

PROGRESSIONS: PEER-LED TEAM LEARNING

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WPA AWARDS LEAD TO IMPLEMENTATION: DEVELOPING THE MOMENTUM

What progress Workshop Project Associate (WPA) grant recipients have made toward implementing the Peer-Led Team Learning (PLTL) Model was evaluated in the Fall of 2000. Questionnaires were sent to 16 faculty members who had completed at least one semester using PLTL in their courses. Twelve reports were received in time for this analysis, which reviewed the work of 13 individuals at eleven sites. Some reported on experiences with one course; some with two or three courses during the past year. The average class size was 70 students. With repeat courses, the total number of students included is greater than 1000. The average number of peer leaders per institution was seven, with some leaders covering more than one workshop.

Materials Four professors reported using, with adaptations, the general chemistry or organic chemistry materials developed and provided by the PLTL Dissemination Project. The rest have developed their own materials, generally by collecting and reworking problems from texts, although a few seem to have developed almost entirely new materials.

Training and Supervision of Leaders Regarding initial training prior to leading a workshop, sites reported as follows:

- ? two told leaders to read the leader training materials;
- ? three held a one-session, two-hour orientation class;
- ? seven held orientation sessions of one, one and a half, or two days.

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CRITICAL COMPONENTS FOR DISSEMINATION: SIGNPOSTS TOWARD ADOPTION OF PLTL

Advocates for Peer-Led Team Learning (PLTL) have been able to say, in effect, "You want to try it? Here's how," using six critical components (see page 14). The critical component model helps to implement PLTL workshops by describing its key ideas. While it is not foolproof, it does provide a reliable road map.

Dissemination activities might also be described through the critical component approach. The following preliminary list is based on such activities by the principal investigators, as well as evaluation site visits, observations, interviews, Workshop Project Associate reports, and feedback surveys from conferences.

Definition of Dissemination The dissemination of Peer-Led Team Learning should be distinguished from either implementation or institutionalization. Implementation means using the method with at least initial success. Institutionalization means reaching the point at which the PLTL Workshop course is a regular part of the department's offerings, enjoying financial support and recognition from several levels of the institution.

Dissemination is the process through which the PLTL Workshop Model is presented, found to be attractive, stud-

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PROJECT NOTES: MODES OF LEARNING EXPLORED

The PLTL Workshop Project held its second annual "Rocky Mountain" Leadership Conference at the Newark Airport Marriott Hotel on November 3-5, 2000. It was our hope that progress could be made to inform the development of disciplinary workshop materials and coordinated peer-leader training with ideas from cognitive science. Various points of view were well represented by Robert Blake, Mark Cracolice, Ellen Goldstein, Joseph Griswold, Shawn Kolitch, Ron Narode, Nancy Romance, Lydia Tien and others. In this issue we include articles drawn from the presentations by Nancy Romance and Mark Cracolice. Ron Narode and Joe Griswold discuss the progress in developing physics and biology materials and forming working task forces.

David Gosser and Ellen Goldstein started the meeting with a request that the participants break into small groups and discuss the question: "Remember something you learned vividly and recount the circumstances of how that happened." Since the meeting was focused largely on "how people learn" the exercise was designed to begin the discussion with a down-to-earth and personal approach. This exercise resulted in some very interesting stories, many of which were reported to the entire group. The 40 responses I divided into five categories:

- 12 Physical Model Building and Representation
- 10 Experimental
- 9 Social
- 6 Language and Graphic Visualization
- 3 Introspective

The use of models was widely cited in helping to increase understanding of concepts, for instance, the use of colored beads in illustrating the statistical concept of sampling distribution, or the right hand rule from E&M physics. Next widely cited were experimental results that often incited curiosity, such as floating behavior of wax, sodium in water reaction, etc. Social learning was a close third, with games cited and also some negative but moti-

vational experiences, such as embarrassment at lack of knowledge. Also recorded were references to the use of analogies, mnemonic devices, graphic visualization, and some more introspective comments regarding self-realization of the importance of logical proof and the need for long-term mental persistence in unraveling the "mole" concept.

In many cases, these modes of learning have their counterparts in actual scientific discovery, and historical examples may be borrowed from in constructing workshop materials. For example, physical models have played a significant role in major scientific discoveries, such as Watson and Crick's discovery determination of DNA structure, which matched experimental data such as Chargraff ratios and x-ray diffraction patterns with Pauling-style molecular model building.

In this issue, Nancy Romance discusses the importance of clarifying and organizing knowledge through the construction of formal "concept maps" that can inform the structure and content of materials, and also be a tool for students to explore their newly formed understanding of the discipline. John Deming and Mark Cracolice emphasize that PLTL can be enhanced through the use of a "learning cycle" approach based upon concrete experience (laboratory) and data.

Perhaps the modes of learning provide a means to connect the two divergent approaches of the knowledge-based and experiential discovery approaches. With regard to the apparent dichotomy of the two approaches (knowledge-based and experiential) we can turn to Vygotsky:

These findings led us to a hypothesis of two different paths in the development of two different forms of reasoning. In the case of scientific thinking, the primary role is played by *initial verbal definition*, which being applied systematically, gradually comes down to concrete phenomena. The development of spontaneous concepts knows no systematicity and goes from phenomena upward to generalization.

Continuing the discussion on the knowledge-based curriculum and the contributions of cognitive science will assist in consolidating the larger community that is being formed around the idea of PLTL, and encourage all PLTL'ers to participate in this discussion locally and the larger arena through conferences and website forums.

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PLTL BIOLOGY TASK FORCE: LAYING PLANS FOR MODULE DEVELOPMENT

The PLTL Biology Task Force, under the leadership of biologist Co-Principal Investigators Michael Gaines (University of Miami) and Joseph Griswold (City College of New York), has met, planned workshop modules, and expanded its membership in three meetings during the past year. The first occurred in April 2000 at the University of Miami where biologists and faculty from other disciplines came to learn about the possible application of the PLTL Model in their programs. A total of 25 biologists attended, representing 13 colleges.

In November 2000, a group of nine biologists representing seven colleges, with the assistance of undergraduate peer leaders and an educational specialist, worked in a series of breakout sessions during the PLTL Leadership Conference in Newark, on developing a plan to produce a series of workshop modules.

