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Undergraduates Leading Undergraduates: Peer Facilitation in a Science Workshop Program

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ABSTRACT: This article presents the results of a study investigating the experiences of undergraduates acting as peer leaders in an extensive peer-led team learning program in introductory undergraduate sciences and engineering courses. In an effort to understand the facilitator experience in the program better and to report initial findings on the benefits derived through a peer-facilitation experience, the study identified multiple areas in which peer facilitators reported experiences of growth and the ways in which they understood and responded to this growth.

KEY WORDS: higher education; small group learning; peer-led team learning; science education; minority achievement in higher education.

John Dewey has written that a teacher ought to serve as his or her student's "co-partner and guide in a common enterprise" (Dewey, 1964, p. 10). In undergraduate education in large research universities generally—and within the sciences in particular—this sort of reciprocal teaching relationship is unusual. Students often attend large lectures, all too seldom making individual contact with their instructors, and even less frequently engaging in a genuine back-and-forth discussion of the concepts they are learning to master.

The practice of peer-led team learning (PLTL) in undergraduate science disciplines mitigates the isolation that students can feel as a result of this separation between learner and teacher, and a growing number of colleges and universities have introduced PLTL components into their introductory science courses (Dreyfus, 2002). PLTL typically engages students in small-group discussion to work on problems or to

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complete tasks related to their courses. Gafney (2001) defined PLTL as a learning environment in which small groups engage in challenging work with trained peer leaders, activities are linked to the course in a meaningful way, and support is offered from instructors and the institution.

While students clearly benefit from PLTL, peer leaders may reap the greatest rewards. By acting as "co-partner and guide," the peer leader is engaged not in directing and correcting student performance, but rather in helping students along a path of inquiry and discovery. These leaders play the role of explorer as much as, or more than, that of tutor. As facilitators of learning, they must think through and mentally organize information before explaining it to students. This process forces peer leaders to engage with the material at a deep level, helping solidify their own understanding of it.

This article presents findings of a qualitative study of peer leaders, or facilitators, in a large peer-learning program in the undergraduate sciences. The research was conducted over one academic year and comprised two phases, the first one focusing on facilitators' general reactions to the experience and the second on the ways in which these individuals understood themselves to have developed through the facilitation experience.

Background

While there have been academic gains documented for students participating in PLTL and similar programs (Bonsangue & Drew, 1995; Cohen, 1997; Freeman, 1995, 1997; Fullilove, Fullilove, Terris, & Lacayo, 1988; Gosser, Cracolice, Kampmeier, Roth, Strozak, & Varma-Nelson, 2001; McCaffrey & Meyers, 1992; Treisman, 1992), it is the facilitators who, as peer mentors, may experience the most significant gains. Webb, Farivar, and Mastergeorge (2002) posited that in a peer-learning situation, it is not just the student receiving the explanation, but also the student offering it, who benefits. More specifically, Good, Halpin, and Halpin (2000) contended that mentoring programs designed to improve performance and retention rates for protegés may wind up spurring important academic and personal growth for the mentors themselves. This growth may result in part from increased cognitive demand on the mentor. As Bargh and Schul (1980) noted, students explaining problem solutions to others are forced to first make sense of the solution themselves, a process which may allow

them to grasp underlying concepts more fully. In their description of teaching assistants in science laboratories, French and Russell (2002) similarly asserted that teaching may be "the most effective of all learning activities" (p. 1).

Although this truism may be well accepted and incorporated into practice by educators—teachers have long used peer-to-peer tutoring as a method for consolidating knowledge in the tutor as well as the recipient—scholars have paid little attention to the development of or gains perceived by student leaders in peer-learning environments. This is particularly true at the undergraduate level, where teaching opportunities for students are rare. Of the small amount of research that has addressed peer leaders' experiences, most has examined the reactions of and challenges faced by tutors in their tutoring experiences, rather than focusing closely on tutors' development. Solomon and Crowe (2001), for example, noted that tutors perceived a lack of confidence in group leadership and group management, but also enjoyed the experience and felt they had gained some skills through it. Newcomb and Bagwell (1997) did identify perceived development of peer leaders, namely that peer leaders perceived they had gained in teaching and academic skills, had developed beneficial relationships with other peer leaders, had enhanced their understanding of connections among disciplines, and had experienced general personal development. However, these findings were based on only a single letter written by the peer leaders at the end of the term.

