Chapter Two
The Students' Perspectives

At the heart of the PLTL model is teamwork, not only during the sessions themselves but also in the way we think of the instructional staff. To succeed, this model needs to have a team behind it, and crucial to that instructional team are the students who guide the groups. We do not refer to these students as *helpers*, as in the common term *teaching assistants*. Instead, we call them *peer leaders*. They are the leaders of the Workshop teams; they are the distinguishing feature of the PLTL model.

In the course of the project, we have listened carefully to the experiences and ideas of our students and our peer leaders. They have taught us about how students react and think, about the strengths and weaknesses of the materials we have designed for the Workshops, about our lectures, about the inner workings of a typical Workshop, and about their own personal development. In addition to their insights into the process of learning, our leaders have revealed a remarkable generosity of spirit, good will, and support for their fellow students. They have given us a view of our students at their best. For these reasons, we present the leaders' voices here, speaking from their dual perspectives as students and as leaders. We also include a few student voices. You will hear from students from different backgrounds and different types of institutions. The following reports come from the front lines.

Gaya Amarasinghe, City College of New York
General Chemistry

My association with the Workshop Chemistry Project began as a student in the freshman chemistry course at CCNY. I would like to outline some of the important outcomes of the Workshop Project as seen through my own experiences as an undergraduate student at City College and more recently as a graduate student teaching assistant in the Chemistry and Biochemistry Department at the University of Maryland at Baltimore County.

Being a part of the Workshop chemistry groups as a student, I was able to take advantage of the obvious: gaining a better understanding of the material. For me adjusting to the Workshop group environment was somewhat difficult, because I had just arrived from Sri Lanka, where studying alone was the norm. The Workshops became my first formal introduction to working in groups. In addition to learning chemistry, I was able to develop a number of important skills such as communication, team work, and leadership. In the realm of "hard subjects;" chemistry is likely to be a close second to physics in the courses-to-be-avoided category. From my own experience as a Workshop leader for five semesters, and a leader coordinator for two semesters, Workshops do not in any way make chemistry a "baby subject." Instead they create an atmosphere where students can interact with one another and use one another as resources. At the Workshops I was able to ask questions (and answer some) because I felt that everyone in the group was equal. To some, this process may seem like "the blind leading the blind." In my opinion, this is where the Workshop leaders are critical. One of the primary responsibilities of the Workshop leader is to guide the group. During my period as a leader, I saw my groups become progressively more independent. This was a result of my experience and ability to guide the group better. One semester I had as many as three students join the program as Workshop leaders.

Although I am no longer associated directly with the Workshop Chemistry Project, I see its influence in my work. Most recently, I was able to use my Workshop leader experience in

my TA role in organic chemistry. The first week of the courses, I gave my students the choice of having discussion-oriented introduction to each lab or a lecture introduction. In the discussion-oriented method I used the same type of questioning used in Workshops to guide students to come up with the procedure and a flowchart to the lab instead of giving them a "things to do list." By the end of the semester, the students came to lab prepared and knew what to do. It not only made my work a lot easier but the students learned a little bit more in the end.

Jewel Daniel, City College of New York
General Chemistry

Since entering the City College of New York three years ago, I have been involved with the Workshop Chemistry Project on several different levels. It has been an eye opening experience. As a student taking the course, as a peer leader directing Workshop groups, and as a coordinator disseminating the good news, I have benefited tremendously and learned a great deal. Now as a high school biology teacher, I can and do apply some of these techniques that I learned from the chemistry Workshops.

I can recall my first semester at City College. I was a transfer student from the University of the Virgin Islands, a school with fewer than 5000 students. Just looking at the size of the Chemistry class overwhelmed me. But on that first Friday, we were placed in small Workshop groups. For me that provided the setting I needed for understanding the material. No longer was I sitting amid a hundred other students listening to a professor spout the words of knowledge; I was now a part of my own learning. The cooperative setting gave us the opportunity to do hands-on work. I had seen many of the concepts we covered in the course before, but I had never understood them as I did after being in the chemistry Workshop.