The Newark group addressed several key issues about biology and PLTL:

1. what are the important issues for teaching and learning introductory biology, and which are addressed by PLTL? (Appendix 1) It was agreed by the participants that PLTL addresses many of the critical issues; for example PLTL encourages in-depth study of selected topics in traditional survey courses, which have been characterized as "a mile wide, and an inch deep" (Schmidt, *et al.*, 1997);

2. what enduring concepts should be the subject of PLTL modules? Thirty possible topics were nominated (Appendix 3), some broad in scope and others more focused;

3. what should be the standard elements in biology workshop modules (Appendix 2b)? It was agreed that we recommend two versions for each module, a student's version and an instructor/leader's version. Further, a detailed list of elements was elaborated divided into three parts: a) pre-workshop activities that prepare students to get the most out of the workshop; b) the workshop itself with questions and problems ramping up from simple review items to challenging problems and applications; c) post-workshop activities that provide opportunities

for students to review, practice problem-solving, and take sample test questions. In all three parts it was urged that content mastery be integrated with learning/thinking skills development;

4. What should be the process for developing the modules? A set of steps was presented (Appendix 5) and discussed briefly. It was decided that further reflection and analysis of this process should be an objective of a future meeting. A general recommendation that came out of the Newark sessions was that another conference of only biologists be convened in the near future to continue the work in the development of biology modules. The group felt that having a collection of modules was vital to disseminating the PLTL Model to other programs.

The two-day conference at the University of Miami was held January 12-14, 2001, led by Michael Gaines, Joseph Griswold, and learning specialist Ellen Goldstein. The conference was attended by 22 biologists, four learning specialists, and four student leaders. Three of the four major sessions were devoted to a combination of presentations, work by small groups, and large group discussion. The fourth was devoted primarily to development, by pairs of authors, of action plans for module development and of module outlines. The products of these sessions were shared during the closing session.

The following outcomes were achieved by the participants:

1. information about currently running biology PLTL programs was shared, revealing a great diversity in the way PLTL is implemented at local campuses;

2. a template of common elements and module organization was agreed upon (in large part) by the participants. About ten percent of the elements need still to be decided upon;

3. a process for module development was reviewed, modified and agreed upon that includes reviews by other authors and educational specialists, student testing and using a common format. The participants offered

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PLTL PHYSICS TASK FORCE: REFINING A CURRICULUM

The PLTL Physics Task Force consists of the following people who met most recently at the PLTL Leadership Conference in Newark, November 3-5, 2000: Shawn Kolitch, Lewis & Clark College; Jean Lecuyer, Glendale Community College; Steve Manly, University of Rochester; Ron Narode, Portland State University; and David Sokoloff, University of Oregon. The group worked toward three initial objectives:

1. Establish a successful curriculum in introductory physics to be used in PLTL workshops.

Progress: Shawn Kolitch has provided an excellent beginning with his Mechanics units. He has written workshop problems, key checkpoint questions for the workshop leaders, and a solution key which may or may not be used by the faculty leader. Sample exams, calculus-based questions, and in-workshop demonstrations (hands-on) will soon follow.

Plans: The physics group will meet in Portland, Oregon in March 2001 to further refine the present curriculum and to work on Shawn's optics, thermodynamics, and E&M curriculum.

Note: The curriculum is available for use at the following website: www.lclark.edu/~kolitch. Follow the links, and please contact Shawn to discuss and test the curriculum: kolitch@lclark.edu.

2. Pilot the curriculum and evaluate its success with the PLTL Model. Student academic achievement as well as conceptual understanding and problem-solving ought to be several main criteria for success.

Progress: The curriculum is being used with PLTL at the University of Oregon and at Montana State University,

Northern. It is also being used as a tutorial curriculum at Lewis and Clark College.

Plans: The curriculum will be used with PLTL this year at Treasure Valley Community College, and next year at Lane Community College. Future Workshop Project Associate proposals in physics should include a commitment for implementation and evaluation of the curriculum. Ron Narode welcomes inquiries for such proposals at naroder@pdx.edu.

3. Disseminate the curriculum with workshops, presentations, papers, a webpage, and publication of a text.

Progress: Shawn Kolitch has established a webpage for the present curriculum (see *Note*). Ron Narode is leading the Physics Task Force, most recently at the Newark PLTL Leadership conference. He has been a co-presenter at workshops on PLTL, most recently at the University of Miami, and at the University of California Santa Cruz. Shawn Kolitch presented at the Oregon American Association of Physics Teachers.

Plans: The members of the Physics Task Force have committed to presenting at the Oregon Academy of Science Annual Meeting, University of Portland, OR, on February 24, 2001; Sierra College, Rocklin, CA, on March 2-3, 2001; the Annual Meeting of Pacific Northwest Association of College Physics Teachers, Seattle, WA, on March 23-24, 2001; PLTL West Coast (Pasadena, CA) NSF Chautauqua course, May 21-23, 2001; AAPT Summer Meeting, Rochester, NY, July 20-21, 2001; and the Gordon Conference on Science Education, Mt. Holyoke College, MA, August 5-10, 2001.

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PLTL BIOLOGY TASK FORCE

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many excellent suggestions for providing resources and streamlining the process. For example, a *listserv* will be set up to enable rapid communication among authors, and the modules may be published initially on a CD-ROM so that adopters can adapt the modules for local programs;

4. It was agreed that modules would be authored by collaborating pairs of biologists and the pairings and topic selections were finalized. Eleven pairs of collaborators have elected to write 22 modules. The deadline for submitting tested versions of the modules is July 1, 2001. A variety of smaller issues remain to be followed up so that the process of module preparation can go smoothly.

5. A core group of biologists has been established

to lead the Biology PLTL program to the next stages for resource development and dissemination. Plans are being developed to work extensively on the next phases at the PLTL Leadership Conference to be held this summer.

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Note: The appendices referenced herein can be obtained by writing to info@pltl.org or by e-mailing the author.

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CONCEPT MAPPING AS A KNOWLEDGE-BASED STRATEGY FOR ENHANCING STUDENT UNDERSTANDING

As represented by the Peer-Led Team Learning Project, improving the understanding of undergraduates in chemistry, biology, and physics is a major National Science Foundation (NSF) priority. In pursuit of this goal, exploration of research-based perspectives in science education and related disciplines (e.g., instructional science, cognitive science) that purportedly focus on the learning of science is a fundamental starting point for science faculty whose goal is to improve the effectiveness of their courses. However, when doing so, many faculty teaching science courses quickly discover that the literature contains a wide variety of perspectives, each of which emphasizes different keys to effective science instruction in the form of strategies faculty could implement to improve science instruction.

Activity-based approaches in which students are involved can be (and often are) implemented in a fragmented fashion that has no explicit linkage to the core concepts (e.g., underlying principles, theories, big ideas) of the discipline and, therefore, no potential to build the cumulative understanding of core concepts and principles necessary for mastery of a discipline. As the recent Third International Math and Science Study (Schmidt, *et al.*, 1997) findings have reaffirmed, successful science teaching is associated with the explicit teaching of a coherent conceptual framework rather than simply involving students in activities and hoping that meaningful learning results. In essence, the function of a knowledge-based approach to science instruction is to insure that *all* of the instructional activities in a science course are maximally relevant to students gaining an understanding of the core concepts in a discipline.