Additional research has investigated the developmental experiences of graduate teaching assistants (TAs), who, although taking on a more formal and status-distinguished role than do undergraduate peer leaders, similarly begin as novice leaders and must facilitate learning for others who are frequently only somewhat younger than they are. Their experience might thus be comparable to that of peer leaders. Nyquist and Sprague (1998) described a process of TA development beginning with concern over self-presentation as well as anxiety about knowledge level and moving eventually to concern with student learning as well as interest in exploring and creating new knowledge. French and Russell (2002) found that experienced TAs tended to take more interest in pedagogy and less in classroom management than did their inexperienced counterparts, viewing themselves as "guides" rather than "presenters." Similarly, Robinson (2000) found that beginning TAs focus almost exclusively on classroom management and eventually become interested in helping students learn effectively, and Etkina (2000) reported that

novice TAs struggled with group-management responsibilities and experienced difficulty explaining concepts in depth. In terms of their own academic development, experienced teaching assistants in French and Russell's (2002) study felt that they were better able to explain scientific processes after having led a course and saw a connection between their teaching experience and their research skills.

There is some evidence that for undergraduate peer tutors, the developmental process resembles that of TAs. Haith-Cooper (2003) found that tutors in a problem-based learning program focused mainly on deciding how and when to actively lead the group, suggesting that peer tutors feel somewhat unsure of the degree of leadership they should provide and perhaps corroborating Solomon and Crowe's (2001) finding that peer tutors experienced role conflict. Still, as noted earlier, the position and experience level of peer tutors is quite different from that of graduate TAs. The unique developmental experiences of undergraduate peer leaders have yet to be fully addressed in the literature.

Although the TA research may be relevant to the experiences of peer leaders, the two groups differ from each other in important ways. To understand the particular benefits of mentoring one's peers, researchers must address the peer-leader experience itself. Currently, the literature fails to provide insight into gains made by undergraduate peer leaders. Of the small amount of research available on the topic, much relies only on anecdotal or highly informal self-report.

The Study

This study inquired into the experiences of undergraduate peer facilitators involved in a science-based PLTL program at Northwestern University, a Carnegie Doctoral Extensive institution. Because our goal was to seek understanding of the peer-leader experience as a whole, we employed a qualitative approach using several methods: open-ended surveys, focus groups, and individual interviews. Our participants were peer leaders from four science disciplines within two schools of the University. This broad base allowed us to capture the variety of experience, what Patton (2001) referred to as "maximum-variation sampling" (p. 234), of peer facilitators in a particular science-based program.

The Study Context

In 1997, Northwestern University launched the Gateway Science Workshop (GSW) program, a series of small-group, peer-facilitated workshops open to first- and second-year students in biology. By 2000, the University was awarded a 3-year grant by the Andrew W. Mellon Foundation to develop and evaluate the GSW program in biology and to expand into chemistry and physics. The program is now in its eighth year.

Students take part in GSW voluntarily, receiving a notation on their transcripts but no grade or credit. Approximately 75 groups of 5–7 students, each led by an advanced undergraduate facilitator who has taken the relevant course 1 or 2 years earlier, meet weekly throughout the quarter. Faculty members create conceptual problems, which require integration of information rather than mere application of formulas, for these groups to work through at each meeting.

While the small group size and conceptual problems play a key role in the GSW design, the presence of peer facilitators, rather than faculty or graduate student TAs, may offer students special benefits. For instance, because peer relationships typically involve much less consciousness of power imbalance than do student–faculty relationships, learning in such a dynamic may enable participants to engage more freely and fully (Boud, 2001).

