AN EVALUATION STUDY OF THE BIOLOGY CURRICULUM AT INDIANA-PURDUE UNIVERSITY REGIONAL CAMPUS AT FORT WAYNE

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This is to certify that the

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ABSTRACT

AN EVALUATION STUDY OF THE BIOLOGY CURRICULUM
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CAMPUS AT FORT WAYNE

By

Charles J. McKinley

Problem investigated.--The purpose of this study was a multifaceted approach to the investigation of the biology courses offered at the Purdue University Regional Campus at Fort Wayne, Indiana. An attempt was made to define the student population on this campus and to determine if the current courses were meeting the needs of this population. In addition, the biology faculty was interviewed to ascertain if duplicity or gaps were present in the course content.

Also interviewed were supervisory staff of certain health professions, for ideas relative to the curriculum needs in those areas. Finally, a proposal was made to the Curriculum Committee in the Biology Department as to several approaches for innovation in the biology curriculum at this campus.

Descriptive features and treatment of data.--The study involved 360 students enrolled in biology courses at the Fort Wayne campus during the spring term 1971. During

the last week of classes, a student questionnaire was administered to each biology class.

The major concern of the questionnaire was to determine the demographic background of each student, and to evaluate the course content, skills, and relevance of each course in terms of application. Also questioned was the value of the laboratory associated with each course.

In addition, a set of predetermined questions was asked in interview of the biology faculty and selected science professionals from the local community.

Analysis of the data involved cross tabulation, percentage, and frequency analysis from both the dependent and independent variables of the questionnaire. Chi-square was used to determine significance of data resulting from the questionnaire. The criterion of the minimal level of significance was set at .05 for the statistical tests. Data from the interviews was gathered by taped interview and summary statements made from these findings.

Findings.--An analysis of the questionnaire and interviews seems to support the following major findings:

1. both the biology majors and non-majors found content and application more relevant than they did skills;
2. there was no relationship between science background of the student and his perceived relevance of a college biology course;

3. students with a higher grade point average found content and application of their courses more relevant to their educational needs;
4. the majority of the non-majors indicated that their courses had little or no relevance to their professional needs;
5. faculty response indicated an awareness of the need for relevance of content, skills, and application in their courses; and
6. selected professionals indicated they preferred certain skills included and content of courses revised.

The findings of this study provide sufficient evidence to support the need for continued research and revision in the area investigated. This investigation could also include a follow-up of the performance of the graduates from this biology department.

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CHAPTER I

INTRODUCTION

> "In the conditions of modern life the rule is absolute, the race which does not value trained intelligence is doomed. Not all your heroism, not all your social charm, not all your wit, not all your victories on land or at sea, can move back the finger of fate. Today we maintain ourselves. Tomorrow science will have moved yet one more step, and there will be no appeal from the judgment which will then be pronounced on the uneducated."
>
> --Alfred North Whitehead

This quotation of Whitehead's was made in 1929. Since World War II, an even greater need for improvement of higher education has been evidenced.[1] Indeed, with more than eight million students presently attending colleges and universities, it is not surprising to find more and more interest paid to every aspect of curriculum.[2] In fact, at the college level, some of this increased interest seems to have been generated by the student himself.[3]

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[1]John I. Goodlad, *The Changing School Curriculum* New York: N.Y. Fund for the Advancement of Education, The Georgian Press Inc., 1966).

[2]G. Robert Koopman, *Curriculum Development* (New York: Center for Applied Research in Education, Inc., 1966), pp. 25-46.

[3]*Ibid.*, pp. 76-77.

It is this student input which has generally been lacking in earlier curricular research.[4] Furthermore, few curriculum innovators have paid much attention to the historical dimensions of curriculum planning. Goodland has deplored this fact.[5] He suggests that most of the "new crop" reformers have approached the persistent, recurring problems of curriculum in the naive belief that no one had looked at them before.

