INTRODUCTION

Most beginning faculty have been associated with research programs in their careers, either while obtaining doctorate degrees and/or in industry. This association provides experience in writing proposals, obtaining funding, conducting experimental and/or modeling programs, writing final reports, and preparing papers for presentation. However, formal Ph.D. programs generally do not provide faculty with training in teaching methodology. As a consequence, new faculty often struggle with the basic elements of teaching, i.e., how to organize a class and write a class syllabus; how to conduct the day-to-day educating with lectures; etc; and how to formulate examinations to determine the extent of learning. These are not trivial tasks. They require long hours of thought and care before they are performed well. Often a faculty member's training becomes what he/she has observed others do. Therefore, good or bad, the system tends to perpetuate itself.

In addition, the reward system is not always conducive to allow faculty to spend the time necessary to develop their skills in teaching. Many institutions place more emphasis on developing a productive research program than on developing teaching skills. Improvement in teaching requires time, resources, and effort. If faculty feel that their attempts to improve their teaching are detracting from their research efforts, they often do not feel motivated to work on improving their teaching. Another aspect of the reward system is that good teaching is difficult to measure. If student evaluations are reasonable and not negative, then many faculty feel they are doing "fine" and they do not see the need to improve.

Improvement in teaching often requires an element of change. Change can be frightening and risky, taking individuals out of a comfort zone and into an area of unknown. Rather than risk the unknown, many faculty will fall back to their previously developed styles, particularly if their teaching has been "adequate".

The Engineering and Technology College at Brigham Young University has had a Teacher Development Committee for several years. This committee was given the charge to address some of the concerns mentioned above. In particular, the committee is responsible to conduct a training seminar for
new faculty at the beginning of each fall semester and also to conduct an annual college teaching conclave. The conclave has usually involved a presentation by a member of the BYU Education or Educational Psychology faculty. These presentations have always been good and have stimulated discussion of teaching within the engineering and technology faculty. But often the discussions only last a few hours to a few days, and then people return to the status quo. It appeared to members of the Teacher Development Committee that a long term program was needed in order to make an impact on college teaching performance. As the committee members sought such a program, they learned of a workshop presented to civil engineering department chairs at regional meetings across the country sponsored by the American Society of Civil Engineers. The workshop focused on learning-style theory and improving teacher effectiveness. The material presented in the seminar was referred to as the Integrated Learning System (ILS). Arrangements were made for the dean's office to fund a member of the committee to attend an ILS workshop. More will be said later about the support of the dean's office which has been vital to the implementation of the teacher development program at BYU. After attending the seminar, a recommendation was made to the Dean's office that a proposal be requested from the presenters of the seminar which would allow ILS to be taught to the entire BYU Engineering and Technology faculty.

The purpose of this section of the monograph is to describe how the ILS program was implemented and to provide observations and experiences on its efficacy at BYU [32,33].

BYU PROGRAM

In December of 1988, a member of the Engineering and Technology College Teacher Development Committee attended a seminar on the Integrated Learning System (ILS). This seminar was organized by Dr. Kenneth J. Williamson, Professor of Civil Engineering at Oregon State University, and Dr. Pamela K. Hurt, consultant, and was presented by Dr. Williamson. Subsequently, the organizers were asked to submit a proposal to the BYU College of Engineering and Technology to present the concepts of ILS to the college faculty.

In February of 1989, at the annual college conclave on teaching, Drs. Hurt and Williamson presented a two-hour seminar to the faculty. During the seminar, faculty were asked if they were interested in participating in a rigorous training program involving ILS. About 1/3 (35 out of 100) of the college faculty volunteered to participate. A date of August 1989, one week before the start of Fall Semester 1989, was agreed upon to begin the training. Materials were sent in advance for the faculty to begin assimilating the concepts of ILS. In August 1989, consultants Hurt and Williamson conducted two days of training. The first day of training consisted of the material that was presented at the seminar in December of 1988. The entire college faculty were invited to attend the first day's presentation. Nearly 80% of the faculty were in attendance. The 35 volunteers
participated in the second day of training. The volunteers were instructed on how to prepare a course syllabus containing activities which would incorporate the ILS concepts. Specific examples of both in-class and out-of-class activities in each of the quadrants were presented. Higher level questioning techniques following Bloom's taxonomy were also discussed [13, 14].