By the next semester, I was a peer leader with my very own group of students. I learned the art of facilitation. This meant that I had to prepare the material beforehand by working the problems, and I had to learn to needle the students to participate and contribute constructively to the discussion. It was from leading the group that I realized that one has not learned until one has taught. Not only did I understand the material better, but I was fast becoming an effective communicator.

Before assuming the role of Workshop leader, I thought the duties were centered around working chemistry problems with the group. When I became a leader, I realized the role was much more expanded and developed my leadership skills. Leaders constantly had to evaluate the Workshop materials. After all, we were the soldiers on the front line, constantly in contact with the students using the materials. Troubleshooting was commonplace. I recall on several occasions having to abandon the suggested method of problem solving and create my own. By the end of my time as a Workshop leader, I was able to think critically and make wise decisions quickly. I was also a much better leader than I had been initially.

At City College of New York, all Workshop leaders were required to take a course in leadership training. At first, many leaders considered it just a time-consuming burden. However, the training course gave us many of the skills that became essential as our roles expanded. We learned different ways of assessing student success. Integral to the course was the reflective journal that we had to keep. For the first time in my life I found myself reflecting on my actions. I was able to see my own growth and personal development. I was able to see the effect that my action, my personality, and my qualities had on the students in my group and on my fellow leaders. In addition, the course provided a support base for the new leaders who were uncertain about their role.

Being a student taking part in the Workshop Chemistry Project and being a peer leader convinced me of the effectiveness of the project. After a few semesters of being a Workshop leader, I became the coordinator of the leaders. In this role I had the opportunity to present my experiences with the Workshop Chemistry Project at different conferences. It was during this time that I became aware of the many similar curricula reform projects that were being implemented in different schools. My impression of college faculty was greatly altered as I began to get a sense of a greater community among educators. Speaking to faculty at the many conferences improved my communication and social skills greatly. On a local level, the process of recruiting and managing leaders helped me to understand what employers look for in prospective employees. I was able to reflect on my involvement in the project and assess its effects. I was able to grow in responsibility.

I graduated from City College in June 1997 and found the skills that I obtained as part of the Workshop Chemistry Project integral to my job search. I am presently a high school biology teacher. In my work, I find myself constantly drawing on many of the techniques of peer-led team learning that I garnered during my Workshop chemistry years.

Looking back at my college life and my involvement in the Workshop Chemistry Project, my favorite saying comes to mind, "The journey has not ended, the battle has not been won, till you look back into the mirror and see how far you've come." I am now looking back into that mirror. I see improved social and communication skills. I see improved understanding and retention of chemistry concepts. I see exposure to pedagogy on a grand scale. I see effective teaching tools. I see personal development and a love for education. Most of all, I see a very effective method of teaching in the Workshop Chemistry Project.

Andrew Johanek, St. Xavier University, Chicago

This was written as Andrew was about to begin his Workshop leader assignment in organic chemistry.

The Workshop provides an opportunity for students to get together as a group and use their collective knowledge to solve problems. Workshops are important because they remove the fear of giving the wrong answer. In my Workshop group there were two or three students who hardly spoke in class, but these same students regularly participated in Workshop discussions. Students like these build confidence over the year through the Workshop discussions. I think it was the ability of the students to discuss and explain things in their own way that was so important. Many times a fellow student brought a unique perspective to the material that helped me and others understand it.

When I first began organic, I was indifferent to the idea of Workshops. I did hear some students complain that it should be solely the teachers' responsibility to help them learn. They thought they were paying a lot of money to teach themselves. I was a little different; I was a victim of premedical syndrome. I wanted to learn only what I needed to know to get an A and do well on the MCAT. I had a rough time at first because I wanted to impress my professor almost as much as I wanted to understand the material. I had little concern for my fellow students.