Kliebard also has stated that in the curriculum field, issues seem to arise *de novo*, and that each generation of reformers are left to discover anew the same problems that persist in the field.[6]

In any event, the main function of such historical works should be to make the educator aware of the possibility of change, the complexity of change, and particularly the carryover of the past into the present and future plans. Caswell, who has also presented a historical account of earlier curriculum movements, has identified three continuing, central concerns of curriculum specialists:

1. Assurance of sound sequence and continuity in the curriculum.

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[4]A.S.C.D., *Strategy for Curriculum Change* (Washington, D.C.: Association for Supervision and Curriculum Development, 1965), pp. 4-9.

[5]Goodlad, *op cit.*, pp. 11-19.

[6]Herbert Kliebard, *The Curriculum Field in Retrospect* (New York: New York Teachers College Press, 1968).

2. Formation of consistent relationships between general goals of education and specific objectives that guide teaching, and

3. Curriculum design that provides a reasonable balance of emphasis among various areas of study.[7]

Certainly, Caswell has hit upon three themes that definitely require attention in the planning of a biology curriculum. Yet currently, biology curriculum and curricula in general seem to suffer from not relating to sound planning procedures.[8]

Shaw also has brought to our attention influences he believes have helped to determine the direction of innovations which have occurred in curriculum. He has cited such stimulants to change as:

1. Advances in technology,

2. Concerns for education of culturally disadvantaged,

3. Governmental programs, and

4. Special interest groups.[9]

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[7]H. L. Caswell, *Emergence of the Curriculum as a Field of Professional Work and Study* (New York: New York Teachers College Press, 1966).

[8]George A. Beauchamp, *Curriculum Theory* (Wilmette, Ill.: The Kagg Press, 1968), pp. 55-76.

[9]Frederick Shaw, "The Changing Curriculum," *Review of Educational Research*, 36 (1966), 343-352.

Authors such as Galbraith, Gagne, and Black have cited even newer instances of such influences on the curriculum.[10] But the study of curriculum is more than describing particular courses and studies. It should provide knowledge of better ways to answer perennial questions of what and how to teach.[11] Under this heading is the question of how to formulate instructional objectives. Factors which have come under consideration include: (a) subject matter; (b) society; and (c) nature of the learner. Several authors have added their expertise for classifying these objectives.[12]

Regardless of the wealth of background material available, each institution, each department, and in great part, each instructor is still ultimately responsible for seeing to the task of making his curriculum a useful opportunity. Brenowitz and The Commission of Undergraduate

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[10] J. K. Galbraith, *The New Industrial State* (Boston, Mass.: Houghton Mifflin, 1967); Robert Gagne, *The Conditions of Learning* (New York: Holt, Rinehart and Winston, 1967); and Hillel Black, *The American Schoolbook* (New York: Morrow, 1968).

[11] Robert Hoopes, "Science in the College Curriculum," Conference Report on Oakland University, Oakland University, 1963, N.S.F., Washington, D.C.

[12] Ben Bloom, ed., *Taxonomy of Educational Objectives*, Handbook I, Cognitive Domain (New York: Longmans Green, 1956); Robert Mager, *Preparing Objectives for Programmed Instruction* (San Francisco: Fearon Press, 1964); and H. H. McAshan, *Writing Behavioral Objectives* (New York: Harper & Row, 1970).

Education in the Biological Sciences each have spoken to the importance of this task.[13]

With the information explosion demanding better selection of important concepts and topics, the main effort in curriculum should be in presenting appropriate blocks of information which best meet the needs of the student. Indeed, these needs become very real to students with individual backgrounds who come into a particular college course in biology. In fact, the specific demography of a population of students might well influence the slant or content of a course. Certain regional or professional demands are further examples of this need.

Background and design of the study.--The Fort Wayne Regional Campus of Indiana-Purdue University developed historically as separate campuses within the town. Each began its function as an extension center of the main campus. In this early function, only selected courses of study were offered. In many cases, these were taught by part-time staff. Characteristically, the main campus usually maintained control of the courses to the extent of determining the text used and the exams which were given at the regional campuses.

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[13]A. H. Brenowitz, "Reorganization of the Adelphi College Biology Curriculum" (unpublished Ph.D. dissertation, Columbia University, 1958); and Hope Ritter, Jr., "The Changing Role of Biology In The 70's," *C.U.E.B.S. News*, 7 (June, 1971).