The volunteers proceeded to implement the concepts during the fall semester. Volunteers were encouraged to visit each others classes, to evaluate, and to provide feedback for their colleagues. Both audio and video taping were done to help with the evaluation process. Many faculty were apprehensive of these taping sessions, particularly the video taping. However, those who used the taping techniques found them instructional and helpful. The volunteers were divided into support groups and were asked to meet on a regular basis to share successes and failures that they had experienced during the semester. These support groups became one of the most significant benefits of the training program. Many faculty were having regular discussions about teaching for the first time.

The final training session with the consultants took place in December 1990. A few of the volunteers were asked to present a short presentation simulating a classroom experience. The volunteers were asked to demonstrate how they traversed the four quadrants in order to provide a positive teaching experience for all learning types. The presentations were very well done indicating that many of the volunteers had been successful in learning the ILS concepts and incorporating them in class room instruction. Additional material on the change model and the flow of knowledge within the brain was presented by the consultants.

CHANGE MODEL

The challenge which the Teacher Development Committee faced was to stimulate the college faculty to willingly change their instruction methods, i.e., to abandon their comfort zone and try something new. The change process observed at BYU can be modeled by the Concerns-Based Adoption Model (CBAM) developed at the Research and Business
Development Center at the University of Texas [34,35]. CBAM is highly respected in industry and is designed to orchestrate organizational change. This seven-step conceptually-based model helps organizations change progressively to meet the desired objectives. The seven steps are shown in Figure 11. There are three assumptions used as a premise for this model: 1) change is made by individuals first and then by organizations; 2) change is a highly personal experience and involves the personal growth of all involved; 3) change must be managed by relating to people first and the change second.

**PROCESS OF CHANGE**

(CONCERNS-BASED ADOPTION MODEL: CBAM)

STAGE 6: REFOCUSING

STAGE 5: COLLABORATION

STAGE 4: CONSEQUENCE

STAGE 3: MANAGEMENT

STAGE 2: PERSONAL

STAGE 1: INFORMATIONAL

STAGE 0: AWARENESS

**Figure 11.** Seven Steps in the Process of Change.

In August of 1989, the consultants began with the BYU engineering faculty at steps 0 and 1 by building an awareness of the need for change in the area of college teaching methodologies and giving necessary information concerning the status of engineering education. Approximately 80 members of the College of Engineering and Technology faculty participated in this phase of the program.

In the December 1989 training session, the consultants had a goal of moving a core cadre of faculty to steps 2 and 3 of the change model. Volunteers were requested at this point in the program to commit time and resources; thirty-five members of the faculty volunteered. Support by the dean and department heads was imperative in moving individuals through the change cycle successfully. Higher-level questioning techniques were taught with both video- and audio-taping of volunteers' instructional deliveries. The volunteers left with a commitment to incorporate new teaching techniques into their existing curricula.

The implementation stage of change (steps 3 and 4) was achieved by the formation of support groups, by discussion of innovative teaching ideas at faculty meetings, and by modeling class presentations for one another. In the December 1990 training session, a trainer of trainers program was presented to the remaining volunteers which numbered 20. It was felt that these remaining volunteers were somewhere near stages 5 and 6 on the change process after the 1990 December training session. New research on the way
information is perceived and processed in the brain was presented during the 1990 December session.

As the engineering and technology faculty participated in the program, several barriers to change were identified. These included: skepticism, lack of motivation, vulnerability, inadequate resources, lack of clarity about the change, and the need to take time from other activities deemed more important to promotion and tenure.

OBSERVATIONS AND TESTIMONIALS

During the training session in December of 1989, these observations were made: 1) many courses were entirely redesigned based on the ILS training; 2) new instructional activities were tried and in many cases implemented by faculty who had previously relied on a traditional lecture based format; 3) the majority of participating faculty taped their instruction to determine the use of higher-level questions; 4) many examples were provided of how a 50 minute lecture was broken down into two or three time periods with a different type of instructional activity being used in each period; 5) unique examples were presented on how faculty engaged the students in class with group activities coupled with faculty coaching; 6) all of the volunteers expressed increased personal satisfaction with their teaching; and 7) enthusiasm for the program led to increased faculty discussions about teaching and learning.

Comments were solicited from several volunteers at the end of the December 1990 training session. A few of these comments are presented here.