It is important to note the link between the idea of knowledge-based instruction and that of expertise in a discipline. It is well accepted in cognitive science that experts organize their knowledge differently than novices and that the organizing framework for expert knowledge is in the form of core concepts and relationships. As a result, compared to novices, experts in a discipline are able to

observe and interpret phenomena in more meaningful ways by drawing upon and applying their prior knowledge and understanding of underlying core concept relationships. In considering science faculty as knowledgeable experts, the broad goal of the science courses they teach is for students to gain cumulative, meaningful understanding of the discipline in the same form as their teachers, that is in terms of core concepts, organizing principles, and relationships. This article illustrates the use of concept mapping as a tool through which science faculty can develop a knowledge-based approach to instruction in which lecture, student laboratory activities, and other assignments are coordinated to focus on understanding the core concepts inherent in the discipline.

Figure 1 (see page 6) illustrates a concept map of core concepts in chemistry that were used to organize and coordinate instruction in a one-semester general chemistry course. This was part of an NSF-funded CHEM-BOND project at Florida Atlantic University. Figure 1 was developed in answer to the general questions: "What is chemistry about?" "What core concepts in chemistry are relevant to all aspects of the content in a general chemistry course?" and "What cumulative conceptual knowledge about chemistry should students gain from the course that will provide a conceptual foundation for future learning?" As used in the course, the core concepts represented on the concept map were elaborated in greater detail to incorporate and connect all major course topics. Because of the initial core concept analysis and subsequent conceptual elaboration conducted by faculty, instruction in the course maintained a common organizing focus for all lectures, laboratory activities, and student discussion sessions led by peer leaders. As a result, student understanding of chemistry concepts was significantly improved, students reported greater confidence in their understanding, and student drop-outs and failures were reduced.

Somewhat analogous to instructional models that emphasize the use of activities without linking the activities to underlying core concepts, there are a wide variety of concept

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...the function of a knowledge-based approach to science instruction is to insure that all of the instructional activities in a science course are maximally relevant to students gaining an understanding of the core concepts in a discipline.

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maps (or graphic organizers) presently popular in education. However, in our work, we use a specific form of concept mapping called *propositional concept maps*. As Figure 2 shows (see page 7), *propositional concept maps* are visual representations of knowledge that meet three criteria to insure they are useful tools in designing knowledge-based instruction. The first criterion is that concepts, generally in the form of nouns, are always linked to other concepts by labeled relationships, generally in the form of verbs or verb phrases. The second criterion is that the relationships between pairs of concepts are chosen so that the concept pair and the linking relationship always form a complete thought, e.g., sentence or proposition. And, the third criterion is that the concept map is organized *hierarchically* with the broadest core concepts (big ideas) at the top, subordinate concepts below, and illustrative examples, if any, at the bottom. In fact, both Figure 1 and Figure 2 are illustrations of *propositional concept maps*. Keeping

the three criteria in mind, *propositional concept maps* should be considered to represent a visual perspective of core organizing concepts or principles within a discipline. In elaborating the maps with greater detail, it is important to realize that a variety of perspectives representing hierarchical knowledge within a discipline could be constructed and that additional sub-maps are ordinarily required to represent knowledge in greater detail.

Considering *propositional concept mapping* as a tool in knowledge-based instruction, Figure 3 (see page 8) overviews a number of possible uses by faculty and students. As discussed above, concept mapping could be used by instructors to analyze and represent the organization of the core concepts of the discipline and serve as a guide for instructional planning. However, as Figure 3 also shows, faculty could present concept maps to students to support organization and learning of concepts presented in lectures or laboratory activities. Concept maps could provide faculty with the means for insuring that learning and assessment

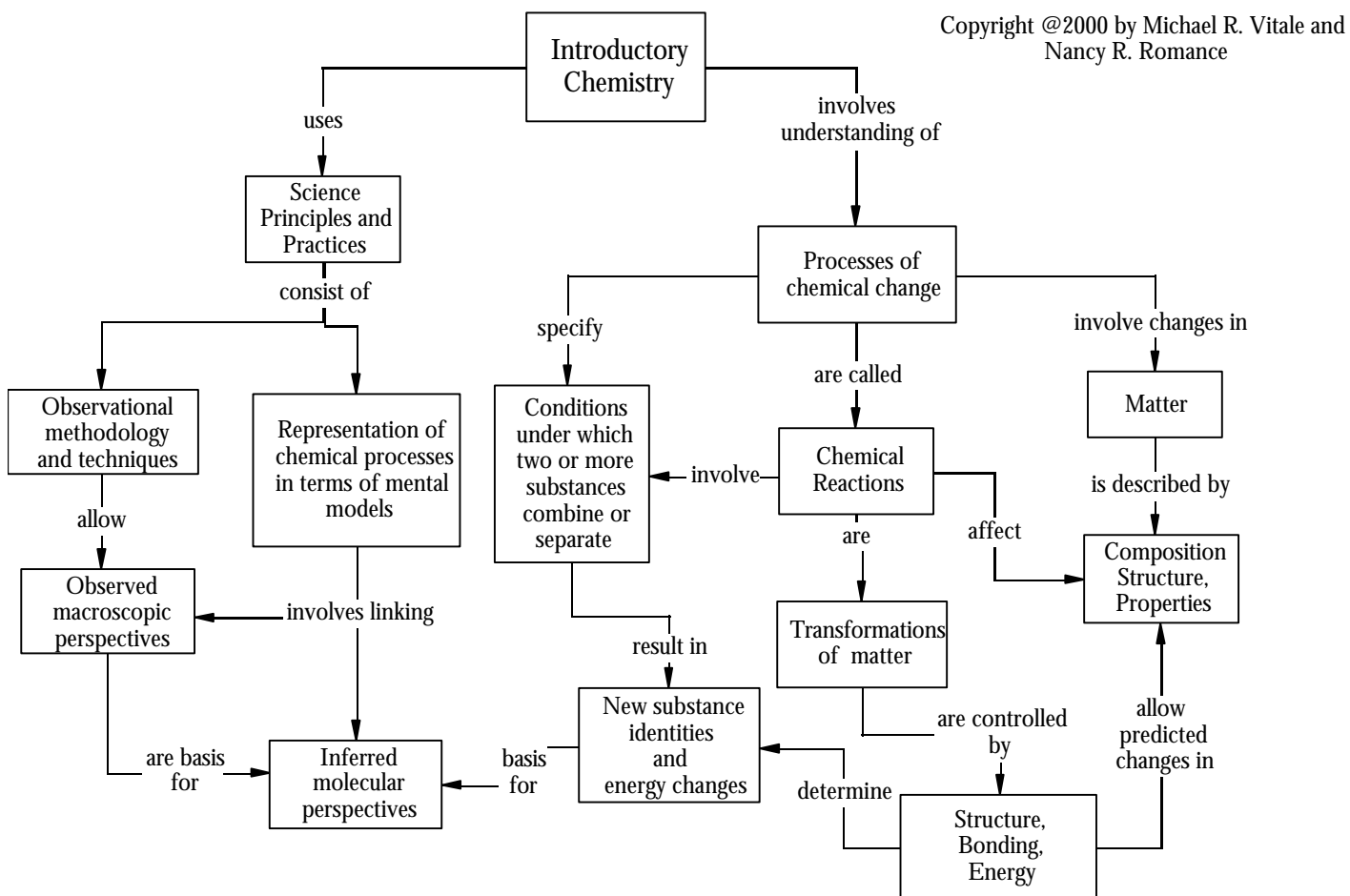


Figure 1

Concept map showing conceptual framework for relating major topics in introductory chemistry (e.g., measurement, atomic structure, chemical bonding, reactions, thermochemistry). Additional concept maps (sub-maps) are used to elaborate major topics and how they are taught through lecture, laboratory activities, and discussion sessions.