The GSW Facilitator Role

GSW peer facilitators are advanced (typically junior and senior) undergraduates who have taken and done well in the course for which they facilitate a workshop. Most of the facilitators in the program participate for one academic year; some continue for a second or third year as "senior facilitators." Candidates for the facilitator positions are hired on the basis of their knowledge of the discipline, leadership skills, and interest in working with beginning undergraduate learners. Currently, facilitators are unpaid but receive one academic credit per year; at the time this research was conducted, they were offered a choice between payment of $400 and one credit.

Although they are responsible for leading the group, facilitators take a coaching rather than a teaching approach to leadership. That is, they are instructed to guide students through problems and only intervene

when necessary, allowing students to seek and find answers on their own.

Facilitators receive both content and pedagogical training: they meet weekly with faculty in their workshop disciplines to review workshop problems; they also participate in a series of workshops on pedagogical theory and practice, designed by Northwestern University's Searle Center staff.[1] The weekly meetings with faculty may allow the facilitators to witness an experienced scholar's approach to explaining and solving problems, which in turn allows them to practice scholarly behavior with their students. The pedagogical course now supplements this content-based learning by addressing such topics as group dynamics, problem-based learning, learning and teaching styles, peer leadership, and diversity in groups.

Research Design

After human subjects approval had been obtained for the study, we undertook this research project in two phases: the first involved collection of broad data on facilitators' experiences with and understanding of their experience, and the second involved a more focused inquiry into the most salient areas of the facilitation experience described by participants in Phase 1. Phase 1 took place during the fall and winter quarters of the 2002–2003 academic year and consisted of surveys and focus groups. Phase 2 took place during the spring quarter of the 2002–2003 academic year and consisted of additional surveys, a smaller number of focus groups, and individual in-depth interviews. In Phase 1, our primary research objectives were to identify areas in which facilitators felt satisfied and dissatisfied with the program, to begin to explore the ways in which facilitators understood their own roles in the program, and to identify the ways in which they felt they had been affected through participating in it. In Phase 2, our research objective became more focused: in addition to continuing to collect feedback on surveys and in focus groups, we sought to probe the areas identified as benefits during Phase 1. Thus, one of the primary goals of Phase 2 was to define more fully the ways in which facilitators described their own experiences of growth during the facilitation period.

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[1]Beginning in the 2003–2004 academic year, a year-long credit course has replaced these workshops.

Table I
Data Collection Methods

Method	Number Phase I	Number Phase 2
Surveys	Fall 2002: 65/65 distributed (response rate: 100%) Winter 2003: 58/65 distributed (response rate: 89%)	Spring 2003: 45/58 distributed(response rate: 89%)
Focus groups	Fall 2002: 5 (1 per discipline with 2 in engineering), 5–7 participants each Winter 2003: 5 (1 per discipline with 2 in physics), 5–7 participants each	Spring 2003: 3 (mixed-discipline)
Interviews	0	8

Data

Over the 2002–2003 academic year, we collected 168 surveys (out of 188 sent) from facilitators, conducted 13 focus groups (3–5 per academic quarter) of 5–7 facilitators each, and conducted in-depth interviews with eight facilitators (Table I). Facilitators were strongly encouraged by program staff to participate in research activities (that is, respond to surveys, take part in focus groups, and participate in interviews) as part of their duties. Participation rates for surveys were consistently above 75%, interview invitations were honored in every case, and focus groups consisted of five to seven individuals, meeting the criteria commonly used for focus-group research (Krueger, 1994). Surveys were sent to all facilitators, and all were invited to participate in focus groups; those who did not participate typically had conflicting obligations, such as classes or extracurricular activities. In fall and winter quarters, focus groups were segregated by discipline; in the spring quarter, we held mixed-discipline focus groups to give facilitators the opportunity to compare experiences across disciplines. For the individual interviews, we used a purposive sampling method (Patton, 2001) in which we sought to represent all four disciplines as well as the ethnic and gender variation in the wider facilitator pool. Four men and four women were interviewed; of the eight, one was African American, one was Hispanic, two were Asian American, and four were White.

