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Title: A Case Study of Course and Faculty Development in College Chemistry in the Philippines

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Abstract

In higher education, a predominant approach to teaching is by lecture where students are passive and most of the time is filled by the teacher or lecturer talking. To address this concern, this paper focuses on the process of course and faculty development in college chemistry classrooms at the University of San Carlos, Philippines. The research aims to increase the amount of work that students do, both in and outside class time. A chemistry course was revised to apply a learning cycle approach in which each class meeting consisted of one or more cycles of three phases: a) a short presentation of new information, b) student work on problems, questions or activities with the instructor moving around the classroom, and c) a plenary summary which includes reactions to learning difficulties encountered by the teacher during phase b. Two instructors, who were involved in the case study, taught the first version of the course. They were coached by the first author who attended almost all lessons within the semester. Analysis of data indicated that only one of the instructors developed teaching skills applicable in this learning cycle approach. Problems on the implementation of the cycle especially by the second instructor were identified and used as the basis for the reconceptualisation of a long term departmental study.

Background and Purpose

This paper focuses on the process of course and faculty development in college chemistry classrooms at the University of San Carlos, Philippines. The aim was to maximise student intellectual engagement following the implementation of a learning cycle approach that consisted of three phases (a) lecture, (b) seatwork activity, and (c) closure or summary. This approach was designed to improve basic teaching skills and to enhance instructors' knowledge of student learning difficulties. Likewise, the instructors' adaptation to the three phases in the approach were analysed together with student perceptions of the teaching approaches in the new course.

The Philippines has an unusually high participation rate in higher education with over 800 colleges and universities offering vocational and degree courses for graduates of the four-year secondary school. However, one significant and longstanding problem in Philippine schools and universities is how to ensure that effective instructional practices find their way into teachers' routines . The absence of a science culture, flaws in teacher training, curriculum and instructional materials and teaching-learning process, are major factors in the low achievement of Filipino students in science and mathematics . The majority of science

teachers, particularly in physics and chemistry, lack subject matter mastery as well as adequate pedagogical content knowledge for effective teaching . The teaching of science revolves around the "chalk and talk", expository and lecture methods, not only in the high school but even in the elementary and continuing in the college level. Results of a small study confirmed that the mode of delivery in college chemistry classrooms was mainly lecture and that students participated passively; further, there was little long-term retention of course material and little stimulation of student interest. Experiences of the Philippine-based authors has shown a number of trends consistent with the above mentioned literature:

- students are passive, 90-100 % of the lesson time is filled by instructor talk;
- alternatives to the lecture method (boardwork, groupwork, reporting, other) are often applied such that most students remain mentally passive;
- the focus in teaching is often on doing standard problems and not on concepts, conceptual difficulties, and the role of context in applying concepts. There is often blind formula work without the conceptual understanding which is needed to realize whether outcomes are sensible;
- students have no books and mainly study from notes taken in class;
- course syllabi may deviate considerably from what is actually taught and tested in the course, the "taught" and "assessed" or curriculum are far from the curriculum as described in the syllabus in terms of level and coverage;
- college teachers in Physics and Chemistry may not be majors in these subjects, even if they are, that is not a guarantee for subject matter mastery at the BS level;
- there is no systematic and sustained effort of instructors to stimulate and maintain student work in the course (the instructor may give homework assignments but rarely checks or uses the assignment in class, thus undermining student dedication);
- sometimes the classroom atmosphere is so noisy that learning seems impossible (engineering classes) but this problem is not officially recognized as a factor contributing to low performance. College teachers often feel that keeping discipline to create a good learning atmosphere is the responsibility of students rather than of the teacher.

It is in this context that the curriculum reform was done incrementally and within the context of the participants involved and their environment. Van den noted that "promoting improvements in conventional teaching may have more effect than promoting sophisticated teaching methods" advocated by current science education research.

Theoretical Framework

The authors' experience working in higher education in the Philippines has provided us with a number of observations mentioned above that delimit the work of college and university teachers and their students. In addition, considerable literature on effective teaching ;; ; provide a practical framework to reconstruct and revise the chemistry curriculum with the intention to engage students actively in the learning process through active teaching.