As I became a bit more comfortable with the chemistry and with the Workshop model it became easier for me to sit back and listen to other people answer questions. I even began trying to think of questions I could ask the other students to help guide their thoughts. Asking the right questions helped me and the other students understand the material better.

As a leader I hope to be in tune to how my group is dealing with the material. I will try to promote the formation of the same group bond that we had in my Workshop group. I will not let any one person dominate the Workshop, and I will do my best to make sure that they understand why this is so important. My goal is to be as good as my Workshop leader was.

William Mills, University of Rochester
Organic Chemistry I

When I first learned that my sophomore organic chemistry class at the University of Rochester would be supplemented by a "Workshop," I envisioned power tools, a cluttered workbench, and sawdust. I was unsure how I was to learn chemistry in this seemingly garage-like setting. After attending my first few Workshop sessions as a student. I began to realize that my preconception of the Workshop program was not too far from the truth. Big, fat packets of hieroglyphic-laden pages, sets of plastic balls and sticks mixed on a tool bench-like surface formed by several pushed-together desks, stacks of used and unused scratch paper and orange pencils, and the low buzz of students talking - sometimes to other students, and often to themselves - contributed to a scene not unlike a brainstorming session in a real Workshop at an industrial company. By the end of the second session I began to feel very comfortable with learning chemistry in such a setting, and so did my classmates. The collegial atmosphere, the team approach to problem solving (often by dissection and distribution of small parts of a complex problem to individuals in a group), and the gratification of sifting through the seemingly incomprehensible chemical jargon to solve a practical word problem ingrained organic chemistry firmly in our minds. People in my Workshop seemed to become comfortable with approaching the most ominous problems by term's end. Having the ability to talk over imposing material in an informal setting helped me gain confidence in my problem-solving ability and fully prepared me for examinations.

The following year, the tool belt and hammer were passed to me. As the year began I was truly excited about being a Workshop leader. I was eager yet not completely sure what my exact role was to be. Through the required leader support class, and mostly by experience, I quickly came to understand how I could best help the students. I would be a guide, not a teaching assistant. I would listen, not lecture. At times, biting my lip was difficult. As the term progressed I found that listening to the students and dropping occasional hints when a group seemed stuck was a very effective strategy. However, there were a few instances in which none of the three or four people in a group seemed to be headed in the right direction. Surprisingly, ideas seemed to flow, and a chain reaction often ensued, leading to the correct solution with no direct help from me. I witnessed students with little chemical confidence at the beginning of the term become adept problem solvers. The students in my group seemed to enjoy their time in Workshop, and I believe they put forth greater effort due to the Workshop approach.

I learned more chemistry during my time as a Workshop leader than I would have thought possible. Perhaps I learned even more than I would have as a traditional teaching assistant because of the need to pay such close attention to what the students were saying rather than spouting my own knowledge. It takes a very deep understanding of the material and personal restraint to play the mental game of chess involved in being an effective Workshop facilitator. To prove how much knowledge I gained from the experience, I took the comprehensive review for the final exam as a student and then again as a leader. As a leader, I was able to answer every question correctly in a short time. This is something I definitely could not have done the previous year.

Being a Workshop leader benefited me in many ways in addition to making me more proficient at organic chemistry. It helped my people skills, my confidence, and my patience. I understand the role of a "teacher" in a new way after years of being a student. The

understanding I gained has given me a new appreciation for those teachers who take time to listen to their students and who realize that often the best way for students to learn is not by didactic presentation but by allowing students to make their own intellectual mess and to learn how to clean it up effectively and efficiently. There is no substitute for a hands- (or brains-) on experience of trial and error.

Carol Munch, St. Xavier University, Chicago
Organic Chemistry

I recently completed a full year of organic chemistry at St. Xavier University. I had the unique opportunity of taking a full year of general chemistry some twenty-five years earlier at a much larger institution, the University of Illinois in Champaign, Illinois.