We included open-ended survey questions in a larger quantitative survey; we asked participants to comment on ratings they had

assigned to various aspects of the facilitator experience. Questions covered five general areas of facilitator experience: academic, teaching, social, career-related, and personal. A final section also included questions that solicited facilitators' advice on ways to improve the program.

Focus-group questions addressed facilitators' overall impressions of the program and their facilitation experiences; their relationships with students, other facilitators, and faculty; their reactions to the conceptual problems used in the workshops; and their feelings about the training they had received. The focus-group data thus helped us approach the overall research question by allowing participants to offer feedback about their experiences on several levels and to consider aspects of the experience they may not have thought of individually. Focus groups were held at the Searle Center and lasted approximately an hour each. Although we presented focus-group questions to participants in a particular order, we allowed for flexibility within the groups and gave participants ample opportunity to move the conversation in various directions. A member of the GSW research staff moderated the groups, and conversations were tape recorded and later professionally transcribed.

Individual interviews addressed facilitators' academic, teaching, social, career-related, and personal experience. As with focus groups, we relied on a set of predetermined questions in the interviews, but used them mainly as a structural foundation and catalyst for in-depth discussion of areas that seemed to be important to participants. The individual interviews were held at the Searle Center and lasted approximately 45 minutes each.

Analytic Method

Once we had collected all of the data and transcribed the tapes, the GSW research team used the thematic-analysis technique advocated by van den Hoonaard (1997) to search for salient points of common experience, as follows. First, we highlighted quotes that seemed to capture an important category of meaning; these might be considered "sensitizing concepts," first defined by Blumer as a tool that gives researchers a "general sense of reference and guidance" (1954, p. 7). Second, we highlighted quotes that appeared to be expressing the same essential ideas and grouped them into a single tentative thematic category. Third, we combined a number of these tentative categories describing specific but similar experiences to create more comprehensive

thematic categories; fourth, we created subcategories for themes that stood on their own but described some aspect of another theme; and fifth, we checked thematic categories to ensure that all quotes contained within them fit their assigned categories. Throughout, categories were reorganized to fit the data; and we deleted some categories that initially had seemed valid because the quotations within them did not hold together as a single theme. We used this process for each set and type of data (e.g., focus groups, interviews, surveys) and then compared themes across types. In conducting the analyses, we treated each "set" of data (type of data by quarter) individually, but then retained only those themes that appeared across at least two data-collection periods.

Findings

Our analysis focused on the ways in which facilitators described themselves as having benefited from, or developed through, the facilitation experience. Through our analysis, we found that facilitators perceived themselves to have progressed in three general areas, which we have termed *cognitive*, *personal*, and *instrumental*.

Vygotsky (1934/1987) has written, "Thought has its origins in the motivating sphere of consciousness, a sphere that includes our inclinations and needs, our interests and impulses, and our affect and emotions. The affective and volitional tendency stands behind thought" (p. 282). In describing the ways in which they felt they had progressed through the facilitation process, the facilitators we spoke with implied, and sometimes explicitly noted, connections between their thinking processes and their emotions. As they talked about leaps in conceptual understanding, for instance, they made reference to their interest in making social contacts and the satisfaction derived from engaging with others in group discussion. This parallels French and Russell's (2002) finding that teaching assistants saw connections between their teaching experience and their own research skills.

Below, we describe in detail each of the three areas of growth described by facilitators.

Cognitive Growth

Consistent with research finding gains in knowledge among tutors and teachers, as well as students who explain concepts to others (Cohen, 1994; French & Russell, 2002; Solomon & Crowe, 1999), the

facilitators we spoke with repeatedly noted a sense of having made strides in their own ability to process and understand material in the discipline. Three such areas of growth emerged: consolidating knowledge in the discipline, enhancing conceptual understanding, and developing problem-solving skills.