The direct instruction model was used as the basis for the three phases in the learning cycle approach in the revised general chemistry course. This model has six steps or functions: (1) review, check previous days work and reteach if necessary, (2) present new academic content or skills, (3) provide initial but guided student practice and check for understanding, (4) provide continual feedback and correctives, (5) provide students with opportunities for independent practice and, (6) conduct weekly and monthly reviews. The same steps were implemented by successful teachers in their conventional teaching . Past researches ; had

used this model in the teaching of reading and mathematics but it was in elementary and lower high school level. The three phases of the learning cycle approach were supported by this model.

Steps one and two were combined in the plenary lecture phase of the learning cycle which included a short presentation of new information or a mini-lecture, after the teacher initiated a brief review or check on the last session activities. The second phase, which is known as the seatwork activity, consists of students working on problems, questions or activities with the instructor moving around the classroom, could be implemented twice or more in an hour or 1.5 hour session. The seatwork activity is guided student practice (step 3) after which the teacher gives feedback and corrections, (step 4). This is followed by independent practice by students through homework assignments (step 5). During the guided activity phase, the students applied skills, held discussions with seatmates, while continuing to receive assistance from the teacher who monitored each group. In this learning cycle approach, the seatwork phase can be cyclical and incremental relevant to level of difficulty of lesson content. Finally, the teacher terminates the seatwork activity and conducts a closure of the entire academic exercise (step 4) or discuss the learning difficulties that students encountered.

Dynamic and integrated teacher development models ; ; ; ; ; emphasize desirable teacher behaviour that would explore students' initial understanding, encourage a high level of performance and assist students in learning how to learn. In so doing teachers would have "to struggle with adapting new teaching methods as they attempt to create learning environments most have rarely, if ever, experienced themselves" . Thus the need to put in-place a teacher development program that would continuously inform the teacher and assist them to adapt to such changes.

A variety of techniques have been recommended to enhance teacher's adaptation to more effective teaching methods including a combination of lecture, modelling, practice and coaching were found to be effective in producing desired teacher behaviour as compared to self analysis . Immersion and workshop strategies for professional learning allowed the teacher to engage in activities that are expected of them with their students. Likewise, coaching promotes changes in teachers' pedagogical practices ; , improves teachers' ability to plan and organize classroom activities ;, use effective teaching behaviours , and enhances teachers' ability to employ classroom behaviour management strategies ; .

Design and Procedures

The new version of the first year General Chemistry course was prepared by the researcher during a seminar workshop on course development applying a learning cycle approach, prior to the commencement of semester 2, 1999-2000. Each participant developed a teacher and student manual for a course. The two instructors, involved in this present study, attended the seminar workshop implemented the researcher's new course in two classes of first year engineering students. Each class had 56 students and met for three hours each week.

The revised chemistry course applied a learning cycle approach in which each class meeting consists of one or more cycles of three phases: a) a short presentation of new information, b) student work on problems, questions or activities with the instructor moving around the classroom, and c) a plenary summary which includes reactions to learning difficulties encountered by the teacher during phase b. This approach was designed to increase the amount of work that students do, both in and outside class time.

A plenary is a teacher talk or short presentation of new information - that is typically a lecture. For example, a 60-minute class session might begin with a 15-20 minute teacher-

directed plenary. Simple problems can be presented and solve to illustrate the concept. Although the instructor remains the centre of the classroom, student participation is encouraged through class discussions. Leading questions can be asked to get students involved, guide their thinking about the pertinent chemistry concept, elicit feedback and verify their comprehension. Likewise this phase can be used to conduct a lesson review and reteach a topic when students misunderstand the lesson. The mini-lecture can be combined with an analogy, a story or demonstration, that would prepare the students for seatwork.

The seatwork phase concerned learning tasks for students, where they work on problems, questions, or activities either individually or in pairs. The first few minutes are allocated to guided, individual practice. In this phase, the instructor moves around the classroom to ensure the students are at work, to monitor student learning and spot difficulties or frequent mistakes. Then a student faces a neighbour usually a seatmate) to discuss and apply the knowledge and skills, while continuing to receive assistance from the instructor. Finally, after perceiving that most of the students demonstrate understanding of the content or skill, the instructor terminates the seatwork activity phase by conducting a closure or summary of the entire learning exercise.

The closure or summary involves a 5-10 minute teacher-directed discussion with emphasis on the difficulties, common errors and misconceptions encountered by the students while doing the seatwork/activity. Homework could be given during this phase, or at any time as the need arose.

