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When Undergraduates Teach Undergraduates: Conceptions of and Approaches to Teaching in a Peer Led Team Learning Intervention in the STEM Disciplines: Results of a Two Year Study

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This study addresses the question of how undergraduates with an opportunity to serve as teachers, or "peer facilitators", at the college level think about and approach teaching. Peer facilitators in the "Gateway Science Workshop" Program at Northwestern University serve in a teaching role for one to two years, leading weekly, small group workshop sessions for students in their first year "gateway" science, technology, engineering, and mathematics (STEM) courses. The research took place within a large, funded intervention aimed at reducing the gap in performance and retention between undergraduate minority and majority science students. The study found that the sample of 19 peer mentors conceived of and approached their teaching task in distinctly different ways, adopting a teaching-centered or a learning-centered framework that changed over time with gains in experience. The developments documented over the course of their teaching experience have important implications for understanding how undergraduates think about learning and how they understand teaching.

This paper shares findings from a two year study of student "facilitators" teaching in a peer led team learning (PLTL) educational intervention at Northwestern University. The Gateway Science Workshop Program (GSW) is a joint Mellon Foundation and Northwestern University funded learning initiative serving undergraduates in science, technology, engineering, and mathematics (STEM) disciplines. The goal of the program is to improve the retention, performance, and experience of all students, particularly minorities, in their first year "gateway" science, engineering, and mathematics courses.

The evaluation of the program has demonstrated that all workshop participants derive specific benefits: students generally earn higher grades and are more successfully retained in the discipline than are non-participants (Drane, Smith, Light, & Pinto, 2005; Micari & Drane, 2007; Pazos, Drane, Light, & Munkeby, 2007; Swarat, Drane, Smith, Light, & Pinto, 2004); faculty rethink the way they teach and write homework and exam problems (Streitwieser, 2005; Streitwieser, Drane & Lainez, 2009); administrators support institutionalizing the program as a regular, self-sustaining part of the curriculum (Chow & Munkeby, 2005); and peer facilitators report numerous cognitive and affective gains based on their experience (Micari, Light & Streitwieser, 2005). It is on the issue of how facilitators change in their approach to mentoring and teaching through their experience of the program that further questions have arisen and additional study has been undertaken. In this respect, we are concerned with the ways in which student peer facilitators change how they think about and approach teaching in the program. We are not focused specifically on behavioral changes. Previous observational studies of facilitator behavior on this program's collaborative learning environment have been reported elsewhere (Pazos, Micari, & Light, 2009; Micari, Pazos, Streitwieser, and Light, under review).

Theoretical Framework

Over the last several decades, research into university teachers' conceptions of and approaches to teaching has steadily grown (Akerlind, 2003; Dall'Alba, 1991; Kember, 1997; Kember & Kwan, 2000; McKenzie, 2002; Ramsden, 1992; Trigwell, Prosser, & Taylor, 1994). The issue has been researched in particular using phenomenography, a qualitative research approach that seeks to highlight the variations regarding the ways people experience and understand educational phenomena (Marton, 1986, 1994; Marton & Booth, 1997; Marton & Säljo, 1976; Micari, Light, Calkins & Streitwieser, 2007; Micari, Knife Gould & Lainez, 2010; Trigwell, Prosser, & Taylor, 1994). Research has disclosed two broad orientations of instructors. They are those who are concerned with teaching as essentially an organization of the content of the teacher's knowledge for transmission to the students, and those who regard teaching as focused on learning as conceptual change (Kember, 1997; Prosser & Trigwell, 1999; Trigwell & Prosser, 2004). Research also suggests that how teachers understand or conceive of teaching informs their teaching approaches (Prosser & Trigwell 1999, Kember & Kwan 2000); indicating that a learner-centered conception of teaching is necessary for quality teaching and learning to occur.

