Term Paper/Poster Session Project: Evolution of a Learning Tool in Medicinal Chemistry[1]

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Increased focus on the achievement of outcomes related to communication, interpersonal interactions, critical thinking, and life-long learning demands that innovative instructional tools be developed and implemented. These endeavors are often time-consuming, frustrating and risky; however, success is extremely rewarding not only for the students, but for the professor as well. This article describes a project that has been used in the medicinal chemistry course at Albany College of Pharmacy (ACP) for the past three years. Modifications have been made in both method and purpose based on annual assessment data. What began as an unpopular assignment for the fourth year students has become an event anticipated and enjoyed by many of the ACP community, including the students. The following manuscript gives a detailed description of the project in its current form, and the evolutionary process leading to its success.

INTRODUCTION

The focus of pharmaceutical education is changing, as highlighted by Background Paper II(1) of the Commission to Implement Change in Pharmaceutical Education, and addressed during the 1996 AACP Institute for Pedagogical Change[2]. Formerly the major concern of a professor was to "get through" a certain amount of material in a designated number of hours. The implicit assumptions were that the students would "learn" what was presented, and that they would subsequently be able to apply what was learned. Our perspectives have broadened; we now also are concerned with developing performance abilities that will enable our students to comprehend, apply, analyze, synthesize and evaluate information in addition to recalling facts (based on Bloom's taxonomy), both within specific courses and across disciplines. Furthermore, we expect our students to develop abilities for communication, social interaction, and life-long learning(2). The desire to achieve these lofty goals in classes of more than 100 students calls for creativity on the part of the instructors. Described herein is an assignment that has been used to address these issues in medicinal chemistry at ACP.

Medicinal chemistry is a required course sequence consisting of two three-credit hour segments, offered in the fall and spring semesters of the second professional year. The typical class size is 125 students, taught by one instructor. This report details an assignment that was created to facilitate coverage of all of the major drug classes, and the prerequisite theories for drug development and drug action, within the framework of a six credit-hour course sequence. The main goal, initially, was to increase course content. In the three years since its inception, an evolutionary process has taken place in response to data from our own assessment tools, and outside influences promoting pedagogical reform. Increased content is no longer the focus; in fact it is no longer an objective. More important is the promotion of ability outcomes such as critical thinking, communication skills and cooperative teaching/learning

The assignment consists of a short term paper and a presentation at a public poster session. What follows is a detailed description of: (*i*) the assignment in its current form; (*ii*) objectives; (*iii*) assessment tools used to measure achievement of objectives; (*iv*) modifications that have been made to the assignment over the past three years; (*v*) the effects of the modifications on achievement of outcomes; and (*vi*) plans for the future.

THE ASSIGNMENT

The project is a two-part, group assignment in which the students are required to: identify a new drug or new drug target, evaluate the pertinent literature, and present their findings in both oral and written formats. The written requirement consists of a five-page (single-spaced) summary detailing important aspects of the selected topic. The oral presentation is in the form of a poster session which is open to the entire ACP community.

The assignment is introduced on the first day of Medicinal Chemistry I. A one-page description (Appendix A) is distributed and students are instructed to work in self-selected groups of three or four. Research topics are identified and selected by the groups with the understanding that: (i) "new" products are those that have been on the market for less than one year; and (ii) no two groups may research the same topic. Groups may sign-up without a topic initially and topics may be changed at will throughout the semester.

The description of the assignment is intentionally vague in order to stimulate critical thought. The students are given a hypothetical situation in which they have been appointed to an advisory panel on the Pharmaceutical Affairs Committee of US Senator I. M. Important. Senator Important is up for re-election and has asked the panel to identify a new drug or drug target that he can promote in a bid to gain public support for re-election. The panel is to provide the Senator

[1] Manuscript based on a submission to the 1997 Council of Faculties Innovations in Teaching Competition.

[2] AACP Institute for Pedagogical Change, Williamsburg, VA, June 1996. American Association of Colleges of Pharmacy, Alexandria VA.

with a brief synopsis of the topic; the students are cautioned to cover both pros and cons so that the Senator will be prepared to answer pointed questions from the media. Also, the panel is required to participate in a briefing session (poster session) in which the Senator and his closest advisors can be apprised of all important aspects of the new technology. No specific instructions are given as to the type of information that should be included in the report.