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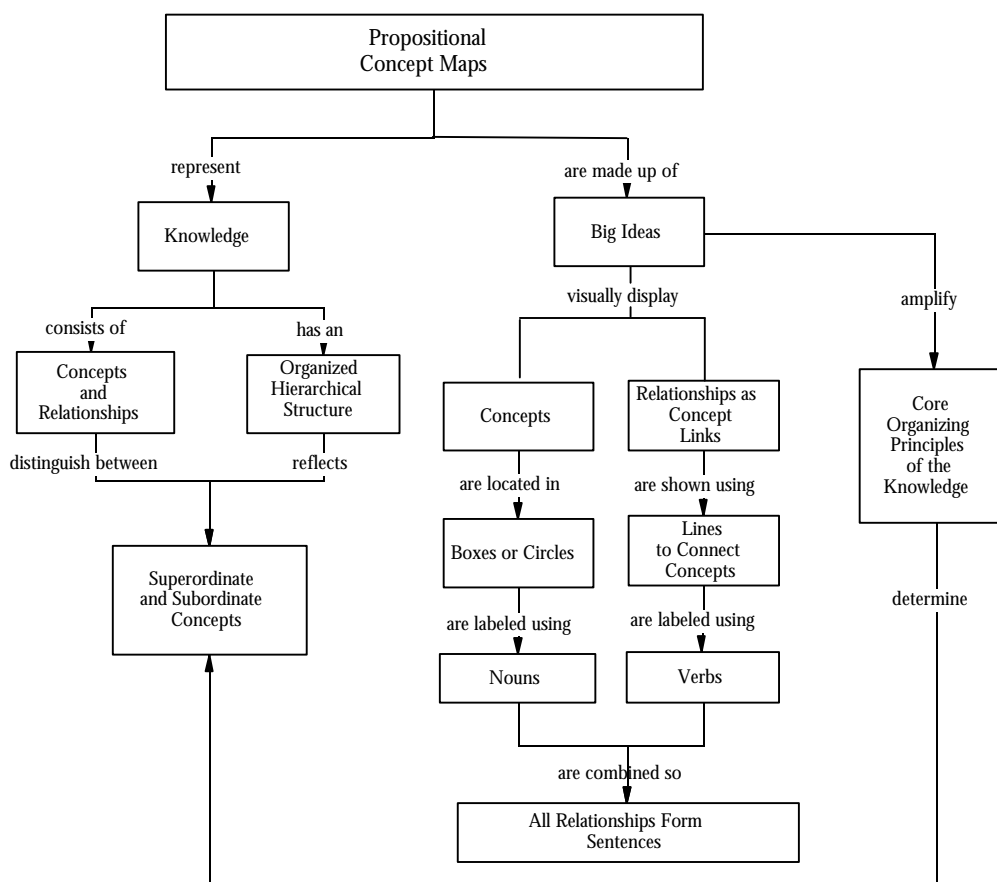


Figure 2. Concept map of propositional concept mapping. Emphasis in concept mapping is on identification of core concepts in the curriculum and use of core concepts to organize knowledge.

activities developed for the course focus on and are organized in accordance with the underlying structure of the core concepts in the discipline.

As Figure 3 also shows, *propositional concept mapping* is a powerful tool for students as well as instructors. First, students could construct concept maps to identify and organize the core concepts in textbooks and other materials they read. Second, students could construct and use concept maps as an organizational guide for writing assignments and other projects. Third, students could construct and use concept maps to organize the cumulative content of the course, e.g., lecture notes, laboratory activities, reading materials, in the form of a study guide.

At Florida Atlantic University, the Peer-Led Team Learning initiative which originally focused on introductory chemistry has been expanded to introductory biology. In both areas, applying the general knowledge-based instructional model and using *propositional concept mapping* have resulted in a strong linkage between lectures, laboratory activities, and peer-led discussion sessions that have focused on the core concepts in the discipline, resulting in

significant improvements in student course understanding and attitudes. In this sense, the results of both initiatives are highly promising and represent an exciting form of “work in progress.”

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Additional Information

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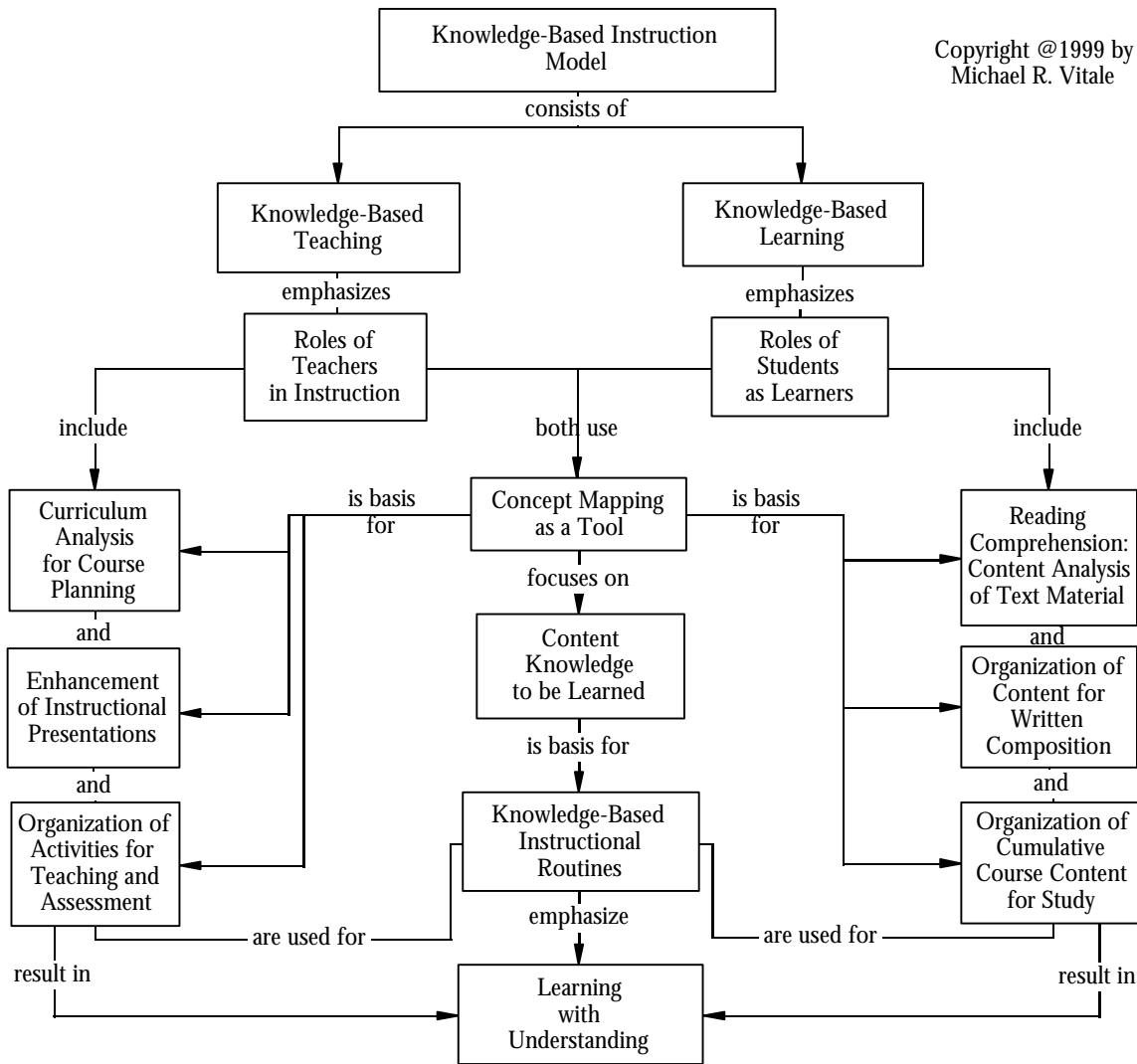