In regard to consolidating knowledge, facilitators spoke of having developed a firmer grasp of the material covered in both basic and advanced courses in the discipline. They typically saw this development as a direct result of having spent more time studying the material as well as having reviewed material they had studied, but perhaps not fully understood, earlier in their academic careers. "It's nice to kind of go back to the basics," one facilitator told us in a winter 2003 chemistry focus group. "You kind of forget those basics sometimes, so you're just reminded of them again." Another comment in a winter 2003 biology focus-group emphasized the depth with which one considers material the second time around: "I think all of us have benefited from going over this material again, thinking more deeply about some of these things that we hadn't really worked on as we specialize more or go off to another major."

In terms of enhancing conceptual understanding, facilitators reported that the experience of facilitating had helped them gain broad understanding of the field. Participants described understanding the discipline in a more profound way than they had before, often attributing this enhancement to having to apply previously learned material in new ways. One facilitator, for instance, said in a spring 2003 mixed-discipline focus group, "Having the close contact with the professor, going through [the material] in a small group, and then going out and teaching it really helped reinforce the material that I had kind of learned before. But now I understand it much better." Facilitators also spoke of searching for connections among disparate concepts as part of the effort to understand the material more deeply, and the concepts fully enough to explain them to others. "When you teach," a physics facilitator told us in a winter '03 focus group, "concepts come together because you are drawing . . . connections in order to make it easier for the students to understand, and when that happens, you start understanding it better." Some facilitators explained that they felt that facilitating had helped them in perhaps more profound and long-lasting ways, although they did not see any direct effect on their academic performance. One engineering facilitator told us on a winter 2003 anonymous survey that his or her grades had probably not been directly affected by the facilitation experience, but, this

facilitator wrote, "I definitely understand core engineering concepts better."

In terms of enhanced problem-solving ability, facilitators emphasized a newfound awareness of their own problem-solving strategies. They attributed this awareness to having to think explicitly about the ways in which they approach problems in order to help students do the same. "Being a facilitator forced me to examine my own problem-solving skills and analytical skills," wrote a physics facilitator. Another facilitator elaborated on this idea in a winter 2003 physics focus group: "I guess in facilitating, a lot of times they don't understand, so you just kind of explain it the way you see problems, and I guess in going through your own problem-solving strategies, you kind of understand yourself better and see how you tend to approach things." And finally, after we asked her whether she felt there had been any change in the way she approaches her own academic work, a biology facilitator told us in an interview, "I kind of went back and realized how it is that I solve [problems], and how it is that I'm asking [my students] to solve the problems . . . ."

That facilitators pay greater attention to their own problem-solving strategies would seem to give them a distinct advantage in their own academic work. As Pressley (1986) noted in the mathematics context, students who use problem-solving strategies well have not only mastered various strategies and content knowledge in their disciplines; they also must understand how problem-solving strategies work and be able to integrate their content knowledge with such strategies. Facilitators may come to the experience with high levels of content knowledge, but the knowledge they develop about *how* they learn during the experience promotes them to a higher level of mastery in their disciplines.

Beyond the cognitive skills practice itself, the affective dimension of the facilitation experience seems to have made an impact on facilitators' cognitive growth. In some facilitators' descriptions, there was a clear connection between cognitive benefit and the social dimension of the facilitation experience. During a fall 2002 focus group, one chemistry facilitator equated the traditional science learning process with "tragedy," contrasting this to the enjoyment found through group discussion of chemistry problems:

> It feels like the only part of the chemistry experience that I actually liked [as a student] was sitting around and talking about problems with people. I had fun learning chemistry but not in lab and stuff like that. [Facilitating] was a way I could keep doing science minus the tragedy.

The role of enjoyment in learning may play a particularly important role for students gifted in math and science, as is the case for GSW facilitators. Csikszentmihalyi, Rathunde, and Whalen (1997) found that, although students excelling in math and science felt optimistic about future career opportunities, they could maintain an investment in the field only by finding pleasure in it. An experience that transforms what a facilitator formerly saw as "tragedy" into fun may thus provide important reinforcement for continued pursuit of the discipline.