Since the project is a team effort, only one paper and one poster are required per group. The written reports are due approximately nine weeks after the assignment is announced; poster sessions are held during the tenth week. There are two poster sessions, the requirement being that each student in the group participates in one of the sessions. A maximum of two students per group may present at any one session to ensure active participation by less assertive students.

Many students are unfamiliar with the concept of a poster session, so more guidance is given in this area. Three weeks prior to the event, about 20 minutes of class time is spent discussing the objectives and desired technical aspects of a poster. The students also get a pep talk on how to prepare for the forthcoming discussions. They are given reassurance that a conscientious effort toward the assignment has made them resident "experts" on their chosen topics and that they should take pride in their ability to educate fellow students and faculty members. The students typically do not work on the posters until one or two weeks before the due date, so the late timing of these instructions is appropriate.

All medicinal chemistry students, whether or not they are presenting, must attend at least one of the poster sessions each semester (as a member of the audience), in order to learn about the new drugs. The poster sessions are held the week before the last hourly exam in the course; students are given advance notice that the exam will contain a 10-20 point question requiring in-depth knowledge of the subject matter from two posters of their choice.

A typical medicinal chemistry section consists of approximately 125 students. For logistical reasons (to decrease strain on library resources, reduce grading load, and limit the space requirements for the poster session), half of the class completes the project in the fall semester and the other half does it in the spring. Semester designations are made on a voluntary, first-come basis. A sign-up sheet is posted on the first day of class; once all of the spots are filled, the remainder of the class must wait until the spring. The instructor reserves the right to assign students to groups by lottery if there are group openings after two weeks of elective sign-up. To date, there has been no need to exercise this option, nor has there been a situation in which students were unable to find a group.

OBJECTIVES

The objectives for this project are divided into two categories, those pertaining to the participants (the students completing the assignment) and those pertaining to the audience (faculty and students attending the public poster sessions).

Objectives for Participants

Practice Cooperative Teaching/Learning. "Lifelong learning is critical for survival and progress in a rapidly changing society and health care system."(4) In order to fully participate in the practice of lifelong learning, students must become adept at learning from others and sharing their knowledge. By requiring that this project be done in groups, the students are forced to discuss and integrate their findings. The group interaction appears to be one of the most challenging aspects of the project, especially for the brightest students. The practical experience gained by giving and receiving criticism, motivating group members, and practicing diplomacy will undoubtedly be of value in the workplace. The teaching/learning that occurs within the groups is augmented by the opportunity for students to teach on a broader level at the required public poster sessions.

Improve Technical Writing Skills. The current curriculum at ACP involves very little writing, with the exception of reflective papers written in the liberal arts courses. This is due mainly to large class sizes (~125 students) and a preoccupation with presentation of factual information. Many of the students have never written a paper in which references are required, let alone a technical paper. There is confusion about proper footnoting techniques and what constitutes plagiarism. Writing is rarely required on examinations, most of which are of a multiple choice format. The term paper component of the assignment is an attempt to give the students practice at writing a clear and concise technical paper.

Think Critically. Critical thinking is one of the most important outcomes of a pharmacy program. The identification of important aspects of a case, ability to acquire and interpret relevant data, and development of rational recommendations are essential skills for the delivery of pharmaceutical care. This project fosters the development of critical thinking by requiring the students to identify a topic, acquire and interpret data, and justify, in writing and orally, their recommendation to promote their chosen product or new technology. Little guidance is given with respect to project content.

Improve Verbal Communication Skills. "Most critical thinking competence is expressed through communication competence."(1) Pharmacists must consult with patients, physicians, and colleagues. Consultation with a patient requires the ability to simplify complex issues without being condescending. Communication with physicians and colleagues requires the ability to concisely and confidently convey information using correct terminology, to think on one's feet, and to integrate information. Traditional student seminars give the participants a chance to practice communication skills, but the process isn't interactive (with the exception of the question and answer period). Moreover, the exercise is summative; once the presentation is over, the student is graded and the process ends. The interaction in a poster session is less "rehearsed" and more formative. Each new visitor provides ample opportunity for practice, improvement, and increased self-confidence.

