DIRECTORY OF TEACHING INNOVATIONS IN CHEMISTRY

L. R. MEETH

DEAN S. GREGORY

PUBLISHED BY
STUDIES IN HIGHER EDUCATION
IN COOPERATION WITH THE DIVISION OF CHEMICAL EDUCATION OF THE
AMERICAN CHEMICAL SOCIETY

DIRECTORY OF TEACHING INNOVATIONS
IN
CHEMISTRY

L. R. MEETH
INTERNATIONAL GRADUATE SCHOOL

DEAN S. GREGORY
INTERNATIONAL GRADUATE SCHOOL

PUBLISHED BY
STUDIES IN HIGHER EDUCATION
4201 S. 31ST STREET, SUITE 342
ARLINGTON, VIRGINIA 22206

This Project Was Made Possible By a Grant

from the

EXXON EDUCATION FOUNDATION

4201 South 31st Street Suite #342

Arlington, Virginia 22206

CONTENTS

Identifying Innovations in Teaching

There is a great need to facilitate communication between people who want to improve teaching. In most academic disciplines, communication about research and scholarship is maintained by professional journals and other information systems, but dissemination of information about teaching has been almost non-existent. Studies in Higher Education received a grant from the Exxon Education Foundation to survey innovative undergraduate teaching methods, courses and programs in several disciplines, and to publish a compendium of findings. The objective of the grant is to provide each of us who works in the field access to individuals and programs to assist us in improving our teaching.

We have tried to assemble a considerable amount of information about innovative teaching and distribute it widely in a relatively short period of time. It will be obvious that this is not intended to be an authoritative treatise on teaching, but rather a readily useable reference work.

We constructed a questionnaire on innovative teaching practices and mailed it to nearly 3,000 chairpersons of undergraduate programs in the United States (including two-year institutions). The responses from our survey constitute the core of this directory.

In attempting to define "innovation" as our subject of study, we start with the idea of something "new", but then must ask, "New to whom?" Our practical response has been, "If a practice is new and innovative to the person doing it, it is likely that it will be new to some others as well." Even "old" ideas might be reconsidered by those who for lack of opportunity or institutional support in the past may now be predisposed to try out a "new" idea.

The directory is intended to be functionally descriptive rather than evaluative. An idea need not be entirely successful to be reported, for what does not work in one situation/institution might very well work in another context. While our resources constrained us from providing any evaluation of programs, most of the innovators gave some evaluation evidence, and many others discussed the problems and pitfalls of their efforts. By publishing all survey responses we can give attention to ideas that, upon modification/revision, might prove worthwhile in many institutions beyond their point of origin and without regard to their degree of success.

The category system used here to describe innovative activity was adapted from a system developed by Dr. Richard Johnson of the Exxon Education Foundation, and from the Teaching Reports published by Change Magazine. The idea for the directory came from the experience of James B. Maas of Cornell University who developed the Yellow Pages, which attempted to survey all areas of undergraduate instruction and the Directory of Teaching Innovations in Psychology which is the prototype for this directory.

In compiling the directory, we have noted several trends. One of the most salient seems to be an attempt to make the content of the discipline more meaningful and useful to the student's own life; to provide information and techniques for analyzing one's own phenomenological world. Another trend is the individualization of instruction, making it more effective and efficient for the heterogeneous student groups of today. With regard to the latter, Dr. Fred Keller's Personalized System of Instruction (which is described in some detail further on in this directory), was by far the most commonly mentioned innovative approach utilized.

We hope that this directory will encourage a higher level of willingness to experiment with alternatives in teaching. Increasing professional pressures suggest that innovative/improvement efforts will take place only to the extent that they are supported and encouraged by department chairs, administrators, and those colleagues who are also taking "risks" in changing from traditional ways. Shared responsibility and commitment for improving teaching should lead to progress where individual efforts have failed.

As this volume goes to press many new ideas are being implemented and many others continue to go unrecognized. This directory is meant to be a starting point.

Arlington, Virginia
September, 1981

L.R. Meeth
Dean S. Gregory

How to Use This Directory

As indicated in the table of contents, this directory is divided into two major sections: the first specifies the various categories of innovations and the second consists of descriptions of the innovations themselves. In the first section, each category definition is followed by a list of the titles of innovations falling into that category, together with the page number where the detailed description for each innovation can be found. In the second section, each detailed description appears on the front side of a page, with the relevant biographical and institutional information for that innovation on the back.

If you are interested in a particular kind of innovation:

1. Check the table of contents for the various categories.
2. Read the category descriptions in the text to better determine the nature of the innovations listed in that category.
3. Read the listings following the most appropriate category description, turning to the pages corresponding to the titles of most interest to you.

Example: You have an interest in the use of audio-visual materials; in the table of contents under"Use of Various Media." Read the description to verify that you are in the right place, and then refer to the listings that follow.