Personal Growth

In describing their own increased ability to engage with students, facilitators suggested what we term *personal* growth. They spoke of growth in communication skills—confidence, audience understanding, and self-expression—and pedagogical skills.

In terms of confidence in communicating, facilitators reported feeling more confident speaking in front of groups, as the following interview quote from a chemistry facilitator illustrates:

> I remember taking drama in high school. I took that class just so I'd be more comfortable speaking in front of people. I didn't do the facilitator thing for the same reason, but it kind of works the same way. It helps me get prepared. So I'm able to speak in front of people more comfortably. I'm able to express myself in front of people without being nervous and just quivering from the whole experience.

A physics facilitator we interviewed described a process of becoming increasingly comfortable communicating in social situations:

> I think it's forced me to become a little bit more social just because I know more people now, and, as a facilitator, you can't sit back and do nothing and not talk. It's forced me to kind of open up to my students. You have to start conversations, so by telling them more about myself, that's how I get responses from them about different things. You just kind of have to share more in order to get them to open up and feel comfortable.

Regarding ability to read one's audience, facilitators described feeling better able to understand others, which they felt in turn allowed them to communicate and facilitate more effectively. A chemistry facilitator told us in an interview, "Reading people in [the facilitation setting] kind of extends to reading people in other areas, in other settings."

When it came to self-expression, facilitators also told us they felt that they were more articulate than before, some noting that they used to feel frustrated at not being able to explain their own ideas clearly. This

often extended beyond the academic setting. A chemistry facilitator we interviewed described the connection between facilitating and her ability to help a family member: "I have a younger sister who is in chemistry classes right now. She's a sophomore in high school, so I am a lot more prepared to explain things to her."

The chemistry facilitator who spoke of "reading people" also described his new-found ability to "push" ideas "out there":

> At first, before the facilitator thing, I was not that great at explaining myself or explaining the concepts that were in my head. They were there, and I could understand them well for me, but for other people, I couldn't push it out there and give it to them. So, being able to do that in the workshop, you know, was number-one helpful.

Some of this sense of having developed interpersonal skills may have stemmed from the enjoyment facilitators took in connecting with their students. As one chemistry facilitator told us in a winter '03 focus group,

> I've had a lot of fun facilitating. I've had some very good groups. It's a job, but it's also not something that's a chore to do. It's fun, and you like the kids you work with.

This quote reveals something about the way the speaker conceives of work generally. The facilitator job is contrasted with job-as-"chore"; facilitating is thus both work and pleasure, presumably unlike other job experiences this person has had. Such a revelation might lead to enhanced interest in pursuing facilitation-like activity as a career; indeed, a number of facilitators told us that the experience had led them to consider teaching in some form as a career pursuit. Other studies of peer tutors (e.g., Solomon & Crowe, 2001) have similarly found that the experience of peer facilitation leads to an interest in teaching or tutoring.

When they spoke about pedagogical development, facilitators described gaining knowledge about and skill in teaching. These gains included the ability to use the workshop problems in a productive way, to help students arrive at a profound understanding of problems and concepts, to sense when to become an active leader (essentially, a teacher) and when to stand back and let students work on their own, and to create a positive learning environment. Facilitators also explained that they had developed teaching strategies over time through a process of trial and error. They talked about having developed as teachers in terms of both gaining teaching skills and coming to more fully understand the role of a teacher.

Gaining Skills. Among the skills facilitators noted, an improved ability to explain concepts (in addition to the improved ability to understand concepts and solve problems, as described earlier) stood out as one of the most important benefits of facilitating. The chemistry facilitator who spoke of helping her sister attributed this to having developed a better understanding of exactly what she wanted the students to gain from their work:

> Having gone through the workshop sessions for a year, I know how [students] want things explained. I feel that last year I just wasn't clear. I wouldn't explain things well. I wasn't quite sure what I wanted them to get out of the explanation, and I would just kind of rush through everything.