Develop Professional Confidence. At the College, a significant amount of time is devoted to teaching students facts and concepts. A written test is then administered for them to prove that they have mastered the material to a satisfactory degree. There is a major difference between answering written questions on an exam with limited coverage, and conversing with other professionals about broad topics in pharmacy. Students often enter the fourth year feeling

insecure about knowledge acquired in previous years, many expressing fears of incompetence. The poster sessions associated with this project build confidence, giving students the opportunity to speak with peers, underclassmen, and faculty from all disciplines. The confidence comes from the fact that all of the topics concern experimental or newly-released drugs; the students are usually more knowledgeable than the audience with respect to the subject matter. Most questions asked by professors represent true curiosity rather than "grilling". The students are enthusiastic about these interactions as demonstrated by subjective comments in their evaluations.

Practice a Professional Presentation in a Controlled Environment. PharmD's obviously need to be skilled at professional presentations, and they are trained to do so through a seminar program in the professional curriculum. Undergraduates at ACP typically do not have this opportunity. The goal here is to provide presentation experience in a non-intimidating environment in order to ease fears and build confidence. Pharmacists at the BS level may never be called upon to present a paper or a poster session as a professional requirement, but it is likely that they will participate in department meetings and patient education programs. Logistically, a poster session is more manageable and less intimidating than individual seminar presentations.

Integrate Material Learned in Various Courses. Compartmentalization of information based on discipline is a direct result of traditional curricular design. Problem solving requires integration of knowledge and skills across disciplinary boundaries. Such integration can be facilitated by reading journals about drug research and by speaking with faculty members from various disciplines about a particular drug. This project encompasses both of these activities.

Objectives for Attendees

Survey New Developments in the Field of Pharmacy. The community includes faculty, underclassmen, upperclassmen, fellows and residents. Faculty members and PharmD students have commented that they look forward to the poster sessions because they provide quick and easy access to information about new drugs. Most recently, community pharmacists have expressed interest in attending.

Be Inspired (for Underclassmen). It is hoped that the fourth-year students will serve as positive role models, and that the public display of knowledge, skills, and attitudes directly related to the profession will stimulate the interest of those who follow.

ASSESSMENT

In order to assess the effectiveness of this assignment as a learning tool, both student performance and student attitude have been evaluated. Student performance was measured by project grades and results from project-related questions on examinations. Student attitude was gauged by results of student surveys in which objective and subjective data were collected.

The project grade, which made up 14 percent of the final course grade, consisted of three parts: a term paper grade, a poster presentation grade, and a participation grade. The term papers and poster presentations were graded by the instructor; participation was assessed through peer evaluation. Each student ultimately received an individual project grade, but the assessment was based heavily on the quality of the final product and therefore the work of the group. Numerical grades (100-point scale) were assigned to the term papers and posters. The two components, when averaged together, represented the maximal project grade for any member of the group. These grades might then be attenuated, based on peer evaluations, to reflect individual contributions. Each student was asked to evaluate the work of every other member in his group, assigning a grade of 100 percent to the person(s) making the most significant contribution, and normalizing grades for other group members to that level of effort. The formula for calculating individual project grades is discussed under "evaluation" in the "modifications" section of this report.

Since all term papers and posters were graded by the instructor, the standards were uniformly applied. Extensive comments were provided for both parts of the assignment. The written reports were evaluated on the basis of content, critical evaluation of the literature, organization, and writing style. The poster grades were based on content, style, and competency of the group as a whole in answering questions. The interchange between each student and the instructor during the poster sessions was very short (approximately four minutes per group of two students) and relaxed. It was truly a discussion, rather than an interrogation.

Peer evaluations were monitored for consistency. When particular students were graded low by only one group member, that grade was considered to be an aberration (possibly due to a personality conflict) and discounted in the average. The students were not aware of this editing process. Although all group members saw the grades assigned to the paper and poster, individual grades were kept confidential.

Formative assessment was introduced by giving students the option to improve term paper grades by addressing the instructor's comments and submitting a revised version. In that event, the term paper grade was replaced by an average grade for the original and revised papers. There was no avenue by which the grade for the poster session could be improved.

Examination performance was the assessment tool for individual student learning. Each semester, a 10-20 point question pertaining to the material from the poster sessions was included on the last hourly exam. The performance on these questions was then compared to performance on the remainder of the exam. The data are presented in Table I

Student attitude was assessed using a standardized survey form (Appendix B) designed to measure student perceptions about the achievement of desired objectives. At the end of each semester, students who participated in the project were asked to complete the evaluation anonymously. The form contained both objective and subjective components, consisting of ten questions based on a three-point Likert scale, with an invitation for narrative comments at the end. Since the exercise was completed during class, participation was close to 100 percent. The same form was used all three years, allowing for direct comparison of the results.