I eventually went on to complete an accounting degree at DePaul University and spent the next twenty years as an international tax practitioner both in public and private accounting firms and in large corporations. I returned to St. Xavier University recently to complete the requirements necessary to teach in the field of science.

In returning to school I noticed that the way chemistry is taught had changed dramatically over the last twenty-five years. I was extremely lucky to participate in a very different way of learning organic chemistry. We met on Mondays and Wednesdays for the usual one-hour lecture. On Friday, the format was changed: we met in a small peer-led Workshop group for two hours.

My organic chemistry professor will acknowledge that I was not a strong proponent of peer-run Workshops. I was a firm believer that chemistry, especially organic chemistry, was a subject best taught through lecture and repeated independent study. I was adamant that lectures, along with the numerous resources available on the Internet, were a better learning tool than any peer-led Workshop. What could a student who had just completed a year of organic chemistry teach me in a Workshop? After a full year of Workshop participation, I reversed my opinion about peer-led Workshops.

Someday, I hope to teach science. Why one method works over another is of special interest to me. For that reason I have tried to summarize why I believe the addition of peer-led Workshops to certain sciences, especially organic chemistry, is an effective teaching tool.

In our small Workshop setting, I found that students who did not participate in lecture or classroom discussion did participate in a Workshop. After a few sessions, students began to recognize that they alone were responsible for the material. No one was "spoon feeding" them. During the first few Workshops it became clear that most of the students were operating at the same level of uncertainty. I asked questions because I needed to know the material. I answered questions to obtain confirmation that I was heading in the right direction. Problem solving was addressed in an organized fashion in the Workshops; we learned a systematic approach to problem solving. Organic chemistry is cumulative. By watching our participation in the Workshop, our peer leaders recognized areas in which individual students needed additional attention. Without this intervention it was usually would be exam time before a problem was noticed.

I had a different peer leader each semester. Both peer leaders were well aware of the errors we made as students, having made the same errors and experienced the same problems just the year before. Both peer leaders were fair and nonjudgmental. Although they maintained an active profile as the peer leaders, they still made us do the problems. Each acted more as a facilitator than as a leader.

We used the Workshop as a communication forum. Science majors, myself included, are not known for their interpersonal skills. The Workshop gave us a chance outside of the larger lecture hall setting to exchange ideas on reaction mechanisms, on synthesis problems, and even on lab experiments results. I know that participating in the Workshop better prepared us to exchange ideas without criticism.

Finally, I strongly believe that peer-led Workshops prepare the student for the years after college. I spent a number of my working years as a manager in three of the largest public accounting firms. During those years I was involved in hiring new accounting graduates. Like the graduate and medical schools, the better accounting firms want to hire only the accounting students with the highest GPAs. Unfortunately, there was no correlation between a student's GPA and his or her ability to work well in a business environment. In today's corporate environment, success is measured not only by personal performance on the job but, more importantly, by what the individual contributes to the team and to the corporation as a whole. Teaching peers to work as a team in Workshop prepares them to be successful in group situations after college. Although I am certain we will forget much of our organic chemistry, I think we will not forget how to go about learning new concepts or how to work together.

Elna Nagasako, University of Rochester

I am currently a project coordinator in the Department of Anesthesiology working on a study of pain sensitivity and affective deficits in schizophrenia. I am also finishing up my Ph.D. in optics in the area of spatial soliton propagation. I have been volunteering at a local psychiatric hospital and am considering applying to medical school with the intent of working with the mentally ill. I took a year of organic chemistry in order to fulfill the admission requirement for medical school. I found the Workshop enjoyable and productive for a variety of reasons.

The Workshops increased my interest in the subject material. An opinion that I have heard expressed in discussions of science education is that any course change that makes students more enthusiastic about the material must also involve "dumbing down" the material. I thought it was great that the Workshops in organic chemistry defied that assumption. I felt that the Workshop problems were challenging and that the additional factor of group discussion kept me alert and motivated to explore the material.