Facilitators also spoke of having gained skill at learning to "hear things out," to allow students to work out their ideas on their own without interrupting to offer guidance. A biology facilitator told us in an interview,

> Before, when I first started, I was, I think, a little less patient. I've definitely learned to hear things out . . . . I like to see people's thought process when they're hearing questions, and I think that's helped me be a better facilitator and adapt to different learning styles.

Understanding the Role of Teacher. Facilitators also noted that they had gained insight into the role of the classroom leader. Said a biology facilitator during a winter 2003 focus group, "As a student, I thought a facilitator would always have the answers if I didn't. Now, . . . I know that I don't have all the answers, so I see it as more 'we all work towards the answer . . . together.' " Another comment in this focus group similarly addressed having learned that good facilitating does not come easily: "I've noticed you can get by without doing a whole lot of preparation, but when you really put in the effort, it makes a huge difference in your workshop."

In describing their teaching experiences, facilitators placed particular emphasis on the pleasure of serving as a role model. They spoke of the excitement of leading a group of peers and the pleasure of serving in an advising role and of helping others to learn. A chemistry facilitator, for instance, said during a winter '03 focus group, "A lot of my students actually asked me questions once we were done with the workshop. Not about the material itself, but about the pre-med thing, about the whole chemistry major, advice on what classes to take, and things like that." A winter 2003 physics focus-group comment highlighted the delight of seeing students want to emulate you: "I kind of saw

their thinking was going more towards the lines of mine, which I really liked." The following winter 2003 physics focus-group comment sums up the mentor role many feel they play:

> I think that they look up to us a lot just because we have gone through the class. And because we are teaching it, we had some level of success, so a lot of them ask about test-studying strategies and what the professor usually looks for. And a lot of them are pre-med, and so are most of us, so I guess for parts I've taken on more of an advisor role.

In a fall 2002 engineering focus group, a facilitator talked about having received direct messages of appreciation from their students, suggesting that their facilitation was, indeed, helping: "It was an added bonus that they appreciated what you did. A lot of my students said 'thank you for your help' every time they left. That's so rewarding, when they thank you."

Instrumental Growth

Some scholars and practitioners (e.g., Bos, 1998; Drott, 2001; Swartz, 1996) have pointed to the benefit of an undergraduate tutoring or mentoring experience for later career development. Facilitators do not overlook this practical value. Although, as the preceding sections illustrate, the facilitators clearly valued the cognitive and personal gains they believed they had made, most were quick to point out the instrumental benefit of these gains: the facilitation experience would be good for their professional growth.

They consistently spoke of having made strides toward professional goals. These goals included preparing for placement exams as well as gaining experience that would assist in future careers, such as teaching and leadership experience, and developing a well-rounded understanding of the discipline. "I took the MCAT this year," a chemistry facilitator told us in an interview, "so taking that and like doing the chemistry facilitator thing concurrently kind of helped me to keep up on my chemistry stuff." Along the same lines, a biology facilitator said during a winter 2003 focus group, "It's really good for your resumé . . . . Being a TA is one of the three major things that grad schools look for." Yet another, a physics facilitator we interviewed, felt that facilitating may have opened new career possibilities: "I was doing the pre-med track as it is, but I think it opened up a possibility that maybe I would like to teach medicine at some point. It gave me a little

bit of hands-on experience in that, and I like what I've seen, and I've enjoyed it. I think that's a possibility in the future."

The facilitators' focus on their own professional growth is sometimes seen among faculty and GSW program administrators as a less noble goal than those related to conceptual and teaching skills, but clearly it represents their serious and worthwhile concern over their own future professional success. Perhaps more important, though, are the possibilities the experience seems to have created in the minds of facilitators. That several spoke of newly developed professional interests (such as teaching) supports the notion that the facilitation experience sparks new lines of inquiry in more than an academic sense. By pursuing their disciplines in a new way (that is, by acting as peer leaders), these facilitators are broadening their own understandings of the breadth of those disciplines and are coming to see that there are multiple ways in which to engage in these disciplines. Facilitators may also, as Moore and Holmes (2003) found in their study of high-school students participating in a science research project, come to more fully understand the dimensions of what it means to be a scientist in a particular discipline. This is likely especially in light of facilitators' regular interaction with faculty, who ideally model scientific behavior, for instance, collaborative problem-solving. For those facilitators who seek to pursue an academic career, the facilitation experience may also provide an important socialization experience. As noted by Austin (2002), early socialization into the academic community is often critical in the development of an academic career.