RESULTS AND DISCUSSION

This project began in the spring semester of 1995 at which time the entire class participated (year one). It was repeated

Table I. Evaluation of project grades

Project	1995 Spring	1995-96 Fall	1995-96 Spring	1996-97 Fall	1996-97 Spring
Average score for term paper	92	99	95	90	93
Average score for poster	90	93	96	93	92
Average total project grade (Average course grade excluding project contribution)	90 (76)	97 (74)	96 (72)	92 (72)	92 (73)
Medicinal Chemistry Exam					
Average score for question on poster material	No data	89	94	85	94
Average score for remainder of the exam	No data	65	68	70	63
Effect of Project Grade on course Grade					
Average effect	+1.4	+2.1	+2.5	+2.5	+2.8
Maximal reduction	-1.0	-0.4	none	-0.3	-0.6
Maximal increase	4	4.2	4.7	4.8	5.7
Effect of Peer Evaluation on Individual Project Grade					
Average effect	+0.7	+0.3	-1.0	-0.3	0
Maximal reduction	-5.0	-3.0	-15.0	-4.7	-5.0
Maximal increase	+3.5	+1.5	none	none	none
Average decrease [for those evaluations reducing grade] (% of grades reduced)	none	none	-3.0(38%)	-1.2(27%)	-1.8(8.6%)

in the fall of 1995 (half of the class participated) and in the spring of 1996 (the other half of the class participated), designated year two, and most recently, in the fall of 1996 and the spring of 1997 (year three).

Evidence of Student Learning

The traditional measure of student learning is performance, as evaluated by some instrument such as a written examination, assignment, or presentation. Such instruments were used in the present case. The quality of the term papers and poster presentations was indicative of collective competence in written and oral communications, and the ability to collect, interpret and evaluate data. Average grades from term papers, posters, and exam questions pertaining to the project were tabulated for each of the three years (Table I). When compared to average course grades from which the project contribution has been excluded, the average scores for the term papers, posters, and projects as a whole are 14-25 points higher. This indicates that the students have been more successful at meeting the expectations of the instructor for the project than for examinations. This doesn't necessarily mean that more learning has taken place via the project.

It is uncertain that the level of expectation for student performance is comparable for the two instruments, the project and the hourly examinations. In addition, the grades on the projects represent team efforts, not individual student learning or competency. One approach to resolving this issue is to evaluate learning associated with the project and learning associated with classroom lectures, each on an individual student basis, using a common assessment tool. This has been done. Students were tested on the material presented at the poster sessions. The questions were subjective in nature (essay or short answer), a typical exam containing a page of structures representing drugs presented at the poster sessions, with the requirement that students choose two drugs, identify them by name, and answer a series of questions about each one. The questions were general, but were not revealed to the students in advance of the exam. The remainder of the exam, focusing on lecture material, consisted of subjective and objective sections. There were choices associated with the subjective questions,

Table II. Objective data from student evaluations

Questions[a]	Percent Agree	Percent No opinion	Percent Disagree	Sample size
1994-1995				
1	51	31	18	111
2	29	37	34	114
3	31	35	34	114
4	30	35	35	113
5	61	30	10	114
6	46	15	39	114
7	32	20	47	114
8	28	16	56	114
9	27	27	47	113
10	59	22	19	113
1995-1996				
1	58	29	13	98
2	61	26	13	98
3	49	34	17	98
4	46	44	9	97
5	56	32	12	97
6	56	20	23	98
7	60	20	21	97
8	14	10	76	98
9	13	27	60	97
10	55	20	26	97
1996-1997				
1	74	19	8	145
2	52	35	12	145
3	59	32	9	145
4	65	23	13	144
5	79	17	4	144
6	67	20	13	144
7	60	14	26	145
8	12	10	78	145
9	13	16	71	143
10	50	26	24	145

[a] Numbers refer to corresponding questions in Appendix B.