In addition, phenomenographic studies have also looked at how students approach and conceive of learning (Biggs, 1987; Entwistle & Ramsden, 1983; Marton & Säljo, 1976; Säljo, 1979), and links between teachers' approaches to teaching and students'

approaches to learning (Trigwell, Prosser & Waterhouse, 1999; Light, Calkins, Luna & Drane, 2009; Light, Cox & Calkins, 2009). A number of studies have revealed a relationship between teacher approaches to teaching and student approaches to learning (Gow & Kember 1993; Kember & Gow, 1994; Prosser & Trigwell 1999; Sheppard & Gilbert 1991). They reveal that transmission teaching approaches are linked to surface approaches to learning, and teaching approaches focused on fostering conceptual change are linked more strongly with deeper student approaches to learning. The relationship between deep approaches to learning and better learning outcomes, moreover, has been widely demonstrated (Biggs, 1987; Dart & Boulton-Lewis, 1998; Entwistle & Smith, 2002; Kember, Biggs & Leung, 2004). While a limited number of research studies have looked at the development of new university-level teachers (French & Russell, 2002; Nyquist & Sprague, 1998; Thompson, Westfall, & Reimers, 2001), there has been little study of what undergraduates who have peer teaching opportunities at the university level derive from the experience.

For the purpose of studying undergraduate peer facilitators' first time teaching experiences, phenomenography offers a particularly relevant research paradigm. As Bowden (1995, 2000) has argued, this line of inquiry can be helpful to "develop generalizations about better and worse ways to organize learning experiences in the particular field of study" (1995, p. 146). By learning more about how one group of students experiences a particular type of learning—in this case undergraduates in science serving as first-time teachers instead of as learners, a role to which they are traditionally unaccustomed—we stand to learn in two important ways. First, how one educational activity, teaching experience, may be particularly impactful as a learning exercise for students who must come to know the material well enough to make it comprehensible to their fellow students. And second, how administrators leading this kind of learning intervention in the sciences can help us gain valuable information about the ways our inputs, creating peer-led teaching opportunities, are meaningful to students and may lead to better outputs, the learning experiences of advanced undergraduates.

The concept of peer-led team learning (PLTL) in undergraduate science disciplines has blossomed over the last several years with the growth of programs at a large diversity of institutions (Dreyfus, 2002). According to Gafney (2001), PLTL is a learning environment in which small groups engage in challenging work with trained peer leaders; instructors are involved, and activities are linked to the course in a meaningful way (2001). Although research has documented academic gains for students in PLTL programs (Gosser, Cracolice, Kampmeier, Roth, Strozak, & Varma-Nelson 2001; McCaffrey & Meyers, 1994; Treisman, 1992), it is the facilitators acting in the role of peer mentors who many believe in fact experience the most significant gains (Gafney & Varma-Nelson, 2007).

The Program

In 1997, Northwestern University launched the Science Workshop Program, a series of small-group, peer-facilitated workshops open to first- and second-year students in biology. Since then, with additional funding from the University, the program has expanded to include chemistry, physics, engineering, mathematics and Organic Chemistry. Today the program runs 75 workshop groups of 5-7 students each and serves a total of approximately 750 students, 107 facilitators, and 17 faculty per year. Faculty write the weekly workshop problems, and students participate in the program voluntarily; they receive a notation on their transcripts but no grade or credit. In terms of which subjects are covered for each participating discipline, the program engages students in challenging problems from the first year 'gateway' courses. These courses include the biology 210 courses, the chemistry 100 level and 210 sequence courses; the four Engineering Analysis course sequence; the mathematics 200 level calculus based courses; and the physics 130 and 135 courses. While students remain in their workshop groups for the duration of the program, they may participate in more than one discipline thus, for example, participating in the biology workshop as well as the chemistry workshop. While facilitators only cover one subject per workshop group they are leading, they may, however, choose to facilitate in more than one discipline. And, while facilitators only cover the topic of the discipline in which they are facilitating, some content may be integrated, thus they may cover some concepts in calculus as part of the physics workshop problems. The facilitators, who meet with students weekly throughout the year, are advanced undergraduates who performed well in the course previously. First year facilitators receive one academic credit after taking a training course in the education school, and second year "Senior Facilitators" receive a modest financial stipend. Finally, although the program spans one year, the resources of the program continue to be available in the form of the facilitators and peers they have come to know and work with on solving challenging, conceptual problems.