Figure 3. Overview of a Knowledge-Based Instruction Model. Enhancement of instructional presentations includes use of concept maps to visually support teaching. The idea of knowledge-based "routines" is that all teaching and learning activities used in instruction should be based on an overall curriculum framework that focuses on the logical structure of the discipline.

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"...the greatest strength of the PLTL model is that it presents a structure that creates a real sense of community of scholars, where students can realize the ultimate goal of taking responsibility for their own learning."

David Gosser

LEARNING CYCLES AND PEER-LED TEAM LEARNING

Peer-Led Team Learning (PLTL) encourages active participation and group interaction among students. In many cases, this interaction leads to greater conceptual understanding and helps students apply those concepts to new settings. Historically, instructors using PLTL would give students some general knowledge background, terminology, possibly some conceptual understanding, etc., and then allow students to develop a more thorough understanding of the concept(s) during PLTL workshops. However, an alternative use of PLTL would be as part of a *learning cycle*.

A learning cycle is a three-phase model of instruction (Lawson, *et al.*, 1989) that includes exploration, concept development/term introduction, and knowledge application to new settings. This is drastically different from traditional methods that follow a model of inform, verify, and practice (Lawson, *et al.*, 1999/2000). For example, a traditional student laboratory experiment generally begins by telling students the concepts they will encounter. Often students are even told the probable outcome. Once the students have been told what to expect, they are given the opportunity to confirm the concepts presented earlier. This method of instruction requires little student cognitive effort because they already know what the outcome should be. The three phases of the learning cycle rectify this by challenging students to develop the concepts on their own. Although more rigorous for students, this method allows students to actively construct their own knowledge.

The first phase of the learning cycle is *exploration*. During this time students are usually given a question to answer. With the help of laboratory materials, students begin to generate data that will help them answer the question. Initially, these laboratory experiments are instructor-led (guided inquiry). As students become more experienced, student-led (open-inquiry) experiments in which students generate their own question and experiments can be used. After generating the data, the students attempt to make sense of the data by looking for trends or patterns.

As patterns are found, *concept development and term introduction*— the second phase of

the learning cycle— can begin. PLTL workshops fit perfectly into the learning cycle in this phase. Data generated in the laboratory can be scrutinized and discussed with the group. Students can discuss patterns they found and generate possible reasons for these patterns. In some cases students may want to go back into the laboratory to test their hypotheses or to alter the experimental conditions. They will also be able to pool their group's data in order to develop a more complete picture of the experiment. By working together, students should be able to develop concepts that explain their experimental results. During this time, appropriate terminology is introduced. Notice that all students have had the opportunity to work through some experiments and discussion before terms are introduced. This is important because students now have an appropriate context for each new term. By the end of the PLTL workshop, students should have moved from data generated in the laboratory to a level of conceptual understanding.

The educational experience does not end there, however. The student now moves into the third phase of the learning cycle, *knowledge application to new settings*. Instructors help students apply this knowledge by assigning homework, other labs, giving exams, etc. Students encounter slightly different problems and must use their new knowledge to work through them. At this time, the instructor can help to refine the student-generated concepts (if needed). This last phase is extremely important in science education. Many times students feel they learned or memorized a great deal of facts, but never understood how these facts all fit together. Knowledge application allows students to test their understanding of concepts in new or novel situations. As these new or revised concepts are linked to other mental structures, students will gain a richer understanding of the concepts presented, as well as an enhanced understanding of how these concepts fit together. As concepts fit together, the knowledge gained becomes more meaningful.

By using learning cycles in this way, the laboratory is now directly linked to PLTL

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Knowledge application allows students to test their understanding of concepts in new or novel situations. As these new or revised concepts are linked to other mental structures, students will gain a richer understanding of the concepts presented, as well as an enhanced understanding of how these concepts fit together.

CRITICAL COMPONENTS FOR DISSEMINATION

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ied, and implemented. Successful implementation may well be able to proceed without attending to one or several of the following components. This dissemination model is presented as a package that the dissemination team uses or recommends. Some of the components are the responsibility of the dissemination team; some must be undertaken by the adopters; some are to be addressed cooperatively.

These components are to some extent sequential or chronological; yet it is easy to imagine them being in a different order. For example, the first and second components might be reversed. The fifth component listed could be the first in a dissemination discussion; but we have to start somewhere, so here goes:

1. Presentations of Peer-Led Team Learning

Interviews and surveys with recent adopters indicate that all were introduced to the program through a colleague or at a conference presentation, e.g., Gordon Conference, Project Kaleidoscope, and Biennial Conference on Chemical Education (BCCE). As the Project expands, it is expected that there will be more general interest presentations and reports at association meetings and at biology, physics, and mathematics conferences.

Future adopters are often instructors who believe that both they and their students can do better. Forty percent of those completing post-conference surveys said they wanted students to be more active in their learning...so they perk up when they hear about workshops.

This first exposure whets the appetite and leads to participation at a longer session, usually two days in length, making it possible for potential adopters to learn enough about the method to make an informed decision about whether or not to try it.