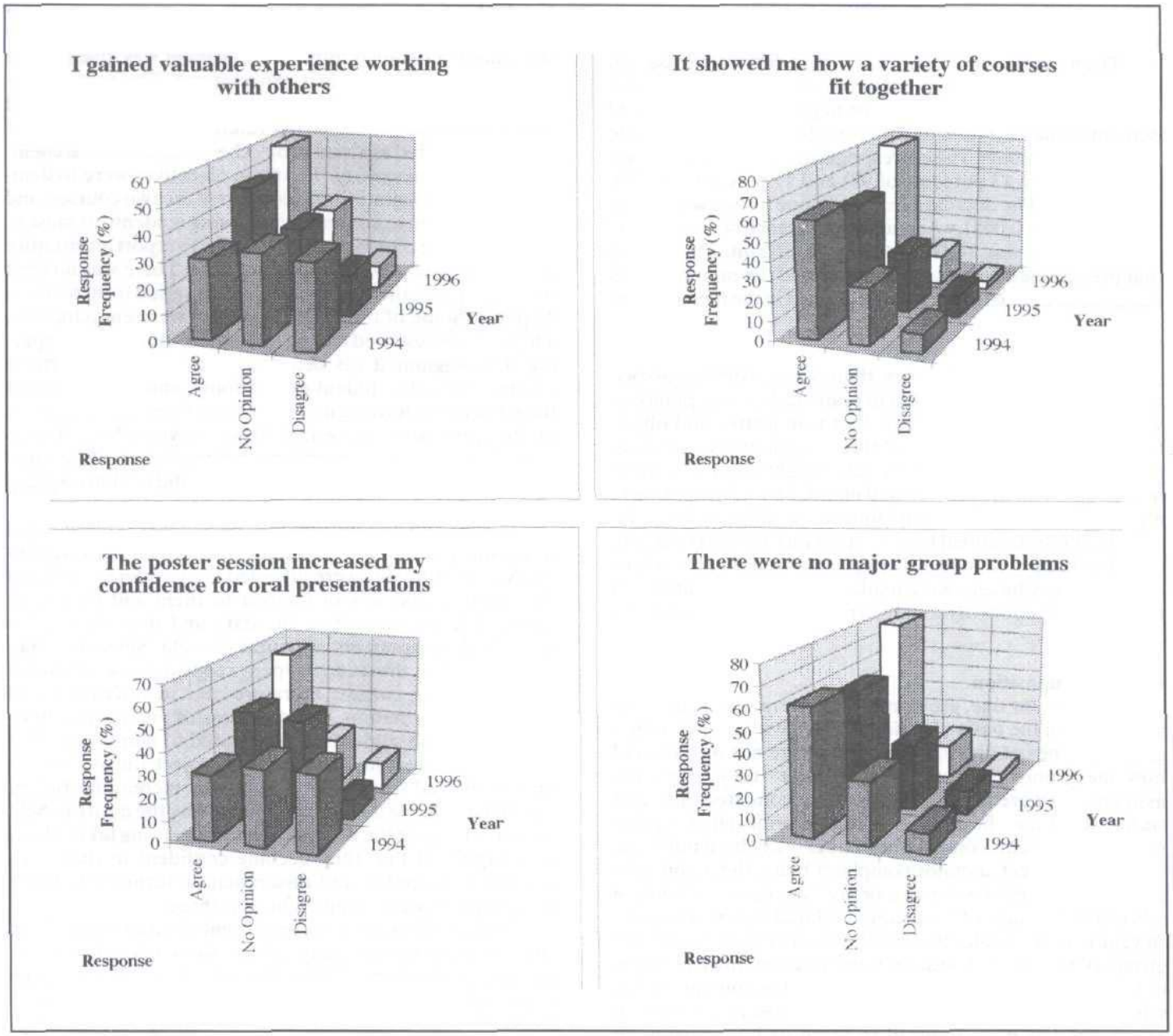

Fig. 1. Graphical representation of objective student survey data.

consistent with the choices pertaining to the poster drugs described above. The data (Table I) again reveal grades on the project questions to be 15-31 points (on a scale of 100) higher than those for the remainder of the exam. Thus, evaluation of individual student learning under conditions in which experimental and control data were gathered using a similar instrument confirmed the conclusion that enhanced learning was associated with the project as compared to pure lecture.