The Study

How do peer facilitators, who effectively serve as teachers of undergraduates for one to two years, think about teaching in higher education? Although facilitators do not assign grades or write workshop

problems, they lead students two hours each week through complex, conceptually challenging problems in the discipline. Although facilitators' employment is not contingent upon the performance of their students, they receive financial compensation for their work and, by their own admission, feel a strong responsibility for the performance of their "kids." Sustained and intensive teaching opportunities are rare for undergraduates. With the exception of oral presentations or leadership on a group project, most undergraduates do not gain university-level teaching experience. While previous educational research has explored ways that faculty think of and approach teaching, little is known about how undergraduates teaching at the college-level view the experience and vary in their beliefs about the purposes of education and the goals of teaching.

The Sample

Over a period of two academic years, two groups of peer facilitators were interviewed in the first few weeks of the fall semester (pre-interview) and again during the last few weeks of the spring semester (post-interview). Facilitators were asked to discuss their experiences as peer-leaders. The sample of facilitators represented the program's overall ethnic, gender, and disciplinary breakdown. In the first year of the study, 8 facilitators were interviewed; in the second year, another 11. Of the 19 total in the sample, 12 were female, 7 were male; 13 were White, 3 were Black, and 3 were Latino/a. Four students were in chemistry, 2 were in organic chemistry, 3 were in mathematics, 4 were in engineering, 4 were in physics, and 2 were in biology.

Data Collection and Analysis

Data Collection

Interviews lasted between 45 minutes and one hour. In each interview, facilitators were asked the same questions in the same order, with only occasional digressions to expand upon relevant points of interest (Patton, 2002). There were only slight modifications made to the items asked over the two years. Generally, the first part of the interview asked facilitators to describe what they did in the classroom (i.e., "Take me through a *typical* workshop session that is representative of your experience as a facilitator in SW"). The second part of the interview asked facilitators to reflect on their beliefs about teaching (i.e., "What do you think are the essential ingredients of teaching? How does that relate to what you've done as a facilitator in the SW program?"); how they felt their beliefs shaped their classroom behavior; and (in the post-program interview) how they felt they had developed as teachers through the experience. Each interview was fully transcribed by an independent transcriptionist and analyzed by a team of researchers. The analysis placed special emphasis on those items investigating how facilitators described their teaching goals, what they regarded as exemplary teaching, and (in the post-interview), what they reported in terms of changing their teaching behavior and beliefs over the year. Examples of items included, "What would you say is your main goal when you facilitate?"; "What do you feel is essential to being a facilitator, to doing it the way you think it should be done?"; and "How, if at all, have you changed in terms of your approach to facilitating over the year?"

Analysis

Three researchers conducted the analysis of the data. The initial coding stage of analysis in which the coding structure was developed was conducted by the study's senior analyst and a trained graduate student in the school of education. The latter was hired to work on the project on a part-time basis. To analyze the data, the two researchers independently went through each transcript and highlighted the answers to those questions deemed in advance to be of particular interest for learning about facilitators' conceptions of and approaches to teaching. Second, statements corresponding to those questions that were "found to be of interest for the question being investigated" (Marton, 1988, p. 154) were independently highlighted. Third, an independent summary of each highlighted statement was made, thus creating a list of the different types of conceptions of and approaches to teaching being taken by the pool of facilitators. Fourth, the independent lists of summarized statements were compared with respect to those types and after discussion were combined, based on consensus between the analysts, creating the intermediary coding table that laid out examples of facilitator's answers to each question of interest. Fifth, from this summarized table, combined facilitator statements with supporting quotations as illustrations were used to code teacher-centered and learning-centered conceptions and teacher-centered and learning-centered approaches.

In the second stage of analysis, the coding scheme described above was used to assign individual facilitators to the coding categories. For this, each researcher went through one year's set of transcripts independently to create summaries and a data table of their individual assignments. Second, the researchers switched piles and independently critiqued one another's analysis and identified points of difference with respect to each of the 19 facilitator data sets. Third, the researchers met to discuss their analysis of the full, two-year pre and post sets of data and came to

consensus on discrepancies in the analysis. Each data set was assigned to one of two types (teacher-centered or learner centered) of conceptions of teaching and one of two types (teacher-centered or learner centered) of approaches to teaching. Agreement was reached on the analysis of all data sets. Finally, a third, independent researcher reviewed the assignment of conceptions and approaches to their respective categories. The first and the third researcher then mapped out the individual differences in the pre and post conceptions and approaches to examine individual change over time for each of the 19 facilitators.