Only since 1964, have the two colleges been under the same roof. Still, each has maintained strong ties to the mother campus. Both abide by the requirements set forth within the catalogs from the main campuses. Also, in 1964, each college was given certain "mission determinations," with the philosophy that each would be responsible for specific educational areas. The plan, according to the Regional Campus Administration, was to reduce duplication or overlap of courses taught by each college.

At the present time, this mission determination plan has only been partially successful, as indicated by catalog listings. An example from the catalogs would be that of the Medical Technologist program and the program in pre-nursing that each lists.

Since each institution has somewhat different requirements to complete degree programs, there has arisen the problem of "course equivalents." In essence, this means that if one university requires a course, the other must offer that course in the appropriate department. In some cases this has meant generating an additional course to meet the requirements within the companion university.

Implicit in the course offering problems is the fact that through the present, the two colleges have maintained separate administrations. Each school has separate deans, registrars, and individual catalogs of course offerings. Under this system, neither college is responsible to the other. The overburden of administrators tends to dilute effectual governing of the campus. A student may find he has taken a course in a particular department that will not count toward his degree; he ultimately can be the loser under such conditions.

As mentioned earlier, there is also the problem of duplicate programs developing at the Fort Wayne Campus. A good example of this exists in the pre-nursing programs. Both Purdue and Indiana University have separate programs in nursing. In addition, a local hospital also contracts with the Purdue campus for certain courses needed in a nursing degree from that hospital. A second example exists in the presence of duplicate programs in Medical Technology. Certainly, under such an approach there is evidence that a problem exists in coordination of efforts.

Further frustrations have developed as a result of resistance from dual fronts. Development of new programs, goals, and curriculum materials must attempt to meet the needs of each university. In some cases they meet neither.

This study was designed to gather both qualitative and quantitative data concerning the biology curriculum at this campus. An attempt was made to determine whether the courses and programs meet the needs of the student population at this campus.

Need for the study.--A review of the literature revealed that relatively little published evidence exists concerning attempts to revise curriculum, in terms of student population and their particular needs. The wealth of curricular material has complicated the picture as to how and what information and instruction is needed for the college student.

Recent years have turned up a variety of approaches, more or less successful, in meeting these new demands for a science curriculum.[14] In general, those science programs which have been developed, were through the cooperative efforts of educators, scientists and psychologists working together.

Presently, due to the planned upcoming autonomy, increased space facilities and enlarging biology staff, this campus is in a prime position for a broader look at the curriculum. In fact, current social and economic pressures really demand such a continual re-examination of all curriculum, if higher education is to remain effective.[15]

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[14] Sam Postlethwait, "Planning for Better Learning," *Current Issues In Higher Education* (Washington, D.C.: American Association for Higher Education, 1967), pp. 17-21; Commission on Undergraduate Education in the Biological Sciences, "Biology for the Non-Major," Publication No. 19, Washington, D.C., 1967, pp. 5-10; and C.U.E.B.S. "Content of Core Curricula in Biology," Publication No. 18, Washington, D.C., 1967), pp. 1-31.

[15] Luther Evans, *Modern Viewpoints in the Curriculum* (New York: McGraw-Hill, 1964), pp. 1-7.

The achievement of a coherent undergraduate program in biology would be a likely place to begin at this campus.[16] With faculty concern directed toward a well conducted biology program, rather than to only their own personal course, it would be possible to overcome such problems as duplicity and omission of certain content.

Student reception of any programs must also be considered, since their perception of needs will dictate the acceptance of a course. Surely, the current lack of needed feedback concerning courses has hampered faculty self-education about course value. In this way, the development of an abstract curriculum without faculty involvement or consensus would be avoided.

Purpose of the study.--The major purposes of this study were: (1) to investigate the current biology courses offered on the Fort Wayne Campus of Purdue University, (a) to determine if current courses meet the needs of the student population on this campus, (b) to examine, and have the biology faculty determine if duplicity or gaps are present in the content; (2) to define as far as possible, the student population as it occurs on this campus; and (3) to make a proposal with the Curriculum Committee as to several approaches for innovation in the biology curriculum at this campus.