The information acquired from student surveys has been vital to the success of this project. The evaluations have provided data about student perceptions, which has led to beneficial project modifications. Objective data from the past three years are presented in tabular form (Table II) and some of the more significant yearly changes are shown graphically (Figure 1). A statistical analysis of the objective data indicate an obvious trend toward increasing student approval of the exercise. The pertinent survey questions for evaluating student perceptions of outcome achievement are Questions 3-6 (Appendix B). The concept of cooperative teaching/learning is addressed by Questions 3 and 6, verbal communication and practice at professional presentations are covered by Question 4, and Question 5 deals with the concept of eliminating course boundaries. Most of the other survey items were designed to evaluate logistical issues. These are discussed under the section entitled "modifications."

For each of the questions on the survey, with the exception of Question 10 pertaining to computer literacy, the results from year one were significantly different from those of year three. This conclusion is based on *chi*-square analysis (3) ($P<0.005$). For each of the items, the changes were in a favorable direction; for instance, more students agreed that the poster session increased confidence for oral presen

tations, and that the project illustrated how courses fit together.

The narrative comments were more difficult to assess in a quantitative way, but we did make an attempt. Comments were divided by tone: positive or negative. In year one, 59 percent of the 114 students who completed the survey wrote negative comments. The corresponding values for years two and three were 13 percent (of 98) and 17 percent (of 145), respectively. The decrease from year one to two was highly significant ($P<0.005$), whereas the difference between years two and three was not statistically significant. The factors that precipitated negative comments and the modifications designed to alleviate them are addressed in the next section.

MODIFICATIONS

As with many new endeavors, there were problems associated with this project that led to poor student acceptance in year one. Student evaluations (both subjective and objective) from year one indicated three major areas of discontent: problems with group members, weight of grade/amount of time spent on the project, and mandatory participation in a poster session. The complaints were addressed by the modifications described below. The data (Table II) indicate that the changes significantly improved student acceptance and attitude. Changes were made in the following areas: (*i*) group composition; (*ii*) content; (*iii*) context; and (*iv*) evaluation.

Group Composition

During year one, group members were assigned by the instructor on the basis of ability (GPA), with consideration given to issues of diversity. Students were not informed of how the groups were selected; as far as they knew, the assignments were random. Each group consisted of five or six members, and the entire class did the project in the spring semester. Students complained vehemently about not being able to self-select, a major complaint being the inability to coordinate schedules for five or six "strangers" outside of school hours. Many of the conflicts related to part-time jobs. In year two, the students were allowed to choose their own groups of five or six. The acceptance rate was much better as indicated by a decrease in negative written comments, but scheduling was still a complaint. In the most recent version group size has been reduced to three or four persons to minimize the problems.

Questions 3 ("I gained valuable experience working with others") and 6 ("there were no major problems dealing with cooperation in my group") on the survey were used to measure the impact of the modifications described above. Steady and significant improvement was demonstrated by data from student responses to each of these questions. For Question 3, agreement with the statement went from 31 percent in year one to 49 percent and 59 percent in the succeeding two years. The results from Question 4 followed the same trend with 46 percent agreement in year one, 56 percent in year two and 67 percent in year three. Subjective student comments also suggest satisfaction with a group size of three or four, and the freedom to self-select.

Although there are valid arguments for instructor control of group composition, student resentment was an overriding factor in the decision to change. Student discontent interfered with the achievement of more important project goals. Self-selection has proven to be a worthwhile compromise.

Content

The first version of this project (year one) was quite structured; a detailed information packet was given to the students providing explicit expectations. The packet contained an outline for the term paper, a list of suggested topics, and a list of suggested references. The assignment was administered as a joint project between medicinal chemistry and pharmacology. The main objectives were to demonstrate the integration and overlap of the two courses, and to increase course content by exposing students to most of the major drug classes. Each group was to report on an entire drug class instead of an individual drug. There was no limit on the length of the term papers, which varied from seven to 29 pages. Some of the resulting papers were encyclopedic. The students resented having to spend so much time preparing the assignment (as demonstrated by explicit written comments on the student evaluations), and the content of the reports was too extensive to expect significant retention of the information presented. It was obvious from discussions during the poster sessions that most students learned their own "part" of the project, but most did not have a grasp of the topic as a whole.