The Workshops encourage questioning and discussion. One thing that has become clear to me after my time in graduate school is the importance of being able to communicate and defend scientific ideas, yet nothing in the format of standard science classes promotes this skill. I think one benefit of Workshops is that they are a gentle introduction to the sometimes combative arena of scientific discussion. Participants are encouraged to state their ideas and to question others in a nonthreatening environment. These discussions build communication skills and deepen the participants' knowledge of the material.

The Workshops provide a social framework for the class. Given my nontraditional background, I began the semester knowing no one else who was enrolled in organic chemistry. This was of concern to me, since I felt that without knowing other students it would be easy to go off track. Knowing other students provides an information "buffer," a way of ensuring that time is not wasted or confusion caused over a missed piece of information. The Workshops provided me a ready-made chemistry network that was invaluable and would have been difficult for me to arrange otherwise. I would imagine that this would be true for other nontraditional students as well as for those undergraduates with an interest in chemistry but whose social network does not include other science majors.

Dawn Patitucci, St. Xavier University, Chicago
Principles of Organic and Biochemistry
Organic Chemistry I and II

I had just completed a chemistry course (Principles of Organic and Biochemistry) for allied health students when Dr. Varma-Nelson contacted me and asked if I would be interested in working as a peer leader for a new project she was going to initiate in fall 1995. It turned out I could not be a peer leader due to a schedule conflict, so I became a tutor for two hours a week. In the following semester, I became a peer leader in a Workshop. What follows is a comparison of my experiences as a tutor with those as a peer leader.

While I was tutoring I was very rigid in my approach: if you want good grades, study. It was all very cut and dried. This attitude was the driving force behind my tutorials. The students would be seated, and I would stand up at the board and pretend that I was the teacher and "spoon-feed" them what they needed to know. I had a group of regulars who became rather dependent on me. They would tell me, "When I'm here with you, I understand, but as soon as I walk out of here, it'll be lost." I thought that meant I was doing a great job. It wasn't until the end of the semester, when most of them had to drop the class, that I realized that it wasn't as simple as I had thought.

The following semester was my first as a peer leader. Because there were not enough peer leaders available, I was assigned a group of twelve allied health students. Twelve students is a bit too many - the model calls for six to eight. If I wasn't careful, the group would almost take on the shape of a small class, with all of them facing me and talking to me instead of to one another. Of those twelve students assigned to me for that semester, four or five of them happened to be excellent students, and the rest were also academically strong. This was a good thing for me because I was still struggling with the impulse to play teacher. It was difficult for me to sit back and let the students figure things out for themselves without running to the board to solve problems for them. Soon I realized how capable this group was, and was able to let go.

I find this model to be beneficial because it encourages communication and teamwork among students. It also provides an escape from the monotony of lecture. The absence of the professor and the small group setting creates a comfortable environment where students can discuss the material in their own language. That, I believe, is an important part of the learning process. It is quite clear to me, as I see the students in my group adjust to the course, that what they will get out of the Workshops is directly proportional to the effort they put into the Workshop sessions. This is the case with just about anything in life, which makes the Workshop experience all the more valuable.

The benefits of being a peer leader are many. The knowledge I've gained has been invaluable to me in my other courses. My problem-solving and communication skills have improved, and I have developed closer ties with my peers. There have been times when I wasn't so sure I wanted to do this. Dr. Varma-Nelson convinced me not only to stick with it but to take the opportunity and run with it. These are all objectives of the Workshop model, and I'm amazed that these things happened to me because the only thing I wanted from St. Xavier University when I arrived was to get a degree and get out. This model really helped me to carve out a niche for myself at St. Xavier. In May 1997 I graduated, but I continue to work as a peer leader and Workshop coordinator for organic chemistry at St. Xavier University. When I graduated I was not ready to simply walk away from the project which had become such an integral part of my life.