The Dissemination Grant and the Community College Supplement have provided for a number of these conferences. This newsletter and other written materials have been useful in presenting information, and additional information can be found on the website.

In summary, the presentation phase of dissemination includes:

- ? a wide range of professional meetings that provide information about PLTL;
- ? two-day conferences about the method; pointing out both the elements of the method and how PLTL responds to a felt need for more active, responsible learning;
- ? contact with dissemination team members to ask fol-

low-up questions;

? the PLTL materials and website, www.pltl.org, as sources of information.

2. Internal Assessment by Potential Adopters

Those considering implementation of workshops look in two directions: at the PLTL Model and at their own institutions. Discussion with implementers and conference feedback reveal that after potential adopters have learned about the PLTL method, they assess their own situation, judging whether the climate and resources will support peer-led team learning. Usually faculty members check into personal priorities, and decide whether recruiting and training leaders, developing materials, obtaining various permissions, and funding are attainable.

The type of institution, student needs, the academic/research environment, teaching assistantship programs, the general level of pedagogical activity in and around the department, the financial resources, and other local factors all play a role in this internal assessment. Based on conference feedback and interviews, we know that although many decide to try the method, others who show initial interest, upon further reflection decide against it, or postpone implementation. Some have concluded that the method is not suited to their pedagogical style. Still others try the method for a year or two and then abandon it as too time-consuming, or because they feel that the effort outweighs the benefits.

But the large majority of the more than 100 faculty members completing two-day workshops on PLTL during Summer 2000 said that they plan to implement the method. They and others preparing for workshops must determine whether to begin with a pilot program, and how to accomplish all of the work needed to get started. To do this they generally need assistance.

3. Support From the PLTL Workshop Project and From the Institution

Members of the dissemination team, after presenting at conferences through the Chautauqua Program, or PLTL-sponsored conferences, are available to give guidance as new adopters consider whether better to write or adapt materials, how to approach administrators, secure funding, select and train leaders, and schedule workshops.

The Workshop Project now has a variety of ready-made materials and organizational assistance available for new adopters. These include the *Guidebook* with information about every aspect of the Project, three published books of

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chemistry materials, and a manual for peer-leader training (see website regarding published materials). In addition, there are conferences on training peer leaders as well as general conferences for those involved in the Project. Initial funding can be obtained through the Workshop Project Associate grants.

In summary, support from the PLTL dissemination team includes:

- ? Workshop Project Associates grants to start up;
- ? visits from dissemination team members;
- ? discussions among adopters;
- ? evaluation surveys, phone interviews, and visits;
- ? incorporation into the PLTL network;
- ? use of the website to provide timely communications.

As PLTL continues to grow, initial implementation will depend more on local resources. In response to surveys about implementation issues, respondents at dissemination workshops spoke about the need for local support. They are much more likely to succeed if their colleagues and administrators assist in making a home for PLTL. It is highly unlikely that a PLTL adopter will find support in all of the following areas, but it is worth noting the advantages:

- ? *Collegial* When several people adopt the method, responsibilities are shared; problems can be discussed; tensions are eased. Adoption by faculty members from several departments builds a stronger foundation.
- ? *Departmental* Strong support from the chair brings recognition to the method. A non-supportive chair can make it very difficult to institutionalize PLTL.
- ? *Institutional/Financial* Support at the level of Dean and Provost further legitimizes the process and opens the potential for implementation by other departments. PLTL can be adopted with outside funds but is not likely to become institutionalized without internal funding. When asked about barriers to implementation and institutionalization, the large majority of respondents at PLTL conferences have cited local funding.
- ? *Pedagogical* The peer leader is central to the success of PLTL. Assistance from learning specialists has been of great value in training the leaders and bringing additional resources to the project through contact with centers for teaching and learning.

In addition to support from a PLTL dissemination team member, those implementing the method frequently report that they consult within the growing network of Workshop instructors. As the PLTL website increases its capability, it will grow as an important resource for implementation.

4. Fidelity to the PLTL Workshop Model

While there is room for adaptation of the Workshop approach to suit local circumstances, different disciplines, and course levels, those who have used, analyzed and evaluated the method for a number of years have found that the critical components for successful workshops are indeed essential guidelines for success.

Students and professors have found the workshops to be vastly different from TA-led recitations, informal study groups, and tutorial sessions. Unless participants maintain a clear vision and commitment to the Workshop method, there is a danger that the program might regress to something more familiar and easier to maintain...but less effective than the workshops. The on-going discussion of the PLTL dynamics is healthy and should eventually lead to a better understanding of how to make workshops more effective. The following are only some of the areas related to critical components in which important activities are taking place:

- ? integrating workshops with the course; the optimum role for the professor;
- ? comparing the benefits and liabilities between optional and required workshops;
- ? training of leaders: role of the workshop leader; how to guide and facilitate more than teach; whether to take a more conceptual or algorithmic approach, and how to balance the two; the role of answers and finding answers;
- ? training and supervision of workshop leaders with input from learning specialists and content instructors;
- ? developing new materials and activities, particularly in disciplines just beginning to use the PLTL method.

5. Data-Driven Decision-Making

The PLTL Project prides itself on the use of data to verify the effectiveness of the method; to explore various connections within the model; to investigate the experiences of students, student leaders, and instructors; and to add to the body of literature exploring the dynamics of teaching and learning.

Considerable data are available indicating that the method has a positive impact on student performance. Studies in this area have compared grades of groups of students with and without workshops. New sites that adopt the method ask new questions or desire local data to demonstrate that the approach works at that institution. This interest in evaluation and research extends to a number of areas, including:

- ? comparative group studies for student performance and retention;
- ? theoretical underpinnings, such as Vygotsky's "zone of

(Continued on page 12)

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proximal development;”

- ? analysis of differences between workshops in chemistry and other disciplines;
- ? the role and activities of the peer leader;
- ? the impact of the workshops on student performance in courses they take in subsequent terms;
- ? connections between workshop attendance and grades.

Summary The PLTL Workshop method has been proven to be effective. Implementation requires a substantial commitment of resources that includes investments of time, money, and a rethinking of teaching/learning priorities. At the PLTL Leadership Conference held in Newark, NJ, in November 2000, attendees were asked to indicate what they believe to be the most critical issues in dissemination. Responses revealed concerns about many of the areas mentioned above: new disciplines, financial and faculty support; connections with other curricular issues;

technical assistance needed, and finding and training leaders.

Working from a critical component model will help place issues, questions, and problems in the context of an overall dissemination framework. It should be remembered that those disseminating are also practitioners of the method. New adopters of PLTL are likely to become part of the dissemination effort in the near future. It is important to see an overall plan and direction.

New adopters generally embrace the method because they feel the need for change, recognize the value of the workshops, and also see continuity with what they have been doing. The model offered here attempts to identify the critical components that lead to successful dissemination. Just as teaching can be called successful only if it results in genuine learning, dissemination can be called successful only if it results in successful implementation of peer-led team learning workshops.