In year two, the information packet was replaced by a single sheet describing a situation and a challenge (Appendix A). The students were afforded the freedom to present the material that was of interest to them and they were responsible for evaluating the data and drawing conclusions, both components of critical thought. Since no topics were suggested, the students spent a considerable amount of time reviewing current literature and identifying useful sources of information. In the process of finding an appropriate topic, the students were exposed to numerous other topics. In the previous version of the project, the topics were simply selected from a list. The goal of increasing student factual knowledge has been supplanted by the desire to help students discover the process by which learning takes place. It is important that they become confident in their own abilities to assemble and disseminate information. These modifications were retained in year three.

Modifications to the project topics had two important ramifications: the popularity of the poster sessions increased, and the enthusiasm of the students doing the research improved noticeably. The event is now much more appealing to the ACP community because cutting edge developments are presented. In addition to generating more faculty interest, popularity among the fifth year and PharmD students has increased, and we have received requests from local pharmacists for permission to attend. The student researchers seem to take the assignment more seriously now; the responsibility of accurately "teaching" fellow students and professors about new products has transformed this endeavor from an exercise to a challenge. Many students take the initiative of contacting drug manufacturers to obtain additional information.

To date, poster session attendance by underclassmen has not been high, but such students have been seen reading the posters during off hours. The posters are displayed in the student lounge for an entire week. It may be that the underclassmen are intimidated by the crowds at the poster sessions or that they don't feel confident enough to ask questions yet. Efforts will be made to encourage attendance by underclassmen in the future.

Context

Context refers to the framework in which the assignment is presented. Student comments from year one indicate that they were unfamiliar with the concept of a poster session. According to one student"... the poster session was reminiscent of the 8th grade science fair". The time spent discussing the poster session in subsequent years has alleviated this misconception. The students are told that poster sessions are a means of disseminating results from numerous projects, concurrently, in an interactive format, and that poster sessions are commonly employed at professional meetings. Negative comments about the poster sessions are no longer received.

Evaluation

Grading of group projects is a controversial issue. The question is one of fairness in assessing individual contributions to cooperative endeavors. In year one, 80 percent of the project grade was derived from the quality of the final products, 40 percent for the paper (TP), 40 percent for the poster (PS), and the remaining 20 percent was from the averaged peer evaluations (APE, peers meaning students within the group).

$$\text{Final grade} = 0.20\ \text{APE} + 0.40\ \text{TP} + 0.40\ \text{PS}$$

The problem with this approach was that many students were either unwilling or unable to objectively evaluate the worth of their respective projects; some were excessively generous, while others were too hard on themselves. To alleviate this problem, the peer evaluations were normalized within each group. This process allowed for a consistent evaluation of relative group contributions, but was accompanied by grade inflation. The average effects of peer evaluations on individual project grades are summarized in Table I.

The original grading procedure was modified between the fall and spring semesters of year two. Instead of counting the average peer evaluation as 20 percent of the project grade, it was converted into an attenuation factor by dividing the average peer evaluation by 100 and multiplying by the instructor's grade. The students were told to grade their peers on the basis of individual contribution, rather than worth of the project. The following formula was used:

$$\text{Final grade} = 0.20\ (\text{APE}/100)\ (0.5\ \text{TP} + 0.5\ \text{PS}) + 0.40\ \text{TP} + 0.40\ \text{PS}$$

Using the modified formula, it is no longer possible for the student evaluations to raise the grade given by the instructor (a measure, albeit imperfect, of the intrinsic worth of the final product). The peer evaluations are meant to promote teamwork, and are used to determine whether or not all group members should share equally in the fruits of their labor.

A summary of the average effects of project grades on course grades is also presented in Table I. The project has a weight of 14 percent and raises course grades by an average of four or five points (based on a scale of 100). Each year, there are student comments requesting that the weight of the project grade be increased. This is not surprising in light of its positive effect on grades. The weight of the project grade was modified slightly (10 percent of the final grade in both pharmacology and medicinal chemistry for year one, 14 percent of the grade in medicinal chemistry for years two and three). More importantly, an attempt was made to reduce the amount of time necessary to complete the assignment by limiting the length of the term paper and narrowing its scope. Analysis of the results from Question 7 of the student survey ("the weight of the grade is a fair representation of the effort required) reveal increased agreement as a result of the change made after year one: 32 percent (year one), 60 percent (year two), 60 percent (year three). Surprisingly, average student-reported hours spent on the term paper increased steadily over the three years; the reported averages being 12,14 and 21 hours, respectively. Combined with the increased acceptance levels, students are putting more time in, but they are happier about it.