Results

The analysis of the data found that facilitators share some important similarities but also diverge in significant ways in their views of teaching. In terms of how they see their students, all of the facilitators clearly expressed an interest in having their students perform well in the STEM courses and enjoyed the experience as much as possible. The facilitators recognized that the gateway courses are difficult and that the large lectures classes with their inherent "weeding out" mentality can be intimidating. Many of the facilitators explained that, aside from hoping to gain teaching experience and an opportunity to refresh the material they expected to encounter on the Medical College Admission Test (MCAT) and Graduate Record Examination (GRE), they also wanted to help students in ways their own peer mentors had helped them when they were GSW students. One student expressed this idea in terms of paying thanks to past professors, "I have had good professors in the past, and it always been very good to interact with them. I feel that it will be good if I could give to someone what the good professors have given me;" while another facilitator expressed the idea of thanking past facilitators, "I was a student in GSW and my facilitator was good and so that was something I wanted to be able to do for other people."

As a group, the facilitators also evidenced a keen sensitivity to the needs of their students. When they noted deficiencies in student understanding or discomfort in the classroom, they tried to be adaptable and react by changing technique. Facilitators provided examples of how they tried to modify the learning atmosphere, such as making sure everyone had a chance to participate, changing the way they went through the workshop problems (i.e., setting up more group work or using the blackboard), or altering the way they lead the class (i.e., stepping back and letting students work more on their own or, conversely, taking more time to explain basic concepts).

Another trend that became evident over the sample of 19 facilitators was that they became more comfortable and confident over the course of the year (Streitwieser, Light & Micari, 2005) and generally worried less about how the students perceived them than what they could do to help students have a more fulfilling experience. However, despite some of these similarities among facilitators, a clear pattern also emerged regarding how differently they thought about their teaching and carried it out over time in the classroom. Primarily, two distinct conceptions of and approaches to teaching were taken by facilitators, which encompassed a practice-centered framework (in the literature termed "teacher-centered") and a learning-centered framework (in the literature termed "learner-centered"). These two frameworks are illustrated in Figure 1.

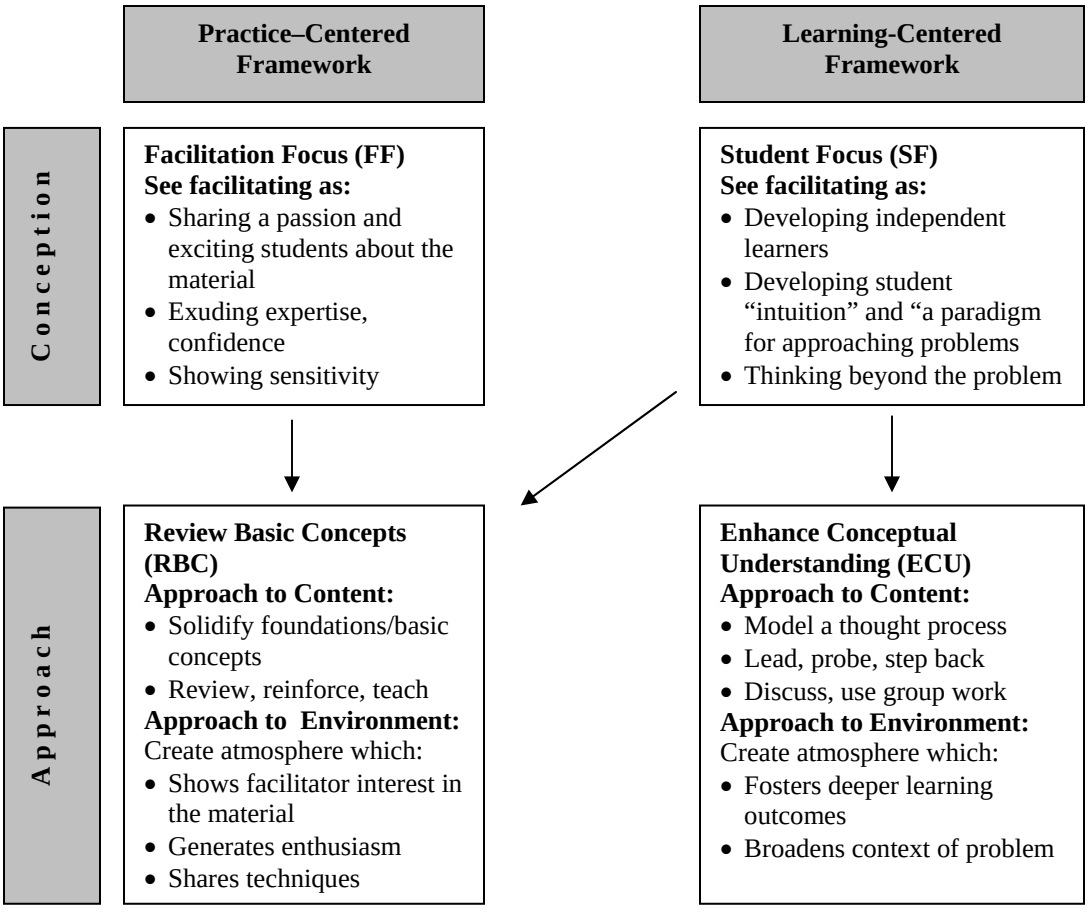
Figure 1 illustrates that, on the whole, facilitators answered the same set of interview questions with two distinct frameworks in mind: they either focused on their role as a teacher, thus using a teaching- or "practice-centered" framework and focusing primarily on how they cover the workshop material; or they focused on what they could do to enhance student learning, thus taking a student- or "learning-centered" framework that primarily concentrated on thinking about how students learn the material.

