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ABSTRACT

This paper discusses a college-level course o contemporary topics in science offered to non-science majors a the State University College of New York. The authors examine the objectives, methods, and various student groupings utilized in the course, investigate why it has been successful, and make recommendations for courses of this nature. The major course objectives are: (1) to take an inter-disciplinary problem-centered approach to teaching and learning, (2) to identify and solve the problem in a humanistic way, and (3) to have students discover and use scientific literature in order to foster scientific literacy and informed decision making. Considerable emphasis is placed upon the practical aspects involved in offering the course, such as selection of topics, preparation, ways of dealing with current topics that continue to evolve, utilization of resource persons, and motivation. An appendix provides two lists of suggested topics for discussion. The first list consists of 36 items edited from student proposals, and the second provides 25 teacher-developed discussion topics. (JR)

CONTEMPORARY TOPICS IN SCIENCE: A Kit for Survival

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As an outgrowth of the widespread student unrest on college campuses several years ago, science faculty scrambled about trying to be more "relevant." With the "return to normalcy" that we've seen over the last two years, most of these "Science for Poets" courses have quietly passed away from faculty disinterest. One such course that is still thriving is called "Contemporary Topics in Science," taught by members of the General Science Department at State University College at Buffalo.

We would like to investigate specifically why we have been successful. We will examine the objectives of our course, the methods and various kinds of groupings utilized, and some recommendations for courses of this nature.

OBJECTIVES

The knowledge explosion has been much in evidence. The sciences have undergone more than its share of rapid transition. Certainly, science has had an increasing impact upon day to day modern life. But often education does not keep pace with the most recent scientific and technological revolutions almost causing a "cultural mutation."[1]

Taking into account the knowledge explosion and the impact of science on modern life, our course objectives have been: (1) to take an interdisciplinary problem-centered approach to teaching and learning; (2) to identify and solve the problem in a humanistic way; (3) and to have students discover and use scientific literature in order to foster scientific literacy and informed decision making.

*Problem-centered Approach

The problem-centered approach consists of expanding the learner's breadth and depth of insight into some of society's problems, and increasing his competence in identifying, defining, and solving these problems. The problem (pollution, population, resources, energy, food, etc.) is not limited by any set of concepts within a definite discipline (biology, chemistry, geology, sociology, etc.). The question the teacher and student must ask of themselves is: "What concepts can we bring forth to clarify and perhaps solve the problem?"

When an individual looks at a problem, he finds it existing within the context of his environment. For example, the problem of population control has cause and effect relationships to almost all of man's basic endeavors. In approaching the population problem, the individual may need to identify and use processes and concepts taken from many disciplines; i. e., interaction, valuing, religion, chemistry of reproduction, energy transfer, predicting, limiting factors, feedback, mathematical probability, population density, etc. A specific course in chemistry or physics simply cannot address itself to this problem without awkward fragmentation.

If we truly have a problem-centered approach, then the only culminating activity should be the proposal of solutions to the problems. Although many of these solutions are either tentative and/or highly theoretical, these solutions represent an element of closure, a kind of psychological feeling of finality of purpose. The function of such an approach is to prepare individuals to think and learn on their own and to be self-motivated in doing so.

*Humanism

In order to identify the problem in a humanistic way, the students collectively must have a voice in the choice and planning of the problem-unit. The underlying assumption is that if the students have a "piece of the action" in selecting and planning the problem-unit, then it is also their responsibility to contribute to its success. Humanistic also means making the unit life-centered, or meaningful, on both intellectual and emotional bases. We are not only concerned with accomplishing mastery of concepts within the cognitive domain, but we are vitally concerned with the changing of old attitudes and formation of new values, interests and attitudes within the affective domain. Experience in successful problem solving fosters self-confidence and shows the student he is capable of understanding and resolving social problems through science and technology.

*Scientific Literacy

The "Contemporary Topics" course facilitates scientific literacy through a critical analysis of both popular and pure literature related to the specific problem pursued by the students.

Both popular and pure literature are utilized by the students in forming an informational or positional basis for the contemporary problems they pursue. Since popular literature is often written from a positional or prejudicial point of view, the students are encouraged to identify the position of the authors and how it bears with the facts. It becomes obvious, however, that both pro and con proponents on an issue base their claims on the very same facts or studies presented in pure literature. Pure literature, on the other hand, is expected to be free of prejudice and can often be cross-referenced or duplicated. A limitation of most pure literature is the lack of generalizeability of the results of studies that it reports. Students learn to determine whether or not the pure literature supports the points of view proposed in the popular literature.