Beginning in year two, the project was spread over two semesters. With fewer papers to grade, the instructor had more time to spend evaluating the reports and writing meaningful comments. In year three a policy was instituted that allowed groups to submit a revised term paper; this was an attempt to make the assessment process more formative. Only three groups took advantage of this option, but the opportunity for revision did prompt students to read instructor comments and consider the extent of the changes that would be necessary in order to improve the paper.

CONCLUDING REMARKS

The current status of this project is very satisfying, and future refinements and expansion are enthusiastically anticipated. Currently in its fourth iteration, the assignment will be continued. There is a core group of faculty members at ACP who are particularly interested in improving student learning within the context of interdisciplinary teaching. This project has the potential to become an integrated exercise shared among medicinal chemistry, pharmacology, and pharmacotherapy. The subject matter already encompasses all three disciplines, among others; what remains is for the respective faculty members to collaborate on a formal level.

Revision and augmentation of the assessment processes are goals for the future. It would be desirable to establish more specific performance criteria for all aspects of the assignment and to expand the peer assessment component. Addition of a self assessment component would be beneficial and is anticipated. The pilot studies for this project have been completed, many of the bugs have been removed, and the acceptance level is high among students and faculty.

Am. J. Pharm. Educ., **62**, 83-90(1998); received 11/16/97.

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APPENDIX A. INSTRUCTIONS FOR YEARS TWO AND THREE

MEDICINAL CHEMISTRY GROUP PROJECT
SPRING 1996

Dear Colleague:

Congratulations on your recent appointment to Senator I. M. Important's Technical Advisory Team on Pharmaceutical Affairs. As you know, Senator Important is up for re-election in 1996 and needs to generate public visibility. What better way to get attention than to introduce legislation that will improve the quality of health care in the US.

Senator Important has assembled a group of five of the best students from ACP's graduating class of 1997 (you being one of them of course). Your first assignment is to identify an area of research that the Hon. I. M. Important can promote. This might be a new drug in clinical trials, a biologically-active natural product that shows promise, a new enzyme or receptor that should be targeted as a site for drug action, or a novel technology for the treatment of disease.

Senator Important has a law degree and therefore needs to be apprised of the merits of this new research area in order to speak intelligently about the subject. It is imperative that any potential problems with the development and/or implementation of the technology be revealed because there are political opponents who would derive great pleasure from embarrassing the senator. Since time is a valuable commodity, your group must submit a summary report of no more than five single-spaced pages describing the technology, why it is important, at what stage the research is currently, what remains to be discovered, and what the implications of success in the area are. The summary report must be submitted to the senator no later than March 28.

Senator Important actually has commissioned 12 other groups to complete the same task. The written reports will be reviewed, but the proposals also will be presented to the senator's closest advisors in the form of a poster session to be held during the week of April 1.

You have been hand-picked for this task due to your enthusiasm and demonstrated competence in the field of pharmacy. I wish you well in this endeavor and look forward to the results. Please contact the office if I can be of any assistance.

Sincerely,
N. Joy Urself
Chairman, Technical Support

APPENDIX B. STUDENT EVALUATION FORM

MEDICINAL CHEMISTRY/PHARMACOLOGY PROJECT EVALUATION

Project Evaluation: Answer each of the following questions with:
1 = agree, 2 = no opinion, or 3 = disagree
There is room for comments on the back of this sheet.

Questions 1 through 5 refer to the following statement:

"This project was worthwhile because…"

1. I learned more about medicinal chemistry and pharmacology. 1 2 3
2. I learned how to do research. 1 2 3
3. I gained valuable experience working with others. 1 2 3
4. the poster session increased my confidence for oral presentations. 1 2 3
5. it showed me how a variety of courses fit together. 1 2 3
6. There were no major problems dealing with cooperation in my group. 1 2 3
7. The weight of the grade is a fair representation of the effort required. 1 2 3
8. I would prefer to take an extra exam in lieu of this project. 1 2 3
9. The groups should have been smaller than 5 persons. 1 2 3
10. Computer literacy (at least word processing) should be 1 2 3
11. taught in a mandatory course at ACP. 1 2 3

12. I spent_____ hours on the written report and _____hours preparing the poster