If you are interested in innovations within a particular content area:

1. Check the table of contents for the location of the particular content area.
2. Check the "All Fields" and "Multiple Listings" Pages for material which may have relevance for that content area.

Example: You are interested in innovations in introductory chemistry; in the table of contents find the pages associated with "General Chemistry" and those associated with"All Fields" and "Multiple Listings," checking these latter two for innovations which have relevance for introductory chemistry.

We recommend that readers do not limit themselves to looking only at their own area. By consulting the "All Fields" and "Multiple Listings" categories, and even other subdiscipline sections, it is likely that something of value might be found.

Perhaps most important, one should use this book as a notebook and phone book. Write in it, make comments, and add relevant information to it. Call or write an innovator for more information or just let him/her know that you share an interest. We sincerely hope this volume will work for you.

The innovations in this category deal with new courses and new approaches to traditional courses. They respond to the questions, "Where else can the discipline go?" and "How are knowledge and experience best organized?" Included are modifications in traditional courses, modifications in the major sequence, new topics, and interdisciplinary courses.

Modifications of a Traditional Course

Instructors are finding better ways to structure the old content areas. By modifying the topics or material covered or by rearranging the order of presentation, the structures of knowledge are reexamined and new perspectives are gained. (Although modification of the unit structure is an integral part of PSI courses, these changes are more instructional than curricular and are identified in other categories.)

Modification of the Major Sequence

Changes in the major represent a reevaluation of the best way of transmitting the dicispline.

New Topics

New courses represent a need to look deeper into selected topics. As knowledge is expanded in new directions, the evolution of related courses of study and specializations is inevitable. Problems arise in identifying instructional resources in the new areas and thus communication between like-minded professionals is essential.

Interdisciplinary Courses

Interdisciplinary courses are a recognition of the shared concerns of different disciplines. Curriculum decision makers frequently assert that greater intellectual benefits are derived from courses which treat knowledge from allied fields simultaneously than from those courses which treat ideas in disciplinary isolation. Another perspective is that of problem-centered education which joins disciplines in attacking some problem or issue.

Among the problems associated with interdisciplinary course are finding appropriate reading material and, to the extent that team teaching is involved, developing a common language and working rapport among faculty members from several disciplines.

METHOD OF CONTENT DELIVERY

While curriculum innovations deal with what is taught, the question of how the content should be presented is quite a different matter. The limitations of the lecture presentation have long been known. In instructor-centered teaching it remains the most popular vehicle for information transmisson, but other modes are being used to supplement, or in some cases replace, the lecture.

Use of Various Media

The use of various media, such as films, slides, videotapes, and audio recordings, enable many students to gain insights and experiences rarely possible from the traditional lecture. Since recorded phenomena can be presented repeatedly (generally at the teacher's and/or student's convenience),experiential learning can be combined with instructional flexibility,

The use of media can also be effectively combined with other instructional techniques. The audio-tutorial approach utilizes slides, film strips, tape recordings, etc., in providing self-paced, modularized instruction.

To accomplish the one-way transmission of information, instructional media can be effective substitutes for some types of traditional teaching. This is particularly true when qualified instructors are not available, or when the traditional format of instruction is not appropriate in view of the learner's special circumstances (e.g., instructional television for remote areas, courses by newspaper). The use of tapes, films, or slides may also serve to free instructors of large lecture courses for more personal interaction with their students.

Users of media claim that the involvement of different senses in receiving information leads to a more integrated understanding of a given topic.

While the potential for using computer systems has been recognized for some time, the development of this potential has proved to be more difficult than was originally expected. Only recently have computer-related procedures been widely employed across different disciplines and content areas. This utilization includes simple drill on content, record keeping, assessment of student learning, training in specific skills, individualized presentation of instructional material, and opportunities for trying out new learning with immediate knowledge of results.

Though frequently used for administration and evaluation purposes, the greatest innovative value lies in the improvement of instruction -- both actual and potential. Because a computer can be programmed to make decisions in response to student actions, computer-related procedures offer the real possibility of moving beyond the limited features of programmed instruction or teaching machines. In recent applications, students use a typewriter keyboard at a remote terminal to interact with the computer and the computer responds with either printed messages or images on a TV-like display device. A program, frequently written by the innovator, determines how the computer will respond to each student input. Such a system allows for considerable flexibility in both student and computer responses.

Computer-related techniques can serve as adjuncts to other innovations. For example, the presentation of a module can be controlled by a program which activates peripheral devices such as films, slides, or videotapes. Computers are also useful for complex simulations and games which involve students interacting with each other or with the computer through remote terminals. This is particularly effective when students must utilize a great deal of data which the computer can easily store. This characteristic, of course, makes the computer useful in any context in which large amounts of information need to be processed and easily retrieved.