The two instructors involved were members of the faculty in the Chemistry Department of USC. One instructor was a 25 year old female with five years teaching experience, while the other instructor was a middle aged male with ten years experience in chemistry teaching. Both instructors have a BSc degree in Chemistry; the male instructor holds a MSc in Chemistry while the female instructor is currently pursuing her masters degree in teaching chemistry.

These instructors were assisted by a coach, the first researcher, who attended almost all lessons in the two classes, in developing the teaching skills required in this approach. The "coach" became a partner to each instructor, although the coaching relationship was more on consultative rather than reciprocal. After each classroom visit, the "coach" provided each instructor with a 10-minute session for feedback and suggestions in employing the new instructional strategy. Initially the coach taught the class and in some cases, the coach team- taught with the instructor. Mirroring and modelling can heighten instructor awareness of the teaching approach . Each month within the semester, the classes were videotaped. The science education expert and the Department chairman visited the classes occasionally and gave feedback. All feedback, including video records, were discussed during the group weekly meetings. A two-hour Saturday session was set for discussion on the course material, sharing experiences of implementation and preparation for the following week’s class session.

The course materials were revised with the involvement of many other chemistry instructors. Then the new course was implemented by 14 instructors during the following semester. That implementation process will be described in another paper. This paper limits itself to the pilot implementation.

Both qualitative and quantitative methods of data collection were employed. The qualitative data included classroom observations, video-recording of teaching, record of instructor meetings as well as interviews with students and instructors. Three independent observers viewed the videotapes. The use of teams of people to review visual data can ensure reliability of coding events that one person alone . Validity of data was established using

triangulation method for examining data . Analysis of these data enabled the researchers to establish the effectiveness of the learning cycle in terms of instructor adopting the three phases in the approach, improving classroom management and enhancing instructor knowledge of student learning difficulties.

Results and Discussion

One instructor adopted/adapted the learning cycle approach and eventually developed teaching skills through coaching. The other instructor implemented the learning cycle as the teaching scheme but was unsuccessful because he was unwilling to work on establishing order in his classes. This report focus on the progress made by Instructor 1 in her teaching. The other instructor was only included in this report in relation to the problems of his classroom management which need special attention and could be addressed in future in-service program.

In all classes observed and videotaped, the learning cycle was implemented as the class meeting scheme in the experimental class. Each class meeting consisted of one or more cycles of three phases- plenary, seatwork activity and closure or summary.

The plenary phase consisted mainly of lesson review and a mini-lecture on a new topic. On a few occasions, repeating quiz items or a handout and discussion of homework, were also done in this phase. Lesson review was initiated by the instructor and usually a recall of the previous lesson was done, either by asking questions or simply a description of the previous lesson, followed by stating the learning target for that session. The lesson review was often accompanied by questions from the instructor. A minimum of four questions and a maximum of 44 questions were asked by the instructors, as revealed by the five videotaped lessons. Some questions were answered individually. Most questions were answered in chorus, indicating the questions were of low level. Students rarely asked questions. If a student asked, the question was to clarify or repeat a statement made by the instructor. After a month, choral answering in the class was minimised.

A mini-lecture was a form of plenary where the instructor introduced and described the content topic for the session. For example, the instructor directly enumerated the general properties of salts as made up of ions, having ordered packing arrangements, high melting and boiling points, being hard and brittle, and wrote them on the chalkboard. The instructor described each of these properties by stating definitions and an example for each property.

The instructor also used analogy or a story or demonstration in combination with a short lecture, as suggested in the course manual. For example, an analogy or a story of two entrepreneurs was used in the mini-lecture to visualise the concept of covalent bond, which involves sharing of electrons . Sometimes a mini-lecture was accompanied by instructions on what the students must do, or an unfamiliar activity was performed. The instructor further demonstrated a small part of the activity, or illustrated a part of the seatwork. Showing a videotape, as suggested in the course manual, was also implemented by the instructors and accompanied by question and answer.

In the first two months, the instructor had 50-60 % of the actual time as plenary. This resulted in a shortage of time for seatwork/activity and almost no time for closure/summary. To remedy this situation, the instructor made the unfinished seatwork into homework and had a homework check in the next session. Then a closure/summary was conducted before another cycle was again implemented. By mid-semester the instructor had reduced the plenary to 20-30 % of the actual time.