Essentially the student learns to read between the lines. Hopefully as a citizen, he can make many other important appropriate decisions concerning his future. Such decisions are often based on the individual's ability to read and listen in a discriminating way. Once a student learns the power and enjoyment of discriminating reading, he is often motivated to read contemporary literature in his leisure time in an effort to keep aware.

We find ourselves in complete agreement with Earl J. McGrath in his advocacy to "Bring Back General Education,"

> "The method of approach to curriculum construction that I am proposing - organizing study around the problems to be solved, rather than making up patchwork courses from subject - is by no means novel. It derives from John Dewey's ideas that education should begin with real situations, that knowledge ought to grow organically, and that interest and effort arise out of the learner's advancement from the familiar toward the unknown, from the concrete to the abstract."[2]

Methods and Grouping

The kinds of methods used in teaching this course reflect the types of groupings that we've experimented with. The relationship between grouping and methods is an organic association. That is, the size and needs of the group generally dictates the kind of methods that will be utilized.

The course has been taught using various grouping arrangements. (1) Small groups of thirty meeting separately one hour on a twice weekly basis. The small groups are combined, one hour per week with one to six other small groups, into one large group ranging from 60 to 200 students. (2) Large groups (between 40 and 200 students) meeting three single hours per week. In some cases, we have combined two instructors (Instructor A having two sections, Instructor B having three sections) into a team teaching situation. We have also attempted making one instructor the "Large Group Coordinator," being only responsible for the one combined section per week. (3) Small groups meeting twice weekly for one hour each session. (4) Small groups meeting twice weekly for one and a half hours per session.

*Large Group Methods

The methodology that has grown out of these variations has been equally as varied. The large groups have been limited primarily to the lecture method with a great deal of visual material in the form of overhead transparencies, slides, short movies, video tapes and teacher demonstrations. However, in a somewhat untraditional mode, guest lecturers and outside resource people have been extensively utilized.

*Small Group Methods

Within the context of the small group, the following student centered methods were used: discussion, reports, interest groups, projects, demonstrations, simulations and experimentation.

Student discussion was the dominant method used. The more successful discussions dealt with problems of high personal interest. Prior reading and directed experiences were essential for an informed approach to the discussion. Documentation, dependence upon critical thinking and evaluative behaviors were elicited by fellow students and instructors alike. As the semester progressed, students questioned each other and interacted profitably with little faculty initiation. Certainly, the advantage of discussion is that a problem may be pursued as the participants deem appropriate. The group essentially verbalized their own logical "thinking through" of problems. In some cases, students and groups of students made reports to the class as a whole. Book or textual reports were generally less successful than reports of visitations, interviews, projects or creative application of the students own skills and background to a problem. If the group was not interested in a specific presentation, then arrangements were made either for presentation to the instructor or to an interested audience. Techniques, such as role-playing, simulations and gaming also proved highly successful.

*Identifying Topics

Perhaps the most innovative factor in our "Topics" course has been the methods used in the topic selection. The pupil-teaching planning process has been extensively used in the selection process.

> "Pupil-teacher planning is far more than as sometimes satirized by critics, the teacher's asking pupils: 'What do you want to do today?' Skillful guidance of the planning process is probably the most difficult and most important of all teaching tasks... Each planning period must be so conducted as to identify appropriate purposes, to select activities which seem likely to serve curriculum goals, to base decisions on full understanding of alternatives, to keep plans on a flexible basis, and in general to encourage meaningful discussions and effective decision making."[3]

The Key to pupil-teaching planning is doing it on a continuous basis. The selection of topics is only the first step. Yet it represents the step that establishes mutual trust between students and teacher. The process of topic selection might be as simple as passing out blank paper and asking the students to indicate topics which they feel might be interesting and at the same time germaine to science. As a result of this specific process, the edited list in Table 1 was developed. The editing involved the identification and organizing of topics and their sub-topics. (Insert Table 1)

Other selection processes might include the teacher coming in with prepared or partially prepared listings to which students volunteer additions. (See Table 2 for such a list). It is worthy to note, each semester some new, unexpected problem-units are proposed by students. As a result, the curriculum can always remain contemporary. (Insert Table 2)

Recommendations

As a result of teaching this course over six consecutive semesters, we have learned a great deal. For those science instructors who might be interested in developing an offering of this kind, ~~or for~~ those who are still struggling, we offer what we consider to be some good advice. There is no reason why man must rediscover the wheel each generation. Our most basic recommendations are to: (1) defer the choice of the selection of topics; (2) identify and utilize good resource people; (3) offer optional discussion sessions; (4) adapt the traditional teacher role.

