhere to a fixed course roster in order to complete their degree requirements within four years. This tight schedule does not allow students to adequately "explore" subjects outside of their major and consequently they do not often change course from their initially chosen college majors. This is a problem when young girls are turning away from the sciences *before* they leave high school. For this reason, it is imperative to reach young women prior to the point in their life at which important choices are made.

Numerous studies have examined when¹⁻⁵ and why^{2,5-7} young girls in their precollege years turn away from scientific career paths at a higher rate than their male classmates. Studies suggest the following three contributing factors to the eventual difference between girls and boys as perhaps most prevalent: teacher's expectations, students' self-perception (attributional factors) and classroom environment. A recent study⁸ showed that these differences may not be as great as originally thought, possibly due to the higher than average gender-fair manner in which students in this particular study were taught. Even so, a difference in what students attribute their success to, effort verses ability, was still apparent. More boys than girls attributed their success to ability, whereas more girls attributed their success to their own effort or external factors such as the test being "easy." A study has found that it is a student's self-perceived ability in a particular field that leads him or her to choose that course of study at the college level.⁵ To change girls self-perceived ability in science, outreach programs target girls of this age group, to encourage them and expose them to positive scientific experiences at this critical crossroads in their life. These programs have had a great impact, though more programs are still needed, to reach the large number of talented girls who may not be getting all the encouragement that they need to fulfill their potential. Hands-on programs are an excellent means of reaching these girls, but these programs are person-power intensive, requiring extensive time and resources.

"ChemPals" Outreach Program

Through a collaborative interaction between chemistry and education faculty, we propose to approach this problem on a more fundamental level. We propose to target girls at this critical stage in life by implementing an email "pen-pal" program by which young girls aged eleven to thirteen are paired with established scientists in a variety of scientific and engineering careers. By fostering email contacts, a common and easily accessible communication pathway for both students and mentors, this program will allow students to "come out of their shells" and have closer interactions with adult mentors than they might otherwise. This critical contact between student and mentor at this age may help to change attributional patterns in these girls, giving them confidence in their ability to do science.

The proposed program, called "ChemPals," which will be run by Lehigh students, will choose and match pairs, initiate contacts, outline possible questions and discussion topics for each party, provide

enrichment sites/activities for students, evaluate interactions and appraise results. Students can access their mentors through email accounts, found in many homes and schools, as well as through chatrooms and group space we will establish on a Lehigh University website dedicated to the eChempals project. Mentor-mentoree contacts will occur between one and four times a month for a period of twelve to eighteen months during which formal contact will occur. After this period, pairs may choose to continue their interaction on a more informal level for as long as they choose. Exchanges can consist of students asking questions related to their schoolwork, scientific questions about their environment, inquiries about other outreach programs, college choices, or future career paths. By using email as the primary medium, we can reach students who may not be able to attend workshops, or who are too timid to ask questions when in a large group. Email allows many people to be more open in discussions and lifts some impediments to interacting with adults that some girls may have. Participants will be chosen by contacting local area schools (in the Lehigh Valley) to solicit participants from their science teachers. Several existing outreach programs at Lehigh (Hughes Outreach and WISE, women in science and engineering) can serve as recruitment platforms for students as well.

To further strengthen these mentoring contacts, video conferencing equipment will be purchased, and loaned to each pair for a fixed time period. The pairs will be able to have online video conversations and exchanges of ideas. One can imagine mentor-mentoree video conversations about chemistry including visual aids such as molecular models and samples that will make for an invaluable experience for the student. Undergraduate students enrolled in the 5-year BA/MEd program—a joint endeavor between the College of Arts & Sciences and the College of Education—will design the project website, as well as the enrichment activities geared toward engaging the students in creative scientific thinking. We anticipate between 15-20 undergraduates in the BA/MEd program and/or chemistry majors being involved.

In addition, an annual onsite "reunion" is planned for the summer. This day long event will be much more like a typical science outreach program such as "CHOICES" in which students visit labs and perform hands-on experiments. This event will be a great opportunity for the matches to meet one another and to jointly participate in the fun of science. The program will be designed for mentor-mentoree pairs to work together on demonstration projects and to visit labs at Lehigh. Because the student will have already developed a rapport with the mentor, a deeper level of scientific interaction can arise than in typical one-day outreach programs.

Precedence

Several adult mentoring programs based on the Internet have been established⁹ and have shown success. These programs couple into the immediate and accessible nature of the internet and email to establish ties between people otherwise unknown to each other. The non-threatening nature of internet communication will be an enormous added benefit to a child-adult program by reducing any barriers that girls may have toward communicating ideas and thoughts to adults in general and ideally reducing any deterrents to the chemistry career path.