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LEARNING CYCLES AND PEER-LED TEAM LEARNING

(Continued from page 9)

workshops and lecture. Most importantly, students are active participants in the entire learning process. PLTL provides the perfect opportunity for students to move from data to conceptual understanding with the help of peer leaders. It is a win-win situation: Learning cycles can be enhanced by using PLTL workshops as a forum in which students can discuss data and develop conceptual understanding. PLTL can be enhanced through learning cycles by revising the traditional inform-verify-practice sequence to one which allows an inquiry approach to constructing meaningful understanding of scientific concepts.

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NEW! SHORTER INTERNET ADDRESS

GO TO [HTTP://WWW.PLTL.ORG](http://www.pltl.org)

YOU WILL BE FORWARDED TO OUR OLD ADDRESS,
[HTTP://WWW.SCI.CCNY.CUNY.EDU/~CHEMWKSP](http://www.sci.ccnycunyu.edu/~chemwksp).

PLEASE UPDATE YOUR BOOKMARKS AND USE THE RELOAD OR REFRESH BUTTON.

References

Lawson, A. E., Abraham, M. R., & Renner, J. W. (1989). A theory of instruction: Using the learning cycle to teach science concepts and thinking skills. Cincinnati: National Association for Research in Science Teaching monograph no. 1.

Lawson, A. E., Lewis, C. M. Jr., & Birk, J. P. (1999/2000). Why do students “cook” data? A case study on the tenacity of misconceptions. *Journal of College Science Teaching*, 29(30), 191-198.

NEW! UPDATED PLTL WEBSITE

?????LIST OF UPCOMING EVENTS FOR PLTL AND MEETINGS DEALING WITH MATHEMATICS AND THE SCIENCES

?????LINKS TO PLTL MATERIALS PUBLISHED BY PRENTICE-HALL INC. AND MATERIALS UNDER DEVELOPMENT

?????FULL LIST OF WPA AWARDS

?????PROGRESSIONS NEWSLETTER ONLINE

?????CONTACT INFORMATION

?????SEARCH CAPABILITY

WPA AWARDS LEAD TO IMPLEMENTATION

(Continued from page 1)

Eleven faculty members reported that they met weekly with the leaders for sessions of one to two hours to review and prepare for workshops. One reported meeting with individual leaders according to need. The following, from one of the reports, describes a weekly peer leader session:

Each week a workshop leader prep meeting was held, in which three topics of variable length were addressed: a) issues from last workshop, b) chemistry of the upcoming workshop, and c) pedagogical and group dynamics issues.

Nine professors reported that others were involved in the workshops. Seven of these were learning specialists or personnel at a learning center. Two mentioned other professors and graduate students assisting with leader training.

Local Interest and Dissemination All twelve respondents reported that other faculty members at their institutions are expressing interest in PLTL. In almost all cases this was described in terms that indicated serious interest with a determination to become further involved or at least to learn more about the approach. This is a very significant finding and one that surpasses previous workshop implementation experiences.

Nine of the twelve respondents reported some dissemination activities. Three said they had already or were preparing to give talks to their own faculty. One is preparing a full day workshop with another experienced PLTL faculty member, as part of professional development sessions. Five reported doing presentations at regional or national meetings.

Success and Problems Ten of the eleven respondents answered "yes," when asked if they judged PLTL to have been a success, with one saying it was too soon to tell, although the rest of this respondent's report was positive.

Problems in implementation varied with no consensus. The following were cited as difficulties, although none was considered serious:

- ? six reported that the project took a lot or a great deal of work. But two said that it was more than had been expected;
- ? two mentioned some difficulty with materials;
- ? two mentioned funding, or the late arrival of funds;
- ? four described some difficulties in organizational arrangements when setting up the workshops.

These were generally referred to as minor difficulties with strong endorsements of the overall PLTL process.

Strengths and Weaknesses Respondents reported a number of strengths and weaknesses. Several were quite articulate in reporting the impact of the PLTL approach. The following summarizes the experiences that many have had.

- ? The strengths of the Model lie in its effective amalgamation of the principles of concept-building, metacognition, and corporate generation of knowledge in a format which is both structured and flexible enough to be adapted. The weaknesses of the Model center about the considerable demand on student manpower, institutional funding, and appropriate space.
- ? Higher grades and lower attrition. The Model also bonds the students to the course and to their leaders. This is reflected in the hard numbers too, but it influences their attitude towards the course in very positive ways. It also benefits the leaders in many ways such as self-confidence and reviewing of course topics.
- ? One hears students discussing chemistry, speaking the language of chemistry; students learn critical thinking skills and become better at working through problems they have not seen before.

All but one of the respondents reported strengths directly related to student learning. Several mentioned improving the materials or making other adjustments.

(Continued on page 14)

I find it difficult to imagine teaching the course the way I do without the environment of the workshop to allow students to discover the central concepts of the discipline.

The strengths of the Model lie in its effective amalgamation of the principles of concept-building, metacognition, and corporate generation of knowledge in a format which is both structured and flexible enough to be adapted.

(Continued from page 13)

The weaknesses mentioned were funding (twice), organizational arrangements such as space or group size (twice); peer-leader skills regarding group management and not having answers (once each). One respondent mentioned that students think the workshop time should relieve individual study time. (This problem has been identified before.) One site has increased group size of ten to twelve students, believing that this works better.

Conclusions In general it can be said without reservation that the Peer-Led Team Learning approach has been successfully implemented at the sites reporting back about the Workshop Project Associates grants. The following stand out from these reports.

- ? Implementers strongly believe that they have seen indications that the method directly improves student learning. At least five (University of Portland, Portland State, Prince George's County Community College, Northern Michigan, Eastern Oregon) already have or are in the process of collecting data to demonstrate this.
- ? The WPA funding was of major importance in implementation at new sites.
- ? There is a high level of collegial support at the WPA institutions, both from science faculty and learning specialists. The mood of the implementers is highly positive and this seems related to collegial interaction.
- ? In spite of the thoroughly positive introduction of PLTL, and the continued generation of data, at a number of locations there is uncertainty about continuation, based primarily on institutional funding. The following expresses the attitudes at several sites.

The search for institutional funding on a yearly basis can be labyrinthine and time-

consuming, and this precarious process puts the long-term viability of the program at risk. A semi-permanent source of external funding would go a long way to alleviate some of the stress of running the show.

I find it difficult to imagine teaching the course the way I do without the environment of the workshop to allow students to discover the central concepts of the discipline.