*Selecting

In selecting topics a good deal of trust and good faith must be felt between students and instructor. Generally, you can come to quick agreement on one problem-unit (i.e., Over-population). We have found that once "you get into" your first unit, mutual sincerity of purpose is manifested. After about two or three weeks, the students seem to be a lot less "uptight" about the professor "playing games" with them. If possible, defer the choice of the remaining topics until this trust is working.

You cannot please all of the people, all of the time. But one can try! If one is pupil-teacher planning openly with his students, then one maximizes his chance towards consensus. If half the class is opting towards a "birth control" unit and a sizeable number towards a survey of "human sexual responses," why not offer to combine these units into a maxi-unit! Give dignity to all student proposals by placing them on the list. Bring up time considerations and whether you have sufficient time to thoroughly investigate all your proposed units. A sincere working through the pupil-teacher planning process, we contend, is working towards consensus and is another valuable experience in problem solving.

The instructor should not be tempted to order the topics as a result of his personal need for preparation time - that is, to place the topics he is unprepared to teach toward the end of the semester. Care should be taken to organize the sequence of selected topics logically with reference to the interactions between these topics.

Unfortunately, not all topics are successful. Most often these are topics that have been beaten to death in popular literature. As in the case of drugs, the topic has often been preached about but seldom handled responsibly. Areas that require in-depth scientific preparation are also generally not successful. Some faculty also feel uncomfortable teaching topics for which there is little definitive scientific evidence available, and as a consequence of this discomfort, the topics do not go over well (e.g., E.S.P., C.B.W., effects of marijuana).

Whether a topic is germaine to the science class is often questionable. Both student and teacher should discuss the criteria for appropriateness of topics to science. Topics that are obviously non-scientific, are immediately eliminated from discussion in such a science course. However, there are times when non-scientific issues possessing some scientific bases are considered. For example, Women's Liberation may be discussed relative to the concept of birth control. Some "quasi-scientific" topics might also be considered, but primarily as a means for the student to test the processes used in providing supportive evidence. Specifically, methods used to support or develop the concepts of E.S.P. can be discussed. Knowledge of the concepts of E.S.P. itself come only as a by-product of the discussions of methodology.

*Resource People

Resource people either from the outside community, or an insider from your own institution can provide varying perspectives on the problem-unit being considered. Such expertise can lend knowledge, or in a more general way, break up the routine. It might take a certain amount of resourcefulness to identify effective resource people. From time to time, you do get a boring speaker, so its back to the telephone! Fellow faculty often give you leads to friends and acquaintances. The yellow pages of the phone book can be quite helpful. Resource people sometimes are identified through unique avenues. A faculty member's wife's gynecologist has been tapped repeatedly; the medical director of a local methadone treatment center, the president of the local Mattachine Society, a local anti- abortion group, a team from an abortion clinic, a Congressman, State and local governmental officials. The development of audio or video tape files of the speakers is also helpful when a speaker cannot attend one particular semester.

*Optional Discussions

The large group system where the instructor is meeting his students in groups of forty or more, tends to cripple the possibility of discussional interchange. The attitudes and values that come into focus as the result of discussion are too important an outcome to sacrifice. It is suggested that if the instructor is willing to give of his time, that he establish optional discussion hours and a discussion place, where all students are invited. A lunch hour is a good idea. It is also suggested that no extra credit or other consideration be established for those attending, nor penalty for those unable or unwilling to attend. It is quite an experience operating a group without the compulsory element that makes them a captive audience.

*Teacher's Role

Some instructors have adopted a new role of moderator rather than instructional authority. We have found that one cannot be an expert in each subject field. However, if the students group into panels in the small groups, then the students inherit the initiative of searching the literature and preparing the instructional content and materials. The instructor becomes a questioner, a clarifier of ideas and a guide to new ideas and approaches.