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[16]Curriculum Committee Minutes, Biology Department, Purdue University, Fort Wayne, Indiana, November, 1969.

Theory.--Curriculum theorists, who believe in the importance of behavioral objectives in building effective instruction, have found that such general principles have often not been used in selecting learning opportunities. Margaret Ammons shows evidence that (a) some departments do not have objectives to guide their programs, (b) some systems do not follow recommended curriculum process to develop their instructional objectives, and (c) some instructors base their programs on what they have customarily done, rather than on the stated educational objectives.[17]

Robert Gagne also discusses the problems of stating objectives and the importance of the problem in the design of effective instruction.[18] He feels that particular opportunity must be available to practice the objective, or the pre-requisite to the objective. In addition, according to Gagne, there should be ample opportunity for reinforcement to the learner. Finally, and this should be obvious, the learner should begin at the level of his ability to respond.

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[17]Margaret Ammons, "An Empirical Study of Process and Product in Curriculum Development," *Journal of Educational Research*, 57 (1964), 451-457.

[18]Robert Gagne, *The Analysis of Instructional Objectives for the Design of Instruction* (Washington, D.C.: N.E.A., 1965).

Speaking more directly to such general principles of curriculum theory are Dressel and Mayhew, who cite that objectives are most likely to be achieved when learning experiences are devoted to them.[19] Expressly, this means that if the objectives are to promote skills in solving problems, the learner must have opportunity to solve problems. Or, if the learner is to be able to solve problems in mathematics, he must have opportunity to solve problems in *mathematics*, not just practice solving problems in other areas. Dressel says that a whole realm of "learning opportunities" should be made available, which means situations, activities, objects or presentations which will elicit desired responses from the learner.

In addition, any educational program, but particularly one dealing in science, should capitalize on the special insights and skills of the local faculty.[20] It should be appropriate to the background knowledge, skills, abilities, and needs or goals of the local students. In short, every college or university must develop its own program of education in the sciences.

In an age of increasing technical advancement, and in an era of unbelievable information explosion, decisions

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[19]Paul Dressel and L. Mayhew, "General Education: Exploration in Evaluation," American Council on Education, Washington, D.C., 1954.

[20]Hoopes, *op. cit.*

about what to teach cannot be made on the basis of what has traditionally been taught.[21] Neither should they simply be an attempt to satisfy pressures from the public, from budgets or peripheral interest groups.[22]

If judgments are to be made, information is needed about the current conditions, demands, opportunities in the local, state, national and international areas of the biological field. Also, as already stated, information is needed about the student's abilities, needs, and readiness to engage in specific learning tasks. These points have been re-stated by Tyler, who emphasizes that if a student is to realize his potential, the curriculum must consider the talents and abilities of the student.[23] Then, as experience in teaching the curriculum provides more data regarding the appropriateness of content and objectives, changes must be forthcoming so the new objectives can be met.

Hypotheses of the study.--In order to investigate the qualitative and quantitative aspects of the biology curriculum now being offered at the Purdue Campus in Fort Wayne, the following hypotheses will be tested.

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[21] *Ibid.*

[22] Paul Dressel, *Undergraduate Curriculum Trends* (Washington, D.C.: American Council on Education, 1969), p. 2.

[23] Ralph Tyler, in *Modern Viewpoints in the Curriculum* (New York: McGraw-Hill, 1964), pp. 13-15.

1. *The biology major's needs will differ significantly from those of the non-biology major.*

2. *Demographic characteristics of the students results in different needs in some biology courses.*

3. *The range of course concepts will be positively related to the student's perceived relevance of that course.*

4. *The range of course skills will be positively related to the student's perceived relevance of that course.*

5. *The range of course application will be positively related to the student's perceived relevance of that course.*

6. *The evaluation of the difficulty of a course will be positively related to the student's perceived relevance of that course.*

7. *Student populations will differ in their perception of the value of the laboratory experience in a given course.*

8. *There is a positive relationship between the perceived value of a previous biology course and the relevance of the present biology course.*

Delimitations and assumptions of the study.--Several phases of the study were carried out by enlisting the help of all full-time faculty in the biology section. In addition, interviews and suggestions were obtained from selected personnel in the Fort Wayne area, who are considered professional medical and para-medical supervisors and administrators.