Resources and Experience

My experience with 5th and 6th grade elementary school classes through the Hughes Outreach Program showed fewer girls raising their hands and asking questions during school visits. My own timidity at that age is also a strong personal motivation for me to initiate this program. While a post-doctoral researcher at the University of Oregon in Eugene, I was very active in the Big Brother/Big Sister of Mid-Oregon program, and was a big sister for two years to a young girl with interests in science. During those two years, she developed a stronger interest in science, but more importantly, she developed confidence that she can pursue any career in which she has interest. I feel that this experience has given

me insight into the needs and expectation of girls of that age. My work with Big Brother/Big Sister has also given me exposure to the organizational and administrative requirements of a program such as this.

Current Progress

The program is now in its infancy with a preliminary website already established (See <http://www.lehigh.edu/~mcm6/Chempalsmain.html>). The chemistry department is generously providing a part-time student (Erin Dickens) as part of cost sharing to Marie Messmer's NSF CAREER grant (no other funds are currently supporting this program.) Erin is a Lehigh University Presidential Scholar (Class of 1999, chemistry major) who is in her fifth year pursuing a master's degree in College of Education. She is working to implement the ChemPals program during this academic year as part of her research project for her master's degree. Her tasks as a research assistant include web-site design and maintenance, soliciting participants, setting up matching and measuring progress and success of the participants through testing.

PROJECT BENEFITS AND IMPACT

That mentoring is important to career success is now a well-understood fact. Developing mentoring programs is at the forefront of science education, and the use of technology in these programs is in its infancy. This program will provide the opportunity for both students and faculty to have unique collaborative interactions between colleges to develop this novel mentoring technology. We anticipate that 15-20 BA MEd students and chemistry majors will be directly involved in this project, through program organization, interactive website design (eChemPals), development and running of the annual "reunion" science exploration day at Lehigh, and in the interviewing and testing of participants for project evaluation. The results of this collaboration could possibly change the way science mentoring is approached in the future. The impact on women in science using this type of mentoring is clear: by encouraging a segment of the precollege girls that may be too timid to benefit from other more direct means of mentoring, future numbers of undergraduate women in the sciences can increase. This program will start out at the local level (limited to the Lehigh Valley) and, if proven successful, will expand to the national level, with enormous possibilities to form a large network for young girls. The potential benefits to Lehigh are obvious: national recognition for student involvement in the design of a novel mentoring program, as well as the increased visibility of Lehigh University to the future freshmen applicant pool.

PROJECT EVALUATION

The success of the program can be estimated in several ways. The first is examination of participants' grades relative to their peers and the second is from participant feedback. Evaluation of the program will be done semi-annually, by an email questionnaire, to students, mentors and the students' teachers to evaluate the program on these two levels. Especially important evaluation criteria will be related to students' perceptions of themselves. For example, their perceived successes may be attributed not to external factors beyond their control, but possibly to their own abilities, due in part to any encouragement and feedback that they might receive from their ChemPals mentor. Finally, we will conduct structured interviews with the BA/MEd students to investigate whether the ChemPals experience affected their ideas about science and female students in any way.

Literature Cited

- (1) Clewell, B. C.; Anderson, B. T.; Thorpe, M. E. *Breaking the barriers: Helping female and minority students succeed in mathematics and science*; Jossey-Bass: San Francisco, 1992.
- (2) Yee, D. K.; Eccles, J. S. "Parent perceptions and attributions for children's math achievement" *Sex Roles* **1988**, *19*, 317.
- (3) Sadker, M.; Sadker, D. *Failing at Fairness: How America's schools cheat girls*; Charles Scribner: New York, 1994.
- (4) Ryckman, D. B.; Peckham, P. "Gender differences in attributions for success and failure situations across subject areas" *Journal of Education Research* **1987**, *81*, 120.
- (5) *Bringing young women to math and science*; Eccles, J. S., Ed.; Springer: New York, 1989.
- (6) Heller, K. A.; Parsons, J. E. "Sex differences in teachers' evaluative feedback and students' expectancies for success in mathematics" *Child Development* **1981**, *52*, 1015.
- (7) Meyer, M. R.; Koehler, M. S. Internal influences on gender differences in mathematics. In *Mathematics and Gender*; Fennema, E., Leder, G. C., Eds.; Teacher's College Press: New York, 1990.
- (8) Gilbert, M. "Attributional Patterns and Perceptions of Math and Science Among Fifth-Grade through Seventh-Grade Girls and Boys" *Sex Roles* **1996**, *35*, 489.
- (9) See for example: *Nature* **1996**, 382, 383 and <http://www.learnwell.org/~edu/ementors.shtml>.

BUDGET

8 cameras for video link to loan to mentor-mentoree pairs (Winnov Videum) 8@ \$300 =	\$2,400
Software for web development and video	\$1,000
1.0 month summer support for Messmer and Bronack	\$10,000
Partial support for between 15 and 20 research assistant students	\$5,000
Funds for reunion science exploration day at Lehigh	\$2,000
Miscellaneous supplies	\$500
<i>Matching funds from the chemistry department (support for Erin Dickens)</i>	<i>- \$2,000</i>
TOTAL	\$18,900