It should be noted, however, that despite these clearly differing frameworks, the two should not be seen as mutually exclusive. Rather, they suggest generally differing views but some natural, expected overlap, as well. Overall, however, facilitators appeared to adopt either one framework or the other. Each conception and approach encompassed for them different goals. In the practice-centered framework, the behavior of the facilitator played the prominent role, whereas in the learning-centered framework, the facilitation of a particular set of cognitive skills was most important.

Practice-Centered Conceptions and Approaches

Conception. Facilitators with a practice-centered conception were primarily focused on the facilitation process. They saw their teaching task as one where they should share their interest in the material and, thereby, excite students to learn; they should know the material thoroughly to exude expertise and, thereby, inspire confidence in their students; and they should create a classroom environment that generates student enthusiasm and, thereby, active discussion and sharing of problem solving techniques. Finally, these facilitators made special efforts to be attuned to the needs of their students. The following facilitator statements attest to these convictions:

Figure 1: Two Frameworks
Facilitator Conceptions of and Approaches to Teaching in the SW Program



> I think overall my goal was kind of just in general to make them like the subject as much as I do because that's what every teacher wants. Every teacher wants the students to say 'this is what I want to do for the rest of my life. (Female, chemistry)

> I try to make sure that they learn the material. I try to make it enjoyable for them; several of my illustrations have been humorous. I also make sure that they enjoy themselves but mostly focus on their learning the material enough to be able to do well on tests. (Male, engineering)

> My number one goal is to provide the students with a positive experience in the academic setting. I really want them to enjoy it; not a chore that they dreaded (sic.). (Male, chemistry)

Approach. This conception of teaching, then, translated into an instructional approach that emphasized reviewing the basic concepts and shoring up the foundations. These facilitators felt that the best service they could provide to their students was to help them get through the course by understanding the fundamental concepts tested on the exams. Therefore, practice-centered facilitators primarily strived to review the material the instructor was covering in the large lecture course. They did not shy away from actively teaching (rather than moderating or guiding as the SW program staff encourages), using the blackboard, or standing in front of students to explain concepts. The following facilitator statements express their feelings:

> Let the students discuss among themselves, use group work and then share good problem solving techniques as a group, based on the good group work problems you've given them. Teach, review, and reinforce so that everyone understands. (Male, mathematics)

> Good teachers don't have the choice of sitting down and letting anything happen because the first time they teach it the students know absolutely