Finally, students currently enrolled at the campus were used in formulating parts of this investigation. However, the study did not attempt to:

a. Assess the specific knowledge gained in a given course.

b. Make correlation between the instructor's perception of courses or programs and the student's perception of those courses or programs.

c. Analyze data from the questionnaire other than those variables which directly bore on the testable hypotheses.

d. Make a judgment as to projected needs for programs in a given biological area.

e. Differentiate between full-time and part-time student's responses.

The instrument used in connection with this study was constructed with the direction of a sociologist from the University of Michigan.[24] Prior to its use in the classroom, the questionnaire was pre-tested on a pilot group of ten students. In the interview portion of the study, it was assumed that the instructors, professionals and students were intellectually honest in their responses.

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[24]Mary Sugrue, "Structure and Process of Inquiry into Social Issues in Secondary Schools" (unpublished Ph.D. dissertation, University of Michigan, 1970.

Organization of the dissertation.--The general organizational plan of the thesis is as follows: in this chapter is presented a statement of the problem area, which includes the purpose of the study, along with the rationale for the investigation of such a study. In addition, the objectives, assumptions and definition of terms are presented.

A review of the pertinent literature related to the study is reported in Chapter II. Chapter III contains a description of the study, sources of data, selection and description of the population, specific instruments used, statistical treatment used, and method of analysis. The results of data collected, tests of hypotheses, and analysis of data are presented in Chapter IV. Chapter V presents a general summary of the study and the conclusions drawn from the findings of the study. Also included in Chapter V are the implications of the study and some suggestions with respect to needed areas of related research.

CHAPTER II

LITERATURE REVIEW

Introduction.--The literature search has provided few examples of anything but general studies of the curriculum. The sciences have been exposed to a few panel studies, which have made recommendations at the National level. Probably the Biological Sciences Curriculum Study at the high school level is the most recognized. Unfortunately, there has been no equal at the college or university level, and several inquiries made to university and National Testing Services revealed no quantitative studies currently underway.[1]

Cited in this chapter are several curriculum and course studies which bear on the current problem under investigation at the Purdue Regional Campus at Fort Wayne. These are divided into four categories. In the first category are the studies involving revision of general content of biology for the B.S. degree in biology. The "core"

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[1]Center for Curriculum Studies, University of Minnesota, personal communication, February, 1972; and William Kastrinos, Educational Testing Service, Princeton, New Jersey, personal communication, April, 1972.

approach is an example, where "essential contents" of a biology program are pursued. The secondary category deals with a survey study and recommendations of biology for the non-major. Those studies concerned with review and recommendation for individual courses make up the third category. The last is a study of biology curriculum, where a multi-faceted approach was used to develop a biology program for the biology student.

The core concept.--Certainly, core curriculum is not a new word in the literature. In fact, serious recommendations concerning such an approach were made at a National Conference in 1958.[2] However, no real revisions seemed forthcoming from this recommendation.

Finally, 1964 brought a series of two conferences, sponsored by the Commission on Undergraduate Education in the Biological Sciences (C.U.E.B.S.). Here was an attempt to look at the possible need for a hard core of "basic biological training" for the future biologist.[3] The first of these conferences was held at Berkeley, California, February, 1964. In attendance then, were eight universities,

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[2]National Academy of Science Report, "Recommendations on Undergraduate Curricula in the Biological Sciences," Publication No. 578, National Research Council, Washington, D.C., 1958.

[3]Thomas S. Hall, (Chairman), C.U.E.B.S., "Core Studies for the Undergraduate Majors," *BioScience*, 14, No. 8 (1964), 25-29.

whose biology enrollment was mostly pre-medical students. The second conference was held at St. Louis, Missouri, May, 1964. This time, there were about fifty colleges and universities represented.

These later conferees generally agreed with the earlier Berkeley meeting, in that biology was indeed amenable to encapsulation by the device of a core curriculum. According to the conference, a core approach should be part of the training of all future biologists, irrespective of intended specialty, for its desired content transcended the possible limits of a typical one-year course or course sequence.