Video analysis revealed that in this phase there was little evidence that the instructor helped students establish a link with prior knowledge. The recall questions, which mostly called for stating definitions and facts, were used to establish a link between the previous topic and the current topic. No sufficient "think time" was provided by the instructor, as questions came one after the other, even though some of the questions remained unanswered. The lengthy plenary session indicated that the instructor had difficulty in identifying important information to be included in the mini-lecture. Thus there was a lack of clear and concise directions given to the students before an activity was done.

Initially, during the seatwork activity phase, students worked in groups of 4-5 but problems of discipline and time wasting were experienced. Later, the instructor adopted grouping in pairs where students could face a seatmate, whenever a task was to be done in groups. As suggested in the course manual, the instructor gave student tasks which were mostly taken from the textbook. Examples of student tasks were: working on problems on chemical calculations, answering selected end of chapter questions, reporting on group discussion, board work, debate, reading a given handout and critiquing an issue such as global warming, pollution in the community. The most frequently implemented tasks were working on algorithmic problems and answering questions at the end of each chapter in the textbook.

In the early part of the semester, the class was noisy during the plenary phase. Many students did not work immediately. Other students did other things like writing a laboratory report. Some students pretended to work, but when checked, were not on task. The instructor moved around, looked at student's work and continuously interacted, but to the whole class rather than to individual students or small groups. Immediately, one or two top students were called to write answers on the chalkboard, while others were still doing their tasks. An uncontrollable noise emerged during this time, with most of the students stopping their tasks, copying notes from the chalkboard, and others having a chat with a seatmate. As observed, the instructor felt awkward about imposing discipline on the misbehaviour of the students, thus had difficulty keeping the class in order. When this happened, the coach team-taught with the instructor to restore order in class.

The chaos in the class was found to be due to problems such as, inadequate time for students to work on the given tasks, as they were not used to do doing this. They received vague instructions and many students choosing not to work because the activity was not graded. Other students were passive and found it awkward to participate in any group work. During the student interviews, students admitted that they didn't know what to do during group discussion. Others asked, "what is the use of working on seatwork when after a few minutes the answers are written on the chalkboard by top students." The coach helped the instructor facilitate the seatwork phase and monitor the students. Students who were misbehaving and not working during seatwork were identified and called after the class for a brief discussion of their problems. Sometimes a strong warning was given. The class was large (56 students) and the instructor's initial experience in monitoring students individually or in small groups.

After two months of implementation and coaching, the seatwork phase was smoothly implemented due to the instructor's good control of student discipline, adequate time provided for seatwork, clear instructions and students having their own textbooks. Likewise, the instructor interacted with students in pairs and constantly moved around, to ensure that students were actively at work. As a result, more than 80 % of the students were actively at work most of the time. Furthermore, the instructor took notes of errors, problems and difficulties encountered by students and discussed them during the closure/summary.

In the closure or summary phase the initial practice of the instructor was to provide the answers to questions or problems given during seatwork, or an able-student provided the

solution of a given problem on the chalkboard. The instructor either affirmed the students' solution or made corrections. By mid semester, the instructor tried to vary the presentation of this phase. Three or four students took turns in reporting results of seatwork or activity. The instructor began to ask other students to comment on peer answers. Few students were involved in the interaction. However, the instructor encouraged students to interact by acknowledging good ideas or correct answers.

Instructional reinforcement was often conducted during the closure phase; to point out common errors, misconceptions and difficulties encountered by the students during the seatwork phase and further illustrate with examples, to correct errors and clarify concepts. A recapitulation of the activities was rarely done; however, homework was assigned as follow-up for the lesson.

Effective implementation of classroom routines

In the first week of teaching, emphasis was on organizing the class. Objectives of the course and expectations from students were presented by the coach. Ground rules on tardiness, attendance and bringing the textbook to every session, were negotiated and agreed with the students.