> nothing about the subject and so they have to get up to the board… The most important thing as a good teacher is to know when they have to switch between the roles of being the lecturer to being another student. (Male, engineering)

Learning-Centered Conceptions and Approaches

Conception. Facilitators with a learning-centered conception, on the other hand, were primarily focused on the end result of student learning. They saw their teaching task as one where they should help students develop into independent learners who, over time, would be able to, as one facilitator put it, develop an "intuition" or, as another put it, "a paradigm for approaching problems". Generally, these facilitators tried to help students see problems in a way that compelled them to incorporate wider issues in the discipline rather than just calling forth the necessary calculation or formula to attack the worksheet problem. The following facilitator statements attested to this view:

> I want them to walk out more inquisitive and curious about the subject and feeing that they just don't want to learn the formula and get an A, but they want to understand why these theories work and why these formulas are used. (Male, mathematics)

> I like them to be able to understand what's going on and often what's behind the [problem], to physically have more intuition about the system…and not just stating points of the equations but to start to develop an intuition about what we are working with. (Male, engineering)

> I am pulling apart problems or concepts. I try and get into the nooks and crannies of concepts so that I can explain it to other people if they happen to ask that question… really understanding why this is the way that this is. It is more like getting below the surface. (Female, Biology)

Approach. This conception of teaching, then, translated into an instructional approach where facilitators mostly strived to model their own thought process by, for example, talking through solving one problem but then stepping back and encouraging students to work on the rest on their own or within small groups. These facilitators thought about how best to convey the material and to generate discussion that allowed students to see the larger issues behind the problems. Thus, they encouraged wide-ranging debate and willingly deviated from the worksheet questions so students could reach a more profound level of conceptual understanding on their own. These facilitators made efforts to probe for answers or lead students to their own realizations and only stepped in when necessary. They also strove to create a classroom environment where what some facilitators termed "deeper" learning could take place. These facilitators, thus, tried to listen to students' questions and guide them but never to directly teach, encouraging students to think independently beyond the concepts and the given set of workshop problems. The following facilitator statements illustrate this view:

> [Facilitators should be] Going in with the attitude that you are not a teacher and you should never instruct – rarely instruct. The students are supposed to look it up. The tenets of the program is (sic.) to actually to observe and understand; it makes facilitating much easier. (Male, physics)

> I have learned to look deeper into problems and think about other concepts that may be connected to those problems that would help students. I have realized how hard it is to get students to think outside of the box and to get them interested in other ideas connected to problems. What helps is that I enjoyed learning about whenever I am facilitating. I am actually excited about connecting the ideas together. A lot of the teaching is also social interaction and it is hard to teach a group that is not committed or involved. Part of teaching is to get the group excited or get them in a good and positive mindset. (Female, organic chemistry)

> A good facilitator must make sure that the students are comfortable and create more of a friendly atmosphere than that between a student and teacher in class. He/she should be able to constructively criticize all the students in a way that doesn't make them feel stupid or inferior... A good facilitator should know what they are doing but then be open to new ways of doing or solving conceptual problems. (Male, mathematics)

As with the previous types of facilitators, learning-centered facilitators also spoke about the importance of paying attention to student needs. However, they emphasized trying to create a classroom atmosphere conducive to self-driven, student-initiated learning rather than one where they would overtly direct the activity. The following facilitator comments explained this view:

> I've had to kind of stifle myself and sort of change my instinct and remember that 'I am not a bad teacher trying to help them; in fact, I'm a better teacher if I let them really delve into the problem on their own.' (Female, mathematics)

> I think listening is very, very important because just coming in with some set idea isn't going to be very helpful. I meant you'll definitely lead them through the answer but they may not get anything from that. So, you first have to listen and then see where each individual is and where they need help. I think also being able to be flexible in terms of how you give information. (Female, chemistry)

> A good facilitator has to maintain a good atmosphere that encourages students to think about the questions deeply for themselves instead of just giving them the ideas. An article I read says that at the end of the workshop the students should feel as if they did it themselves. (Female, organic chemistry)