I participated in the ILS program because I wanted to improve my teaching in an organized fashion with a global view rather than in an ad hoc fashion based on isolated ideas that seem good at the time. The 4Mat teaching system provides the global view. I have implemented it in my classes, and it has been very rewarding. It gives me a model that I can proactively work with to improve my teaching performance rather than simply relying on my "natural ability (or inability)".

I was amazed at how blind I had been to assume that my students were right with me during my lectures. The 4Mat system helped me to realize that in addition to conveying concepts, I must first grab the students' interest, provide hands-on, engaging activities to let concepts sink in, and give the students opportunity to take these concepts and run with them by integrating them into real-world projects.

I have used this model in my undergraduate structural analysis course. I have had many positive comments from students -- particularly about the design projects that I assign. Some students have said that this is the first course in which they have felt like they were doing real engineering work. - Rick Balling of the Civil Engineering Department.

Looking back on my participation and the effect that it has had on my teaching I feel strongly that it has had a positive influence in two principal ways:

1) My effort as a faculty member to pass through the four types of learning activities has definitely increased. I suppose for some time I used this type of approach in my teaching both in industry and before that in academia but now I have some theory and explanation as to why it is important and why it ought to be done.
2) The four step process is definitely a
practical and simple reference frame to use as a skeleton for any concept, technique or principle that needs to be taught. I believe that even though all of us as faculty and students may tend to have a dominant learning style, my experience has shown me that providing learning experiences in all four of the quadrants enhances learning for just about every person no matter what his predominant or preferred learning style quadrant might be. As a result, my effort in designing learning activities is much more diverse than what it was previously.

As a result of my participation in the ILS Program I have definitely become even more sensitized to the importance of having students be involved in the learning process through the use of higher levels of thinking. It's not enough for most students to just be exposed to information; they have to think about questions like "why", "what if" and "how". They also need to "do" some things. I have seen many instances where students retain and understand much better when these higher levels of thinking have taken place with the subject at hand. I find myself spending time developing these types of questions and activities in my lesson planning more so than in the past. - Robert Todd of the Technology Department.

The Kolb learning cycle provides what a well founded model on which my teaching and teaching effectiveness assessment can be based. This fundamental learning cycle model has had a far greater impact on my teaching effectiveness than has any specific teaching style change. Prior to working with the ILS program, my teaching style was based on inputs from several sources including:

1. The College of Education. This source was not very effective.
2. Suggestions from and observation of colleagues. Effective techniques used by others did not always work well for me.
3. Student comments and evaluations. This input tends to be short term and somewhat of a popularity contest.

The Kolb learning model provides the basis for effective course planning and for dynamic interaction with the students in the classroom. This is especially important in large classes where individual attention to each student is not possible. The key elements, at least to me, are:

1. Didactic loading, no matter how well it is dressed up, is only part of the story. If retention is desired, the teaching must include the other teaching (learning) styles. This may require changes in the "course content."
2. The 18 minute law. Change the teaching style several times in a class period.
3. ALL students will learn and retain more if the course material is presented using all four teaching (learning) styles.

Application of the Kolb learning cycle to teaching takes effort. It is probably the most effective model for what teaching is all about that I have encountered in the last fifteen years. - Gene Ware of the Electrical and Computer Engineering Department.

SUMMARY

In summary, a unique faculty instructional development program has been implemented within the College of Engineering and Technology at Brigham Young University. Three key elements were essential to the successful implementation of the program. These were: 1) dedicated faculty volunteers who were (and remain) sincerely interested in teaching; 2) strong support from the college Dean's office; and 3) a Teacher Development Committee that served as a catalyst for the effort.

The program was funded entirely by the Dean's office and cost $11,500 in actual expenses. These dollars were spent on 175 man-days of instruction and training of
faculty, a cost of less than $66/man-day.

Renewed interest and enthusiasm towards teaching has developed with the participating BYU faculty. Faculty who are creative, but who have hesitated to bring that creativity into the classroom, now perceive a rational basis for expanding learning activities beyond the lecture, and are encouraged by the systematic nature of the Kolb Learning Cycle to do so. This has renewed their enthusiasm for the educational process and has eliminated much of the formal stiffness in the classroom. Student comments have been positive about the change in teaching strategies being used.