Monitoring tardiness

As observed, tardiness was common in both classes. Latecomers disturbed both teacher and class during plenary and group work, because they continually asked questions on topics they had missed. Each session, about 6-10 students came in more than 15 minutes late, despite the university's policy on latecomers. The policy allows students less than 15 minutes late to be admitted. Beyond that, students are registered as absent. A student with more than ten absences can be failed. Interviews with students indicated that one reason students were late was the successive schedule of classes at the College of Engineering. The building is about 150 meters from the third floor of the Science building, where Chemistry classes are held. It is a normal operating procedure that a warning bell is given five minutes before dismissal time. This is to give enough time for the students to transfer from one room to another. Despite these provisions, a substantial number of students keep coming late, mainly because some instructors do not release students on time.

To prevent tardiness in the class, the students and the instructor agreed the door would be closed and that nobody be allowed to enter the classroom after 15 minutes. During the first week of implementation of this agreement, two to three students came in late and insisted on entering. When asked the reasons for being late, they cited traffic congestion, far distance of residence and oversleeping. These reasons were considered invalid by the instructor and so the students were denied entry. The next sessions had no late comers, although the closing of the door after 15 minutes was still the practice until the end of that semester.

Monitoring attendance

The usual practice for knowing the students in a class is to have a seat plan. The seat plan is the basis for checking attendance of the students, usually done at the start of the period. In the experimental sections, the instructor found difficulty in knowing the students by their names using only the seat plan, particularly when seating arrangements were no longer

followed during the group activities. The coach suggested name tags for each student. A nametag was distributed to each student so they could wear it during the class. Each student upon entering the class got his or her name tag and wore it during the session. During the student activity session, name tags were useful in calling to attention students who did not work on the activity immediately. It was also used in recognizing students who were actively and sensibly participating in the activities. At the end of the class, students were required to leave their nametag on the instructor's table, as this served as proof of their attendance in class. The use of nametags enabled the instructor to quickly call the students by name, and monitor student attendance, without resorting to a time-consuming roll call.

Name tags served as one way of monitoring attendance and getting acquainted with the students. However, a problem was identified with the use of name tags. As observed, some students not only got their name tag but also the name tags of friends who were late and probably absent. The coach informed the instructors about this misbehaviour of students and both acted immediately by ensuring students took only their own name tag. In the beginning it was seriously implemented but as the course proceeded, the seriousness gradually declined because the instructors recognized the students.

Checking of textbooks

The usual practice of many instructors in the Chemistry Department was to inform students of the required textbook for Chem 4, by giving the authors' name and title of the book. No effort was made to check the student's textbooks and books were rarely used during classes. As pointed out, it is important to get students to read the textbook and do part of the work ahead of the lecture. In the pilot implementation, effort was made to continuously check that students brought textbooks.

At the start of the semester, students were required to get a textbook. The textbook was required to be brought to every session and a deadline of one month was set for the students to acquire a copy. Within this time frame, the coach explored the availability of the textbook and found that local bookstores were selling at an affordable price. Likewise, the university's textbook department had enough copies of the books for loan within a semester at P 65.00 (about A$2.60), per semester. This was a minimal amount which most students could afford. Moreover, the university science library had four copies: Two were in the reserved section for the students to borrow anytime and two were in the general reference for three day loans.

After the deadline, the instructor checked the books of the students and to her dismay discovered only 12 students out of 50 had books. The instructor was irritated by this and the coach and instructor agreed to remove students, who did not have books, from the class for that day. The action of sending students out was unpleasant for the instructor and coach, however, the risk had to be taken. Otherwise few students would participate during class activities or exercises. In the following class meeting, only three students out of 45 did not have books. From then on, the majority of students brought books to the class, though there were still students who did not follow the class because they forgot or lost their books. The textbook was used in almost every class session for student reference to their exercises and class activities, as well as for study of theory. More time in the class can be then spent on processing new information, rather than transmitting and note taking.

Checking homework

Homework is an outside classroom task given to students for continued and independent practice of skills started during the class and to prepare students for the next lesson. The usual practice was to seldom give homework in Chem 4 courses. If given, homework assignments were used to get the students to read the topics for future discussion. Pre-project observation records showed that the most common homework task was solving problem sets, either provided by the teacher, or taken from the textbook end of the chapter problem sets. Checking the homework was rarely done and most often students did not work on their homework assignments. An interview with several students who had previously attended the same course (repeaters), confirmed this practice and is quoted below:

"*Before I was not motivated to work on the homework. My teacher didn't check them. Sixty percent of my homework assignments done were copied from classmates and sometimes I let my classmates copy from me. Anyway, the teacher never read nor discussed the homework. Now, the teacher gave homework every session. The teacher had different ways of checking the assignment; either through a short quiz, random checking in notebooks or passing them on paper."*