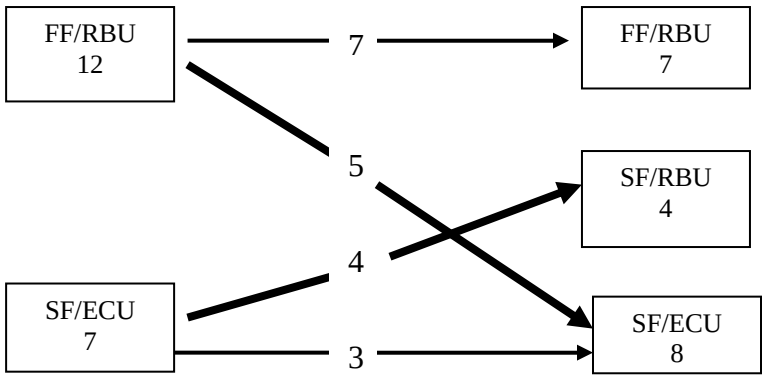
Relationship between Conceptions and Approaches

While the teaching-centered and learning-centered facilitator dichotomy is suggestive of how this sample of facilitators varied in their conceptions of and approaches to teaching, facilitators adopting one or the other framework should not be thought of as locked exclusively into only one model. Some overlap is natural. For example, a learning-centered facilitator may generally believe that students are best served when they learn independently, are able to think beyond a given problem, and can approach it from a wider breadth of conceptual understanding in the discipline. And yet, concurrently the facilitator may realize (or be told by their students) that fundamental concepts are still unclear, thus making a broad, ranging, conceptually rich discussion premature. Therefore, a facilitator may, indeed, have a learning-centered conception but consciously decide to approach teaching and classroom activities in ways that stress the review of basic concepts. On the other hand, it is worth noting that it would be highly unusual for a facilitator with a teaching-centered conception to take a student-centered approach. The reason being that it would be unlikely that someone who's general conception is that students need to review basic concepts would take an approach that focused on engaging students in independent learning. While the study showed evidence of students with student-focused (SF) conceptions taking a review-of-basic concepts (RBC) approach as well as an enhance-conceptual-understanding (ECU) approach, and facilitators with facilitation-focused (FF) conceptions with taking a review-of-basic concepts (RBC) approaches, there was no evidence of a facilitator with a facilitation-focused (FF) conception taking an enhance-conceptual-understanding (ECU) approach, as indicated by the placement of the arrows in Figure 1.

Change Over Time

The typing of facilitators into practice-centered and learning-centered outlooks, along with the fact that they were interviewed two times over the course of a yearlong teaching experience, begs the question of whether facilitators developed in their conceptions of and approaches to teaching over time. One would expect that with weekly preparation and teaching, increased subject matter knowledge, familiarity with one's students, and an education training course on group management and learning approaches, facilitators would be expected to revisit their initial thoughts and practices of teaching. Figure 2 illustrates what changes we observed in our sample.

Figure 2: Change Over Time
Facilitator Conceptions and Approaches: Patterns of Change Over the Program Year



Key: Facilitation-Focus (FF); Review Basic Understanding (RBU); Student-Focus (SF); Enhance Conceptual Understanding (ECU)

Discussion

Generally, when a teacher moves over time from a teacher-centered to a learner-centered framework, such development is regarded as positive. Students stand to gain when their learning is squarely the focus of their teachers' attention. In our sample of 19 facilitators who served as first time peer teachers for one year, twelve of them began the year with a facilitation-focused framework, and seven began with a student-focused framework. Over the course of the year, while seven retained their facilitation-focused conception of teaching, five developed a student-focus. The change in conception was also accompanied by a shift in approach to teaching and a move away from reviewing basic understanding to one focused on enhancing conceptual understanding. While three facilitators retained their student-focused conception and their teaching approach of enhancing conceptual understanding, four changed their teaching approach to one where the review of basic understanding took precedence. No one moved from a student-focus to a facilitation-focus. Such a change would have been considered a negative development. A facilitator who began with a primary concern for students over time would have become increasingly focused on him or herself, which is counterintuitive. Such an instructor would, presumably, be fixated on his or her own development at the expense of the needs of the students.