Maintaining the Momentum What happens when the WPA grant runs out? It is too soon to say with certainty, but it is clear from the feedback we have received in the WPA reports that new implementers will need continuing support if they are to maintain PLTL in their courses. Some ways in which the Workshop Project may assist new members is to:

- ? help them identify ways they can obtain additional funds either from their own institutions or from the National Science Foundation by forming small consortia and writing grant proposals;
- ? help them think of alternative ways of payment to the leaders such as giving them academic credit instead of pay;
- ? set up a mechanism by which the new materials that are being generated at various sites can be peer reviewed and made available to the others;
- ? facilitate the exchange of ideas and materials related to leader training;
- ? have references easily available to those who wish to learn more about the theory behind the practice; and,
- ? include new adopters in PLTL presentations and publications.

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PEER-LED TEAM LEARNING WORKSHOPS SIX CRITICAL COMPONENTS

- ? The Workshop is integral to the course.
- ? Course professors are involved in the selection of materials, training and supervision of peer leaders, and they review the progress of Workshops.
- ? Peer leaders are selected, trained and supervised to be skilled in group work as facilitators.
- ? Workshop materials are appropriately challenging, directly related to tests, designed for small group work.
- ? The Workshops are held once a week for two hours, contain six to eight students per group, in space suitable for small-group activities.
- ? PLTL is supported by the department and the institution with funds, course status and other support so that the method has the opportunity to be adopted across courses and disciplines.

THIRD ROUND OF WPA GRANTS AWARDED

The deadline for submission of applications for the third round of the Workshop Project Associates awards was September 1st, 2000. We received 17 in chemistry of which eleven have been funded. In Biology, Dr. Michael Gaines received three and all were funded. It took us until January 1, 2001 to complete the reviews, communicate with the applicants and finally issue the contracts.

I am delighted to report that the applicants are taking this process very seriously, in spite of the relatively small size of the grants. Most of the proposals are written thoughtfully with a lot of attention given to details of implementation as outlined in the critical components for a successful Workshop program. Most applicants are planning to disseminate the results at various national and regional meetings and have made commitment to do some form of evaluation of their implementation efforts.

Having done three rounds of this process, it is apparent that the WPA grants have provided us with resources and a structure for an ongoing discussion between the Project leadership and the new adopters of the PLTL Model of teaching. These grants also provide an opportunity to test the model in a variety of institutions and disciplines on a national level.

*Pratibha Varma-Nelson
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Note: Please check the PLTL website for more information on the WPA awards: www.pltl.org

Biology

University of Kansas

Dr. Dean A. Stetler
Course: Principles of Molecular & Cellular Biology
Awarded: \$6,700 Peer Leaders: 16 (groups of 8)
Matched: \$18,750 Students: Anticipating 250

University of Rochester

Dr. Terry Platt
Course: Introduction to Biochemistry
Awarded: \$6,200 Peer Leaders: 10 (groups of 8)
Matched: \$7,158 Students: 85

Western Oregon University

Dr. Robert S. Turner
Course: Principles of Biology
Awarded: \$4,380 Peer Leaders: (groups 6 - 8)
Matched: \$1,400 8 Fall 2000
4 Winter 2001
5 Spring 2001

Chemistry

Boston University

Dr. Morton Hoffman
Course: General Chemistry
Awarded: \$5,000 Peer Leaders: 9 (groups of 6 - 7)
Matched: \$4,500 Students: 50-60

Evergreen Valley College

Dr. Sami A. Ibrahim
Course: Introduction to Chemistry
Awarded: \$5,000 Peer Leaders: 6 (groups of 6 - 8)
Matched: \$14,300

Portland Community College

Mr. James Schneider
Course: General Chemistry
Awarded: \$4,885 Peer Leaders: 4 (groups of 6)
Matched: \$2,985 Winter & Spring 2001 Students: 24

Sierra College

Ms. Florence Cardoza
Course: Allied Health Sciences Chem 2A & 2B
Awarded: \$4,996.50 Peer Leaders: 8 (groups of 4 - 8)
Matched: \$5,971

Sierra College

Dr. Karen Walters-Dunlap
Course: General Chemistry
Awarded: \$5,000 Peer Leaders: (groups of 5 - 8)
Matched: \$5,362 4 Spring 2001 - 24 students
5 Fall 2001 - 30 students

Southern Illinois University

Dr. Michael Shaw
Course: Freshman Chemistry
Awarded: \$4,474 Peer Leaders: (groups of 8 - 10)
Matched: \$4,534 5 Spring, 2001
16 Fall, 2001
8 Spring, 2002
Students: Freshman Class of 300

University of Maine

Dr. Mitchell Bruce
Course: General Chemistry
Awarded: \$10,000 Peer Leaders: (groups of 8)
Matched: \$10,000 10 Fall, 00/01 Students: 700
8 Spring, 01/02 Students: 420

University of New Hampshire

Dr. Christopher Bauer
Course: General Chemistry 403 & General Chemistry 404
Awarded: \$5,000 Peer Leaders: 15 (groups of 8)
Matched: \$2,500 Students: 750/Gen. Chem 403
500/Gen. Chem 404

University of Oklahoma

Dr. Michael R. Abraham
Course: General Chemistry I & General Chemistry II
Awarded: \$5,000 Peer Leaders: 24 (groups of 10)
Matched: \$5,000 Students: 300

University of Oklahoma

Dr. Roland E. Lehr
Course: Organic Chemistry
Awarded: \$5,001 Peer Leaders: 20 (groups of 8 - 10)
Matched: \$5,000 Students: 190

University of Puerto Rico - Cayey

Ms. Rosita Baez-Galib
Course: General Chemistry
Awarded: \$4,995.90 Peer Leaders: 4 - 5 (groups of 6 - 8)
Matched: \$7,233 Students: 30

Progressions: Peer-Led Team Learning is a quarterly publication of the PLTL Workshop National Dissemination Project.

Progressions is intended to build the Workshop community through discussion of the implementation of the Workshop Model at institutions of learning.

The editors are looking for contributions: please contact us with special concerns you would like addressed, have a presentation or workshop to announce, or an article that you believe others would find interesting.

The Workshop Project Newsletter

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HOLD THESE DATES!

PLTL NATIONAL CONFERENCE JULY 12 -15, 2001

TOPICS WILL INCLUDE LEADER TRAINING,
MATERIALS DEVELOPMENT, LEADERSHIP, AND
DISSEMINATION OF THE PLTL MODEL.

LOCATION TO BE ANNOUNCED.

PLEASE CONTINUE TO CHECK THE WEBSITE
FOR MORE INFORMATION

CHAUTAUQUA COURSES ON PLTL

WEST - MAY 21-23, 2001 -- JET PROPULSION LAB, PASADENA, CA

EAST - JUNE 16-18, 2001 -- PHILADELPHIA, PA

Peer-led workshops are an effective way to engage large numbers of students with course material and each other. Improved performance and retention, development of communication and team skills, higher motivation and course satisfaction, and increased interest in pursuing further study in science and mathematics are among the benefits of the PLTL Workshop approach. For more information, go to www.pltl.org.

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