Rayner 22/02/00

As noted by the student, the course manual developed for Chem 4 had homework for every session which included reading certain pages in the textbook/references and noting down definition of terms, solving exercises at the end of the chapter in the textbook and answering practical questions in preparation for a class debate. There were two ways employed by the two instructors to check the assignments. One way was to give 5-10 item quizzes on definition of terms or a brief description of a concept. The quiz results showed that no student in both groups got the correct answers in all the questions given. Few students (13 out of 38) got a partially correct answer. Partially correct means that key words were present but the logical presentation of the idea was missing. Another way was to ask the students to write their assignment and submit it, after which a follow-up discussion was given by the instructor. However, the follow-up was seldom undertaken by the instructor.

Maintaining order in the classroom

Instructor 1 had initial difficulty in controlling the class, particularly on the shift from plenary to activity and vice versa. Students tended to be noisy and chaotic during the seatwork activity and continued in the same way during the plenary and closure sessions. To control the behaviour of the students the instructor set ground rules for participation during an instructor-led plenary and closure phases. For example, she would not start the discussion until the students were in order and quiet. Another was raising hands when a student wanted to answer and listening carefully when somebody was talking.

In the seatwork activity, two strategies were tried; one was to illustrate a part of the seatwork to the class before pair work began, the other was to circulate immediately around the room and make periodic checks on individual student progress. These procedures worked against students engaging in off-task behaviour, and enhanced instructor-student interaction.

Managing transition was the most difficult task that the instructor had handled. One common transition problem was when students stopped working long before the allocated time for seatwork activity had ended and then engaged in excessive talking, left their seats to socialize or wander around the room. Some students stayed in their seats but worked on

assignments of other courses. The instructor's solution was to continuously moved around the room, check student activity notebooks and give corrective feedback. Then the student was required to discuss his/her work with a partner or seatmate without leaving the seat. Likewise, the instructor explicitly reprimanded, sometimes confiscated the paper, of students working on assignments for other courses.

Discussion and Implication

The purpose of the pilot study was two-fold; First, to clarify whether the new course structure could maximize students' intellectual engagement. The corollary of this was the feasibility of implementing the learning cycle as the teaching scheme for the Chem 4 course. The second goal was to discover how the instructors would adopt the new course, to examine problems associated with its implementation and to recommend a faculty development program that would best fit the current conditions of the University.

The initial implementation of the new Chem 4 course gave a powerful learning experience to the successful instructor and the researcher. The course manual was lauded for its detailed sequencing and logical arrangement of topics. The inclusion of practical applications was highly accepted and instructors recommended that each topic must include practical examples related to the subject matter being taught. The first revision of the course included these recommendations.

The use of the learning cycle as the teaching scheme not only increased student engagement, but also improved the instructional skills of the instructor. Instructor 1 began with a feeling of inadequacy in her teaching because she was unable to master the sequence of events stated in the course manual. She also felt awkward in her teaching because she lacked the necessary teaching skills to facilitate the new approach, particularly condensing information for a mini-lecture, managing engagement of students, monitoring and assessing student work and giving relevant feedback and controlling behaviour of students during shifts between phases. In her long lecture mode of instruction, the instructor did not learn skills of checking textbooks, monitoring student tardiness and attendance, homework and maintaining order in the classroom.

Instructor 1 was strongly committed to being a learner. She realized that shifting her role from a lecturer to a facilitator seemed difficult but she recognized the need to master the basic teaching skills first, before moving on to a complicated and wide ranging teaching repertoire. Learning these skills came with ease, due to adequate support extended by the "expert coach". Empirical observations by the authors verify this improvement of Instructor 1's teaching skills. She used a variety of approaches in well organised lessons in which student participation was facilitated and encouraged. Students reported that the "classroom atmosphere helped them focus on their work and identify problems that could be helped by the instructor" . None of the students indicated desire to return to only the lecture mode. Although the textbook was an international edition students reported approval of it and found it very interesting. As a result of learning the new methods of teaching Instructor 1 was confident enough to handle the course during summer classes, with 14 other instructors in the Chemistry Department taking turns in observing her class over a period of five weeks.

References