What explains those facilitators who changed conceptions and approaches and those who did not? Of the five facilitators who changed from a teaching-centered to a learning-centered conception, all of them also changed in their approach from reviewing basic concepts to enhancing conceptual understanding. These facilitators over time realized that through a variety of ways of setting up the learning process and class atmosphere –such as group work or whole group discussion, individual use of the blackboard or individual problem solving– they could step back and allow students to discover and problem solve more on their own. However, some facilitators who began the year already with a learning-focused conception retained this conception but changed their approach from one that worked to enhance conceptual understanding to one that reviewed basic concepts. For these facilitators, in contrast to the former facilitators just discussed, it became clear that their students needed more basic review and were not ready for deeper, conceptual discussions. This decision was one that, arguably, was based not only on a sensitivity toward the needs of the students but also a simple pragmatic realization that students need to feel the workshop is helping them in concrete ways. That is, past evaluation of the SW program has shown that when students regard their workshop problems as too far removed (because they are too conceptual) from those they will see on the exam (which are more specific), they become disillusioned with the program.

This last point sets up one dilemma for the program that, from an evaluation perspective, still needs to be resolved. While the intention of the program is to be challenging for students and not remedial or focused on exam review, and facilitators are instructed not to lecture or drill students on problem solving, students often complain that broad ranging, conceptual problems are irrelevant to those they encounter on the exam. Therefore, while facilitators are prepared to draw students into conceptually deep discussions around solving problems in the discipline, if students are stuck on basic misunderstandings or complain that conceptual problems are too esoteric, facilitators often acquiesce. Although students are told by their peer facilitators (based on what the peer facilitators are taught in the facilitator training course) that working through conceptually challenging problems is valuable and is likely to help them perform better on course assignments and examinations, this information is not always well received if the students do not believe it will help them with their exams and grades. Pressure on facilitators to review the basics requires more teaching on their part and leaves less time for conceptual discussions. The question then becomes should facilitators be giving in, why or why not, and if so, is the program serving its intended purpose. One answer might lie in the way the facilitators are currently trained in the educational course they take during the year they serve as facilitators. Perhaps facilitators need help learning how to balance student pressures for basic review with the program's emphasis on conceptual discussion.

Conclusion

The findings from our study of 19 peer facilitators in the role of teachers for the first time in a higher education setting are consistent with some of the studies of other first time college teachers. Our two types of facilitators and their change process matches much of the literature on teachers in higher education. In Nyquist & Sprague's (1998) model for TA development, TAs over time also moved away from worrying about their own performance to feeling concerned about their students' learning. French & Russell (2002) found that as teaching assistants gained experience they saw themselves as guides rather than presenters and placed greater emphasis on the quality of their teaching than on simply transmitting information.

The educational literature has previously argued that there is often an important dichotomy between "teacher-centered" and "student-centered" approaches

taken by instructors at various levels of education (Brown, 2003). Over time, one type of teacher may develop into another type or some variation thereof. Further, conceptions of teaching like those identified in our study are not uncommon for first time teachers (Nyquist & Sprague, 1998). The beliefs and behaviors of the undergraduate facilitators in this program share many points of agreement with other first time teachers. However, our study shows that while in the eyes of the program the facilitators may serve primarily as a means for improving student performance, the facilitators are not a homogenous group: they have highly unique undergraduate experiences which they perceive in dramatically different ways.

When researchers study faculty, oftentimes these instructors appreciate learning important information about themselves and, in turn, make adjustments in their teaching and classroom behavior (Trigwell & Prosser, 1996). In most cases, these changes are beneficial to student learning. Along the same lines, when facilitators in the GSW Program learn about different ways they approach teaching, again benefits accrue to the students. We argue, however, that the benefits these undergraduate teachers derive are, perhaps, even greater and more important in the long-term than those for established faculty. Undergraduates with teaching experience are at the start of their careers and will continue to teach as TAs, medical school interns, laboratory leaders, and instructors in a myriad of other settings. Although we have not conducted a tracking study of this particular cohort of facilitators yet, we believe that a follow-up study, along with collecting more information generally about the alumni of this program, would be an important and valuable future undertaking. The experiences the facilitators in the GSW program have gained as teachers, and their sensitivity to students and the learning process, will likely have powerful influences on future students with which they interact in years ahead.

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