Each of these recommendations have been tried by all or some of our instructors. For the most part they have proven effective toward the improvement of our instruction.

CONCLUSIONS:

We have identified both a need and a demand for a high-interest, general-liberal science course. Certainly, this need and demand are almost universal in college science curricula. If one is still struggling for philosophical rationale for the existance of a Contemporary Topics course, then we feel we have offered a viable recommendation for a problem-centered, humanistic, process oriented approach.

Please do not accept our recommendations as prescriptive. Our accent has been upon flexibility, not blueprinting. The one emphasis we do wish to advance is that our experience with pupil-teacher planning has been extremely positive. Depending upon your individual setting, this type of democratic process might be attempted, providing a sincere commitment to "relevant" education still exists.

Let's not fall victim to the fatal condition of not being true to one's own convictions. The key to survival lies within one's own ability in remaining consistent with one's ideals. Perhaps one will find that our "kit" represents a rededication to that more humane curriculum.

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2. McGrath, Earl J. "Bring Back General Education." <u>Change: The Magazine of Higher Learning</u>. Volume 4, Number 7, September 1972, p. 9.

3. Saylor, J. Galen and Alexander, William M. <u>Curric[illegible] Planning for Better Teaching and Learning</u>. Hc[illegible]art and Winston, New York 1962, p. 440.

TABLE 1

Edited Student Proposed List
February, 1971

1. Pollution (Check those which interest you most)

   Air
   Water
   Solid Waste
   Noise
   Automobile
   Economics
   Pesticides
   Industrial vs. Municipal
   Legislative alternatives

2. Overpopulation

3. Population Controls

4. Drugs (Check those which interest you most)

   Hard
   Soft
   Alcohol
   Tobacco
   Treatments

5. Space Exploration (Check those which interest you most)

   U. S. Space program
   Life on other planets
   Suspended animation
   Moon rocks

6. Evolution

7. Genetic engineering

8. Food engineering (Check those which interest you most)

   Starvation
   Food and Learning

9. ESP

10. Synthetic hormones

11. Transplants

TABLE 1 (Continued)

12. The atom (Check those which interest you most)

    Nuclear war
    Nuclear medicine

13. Biochemical warfare (Check those which interest you most)

    Nerve gas
    Defoliants
    Napalm
    Tear Gas
    Morality

14. Another Ice Age

15. Animal Behavior

16. Astronomy

17. Natural Disasters (Check those which interest you most)

    Earthquakes
    Volcanoes
    Tornadoes
    Hurricanes

18. Cancer Research

19. Computors

20. Utilization of Resources (Check those which interest you most)

    Land
    Food
    Housing
    Minerals

21. Reincarnation

22. Birth Defects

23. Oceans (Check those which interest you most)

    Utilization for water
    Utilization for living
    Utilization for food
    Utilization for minerals

24. Disease breakthroughs

TABLE 1 (Continued)

25. Geriatrics

26. Weather control

27. Potential energy resources

28. UFO's

29. Science and religion

30. Parasites

31. Sexology

32. Probability and chance

33. Urban congestion

34. Transportation problems (Check those which interest you most)

    S S T
    Mass transportation problems

35. Conservation

36. Lasers and Masers

TABLE 11

Teacher Developed List
February, 1970

1. Extraterrestrial landings and observations
2. People pollution
3. Population controls
4. Huge supersonic aircrafts
5. Organ transplanting
6. Remote sensing (e.g., infrared radiation)
7. Environmental pollution
8. Disalinization
9. Sea farming and sea inhabitation
10. Plastics, alloys and glass at present and in the future
11. Space, time and relativity in the space age
12. "The expanding universe" and the Red-Shift
13. Psychiatric drugs
14. Scientific evidence on "Pot" and drugs
15. Scientific evidence on smoking
16. Rebirth of the atom
17. Laser and maser applications at present and in the future
18. Useful radiations
19. Color TV tubes
20. Cosmic radiations and space travel
21. Power reactors and problems
22. Radioisotope tracer therapy and nuclear medicine
23. Nuclear weapons - peaceful utilization
24. Radioactivity in everyday life
25. Applications of space technology