Discussion

The three areas of development identified here—cognitive, personal, and instrumental—represent a fuller picture of the benefit to peer leaders than has been described in previous literature. In their descriptions of the ways in which they feel they have developed, these facilitators tell a story of connected experiences. For instance, the cognitive growth they describe—for example, coming to better understand connections among science concepts—emerges from the act of explaining, which is a component of the growth in personal skills many of them have experienced. Similarly, instrumental growth—as in gaining professional skills—seems to have helped build, and to be built from, the growing confidence that allows facilitators to feel increasingly comfortable coaching their peers. Moreover, the affective dimension

of the facilitation experience—enjoying students' positive feedback, feeling appreciated, and simply having fun—appears integral to all other realms of the experience.

In these ways, the developmental benefits facilitators perceive cannot be described in isolation, but rather work together to compose an overall sense of growth among the facilitators we interviewed. In fact, this group of facilitators describe their experiences in such positive terms that they seem to lack much of the insecurity and hesitancy identified in the literature on graduate teaching assistants (e.g., French & Russell, 2002; Nyquist & Sprague, 1998). It may be that because peer facilitators are not formally endowed with higher institutional status than their students, they feel less pressure to perform as leaders or role models than do graduate TAs. Further, because GSW facilitators are chosen (and know they are chosen) based on their performance and must pass through a screening interview, they may enter the experience with fairly high levels of confidence.

In the typical undergraduate career, rarely does a student enjoy a formal opportunity to help other students advance in their intellectual development. This lack may represent academia's reluctance to endow un-credentialed students with the authority to teach, or it may result simply from the absence of an infrastructure to support such an endeavor. Whatever the case, most undergraduate students are officially positioned as learners, but not as sources of learning; and this positioning surely influences both the ways in which faculty view students and the ways in which students themselves understand their own capabilities and purpose. Students who both learn and formally help others learn become active members of the intellectual community within their disciplines, contributing to, and not merely drawing from, its ever changing pool of knowledge.

Even more significant to the individual student, however, are the intellectual, social, and other personal gains to be derived from helping others learn. As the peer facilitators who shared their experiences with us in this study have illustrated, the old adage that one learns best by teaching rings true even for those who are not placed in positions of official authority. The learning they undergo is not limited to gains in content understanding but can extend to emotional, social, and practical development as well.

Beyond the gains in facilitators' own development, an innovative peer-facilitated program like Northwestern University's Gateway Science Workshop offers important benefits to the institution. Facilitators provide a friendly resource for students who might feel intimidated

approaching professors with questions, an opportunity for students to engage in regular discussion of academic topics, and reinforcement of points important to teaching faculty—all at relatively low cost to the institution. More significant to students' learning, facilitators may also bring an innate ability to teach students in the manner best suited to their developmental levels. Shulman (1987) noted that good teachers need two kinds of knowledge: content knowledge and "pedagogical content knowledge" (p. 125), or insight into the process by which students learn, and fail to learn, the particular content in question. It may be the case that peer facilitators possess pedagogical content knowledge simply as a result of so recently having learned the very material they are helping their contemporaries understand.

Whatever the particular contributions of the facilitators, it is clear that the experience of facilitating in a peer-learning group can provide benefits that may not be available elsewhere in the traditional undergraduate curriculum. Programs that allow undergraduates to serve as peer leaders in an academic setting represent not just a unique set of potential benefits to the facilitator, but also a unique set of ideas about what it means to be a student, and a teacher, in higher education.

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