Concerning the "essential" content to be presented in such a core, the following areas were recommended for inclusion: (a) molecular topics, (b) cellular biology, (c) genetics, (d) developmental biology, (e) organismic biology, (f) population and community, and (g) evolution.

In addition, various participants at the St. Louis conference proposed "theme" or "problem" approaches with such topics as evolution, regulation, or steady state, to serve as organizing approaches for the core. In fact, the concensus was mostly to have the biological curriculum assume some sort of meaningful structure. There should be an attempt to develop offerings that had a common focus or pattern of complementarity. Certainly, the core should be something more than another ensemble of unrelated courses.[4]

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[4]*Ibid.*, p. 28.

By 1967, a number of college and university campuses across the country had spent considerable time and effort on the problem of producing a viable core sequence in biology.[5] C.U.E.B.S. took a sample of four colleges: Dartmouth, North Carolina State, Purdue, and Stanford University were chosen. From these, a detailed review of the core content was made, to determine the shape of the core. This small sample studied by the C.U.E.B.S. panel in 1967, showed that the curriculum revision at the four institutions was characterized by:

1. A set of courses offered in fixed sequence and extending over approximately two years is needed to communicate information commonly required in all biological specialities.
2. The titles and content of these courses vary widely and depart from traditional biology courses.
3. While no preferred course pattern is apparent, it is clear that a primary factor in restructuring curricula has been the de-emphasis of phylogenetic considerations.
4. There is surprising agreement concerning major concepts and categories of information and the relative amount of time needed for each.
5. Relative greater emphasis on molecular, cellular, and population biology necessitates increased collateral preparation in mathematics, physics and chemistry.

Garnered from this panel report was the idea that a multiplicity of judgment exists among the many biologists

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[5]C.U.E.B.S., "Content of Core Curricula in Biology," Publication No. 18, 1967.

contributing to the structure of the four core programs.[6] In turn, then, several questions were raised: did the variability in judgment reflect the feeling of the instructors that many different examples could be used to illustrate the same basic ideas? Also, did the multiplicity of judgments reflect uncertainty and difference of opinion concerning the central concepts and factual foundation of biology? As yet, these and other questions have not entirely been answered. However, since the 1967 survey, the core approach has not only grown, it has undergone evolution. Recently, Donald Cox summarized some of the current shortcomings of the core attempt.[7] In addition, the 1972 Annual Report from a leading university indicated further changes were needed, and listed several of the problems currently present in their core program.[8]

Generally, the Cox survey and the Annual Report included the following concerns about the core in biology:

1. Little success has been seen in simply bringing together a block of pre-existing courses without attempt to co-ordinate them.

2. There is considerable difficulty and much time consumed in maintaining course integration and co-ordination in the core curriculum.

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[6] *Ibid.*, p. 26.

[7] Donald Cox, "Another Look at the Core Curriculum," *C.U.E.B.S. News*, 7, No. 5 (1971).

[8] L. D. Smith, (Chairman), Annual Report of the Core Committee, Purdue University, Biology Department, Lafayette, Indiana, 1972.

3. A great danger exists in any core program to a potential regidity in concept.

4. There exists an assumption in some core programs that a certain body of facts must be mastered before the student can begin to experience the unsolved problems in biology.

5. There is a great tendency for the core to become the entire undergraduate program.

6. There is a greater need to shift the emphasis on coverage of subject to one of concern for the growth of the individual.

Biology for the non-major.--While the core curriculum focuses its problems on the science major, there is a far larger group of college students who find themselves in a biology course as a requirement for another major field of study. Curriculum investigation in the area of science education for the non-major has presented much of the same problems as those in the previous science oriented group.

In a survey of 25 state teachers colleges in all parts of the United States, Raksaboldej found generally that there was "no agreement on objectives and practices in general education science courses."[9] The need for such objectives and goals is further emphasized by F. Reif, who states that in the task of teaching science to non-specialists,

> it is very important to specify clearly the goals to be attained. These students, who likely will never use science professionally,

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[9]Bitak Raksaboldej, "A Survey of Science Programs in Selected State Teachers Colleges" (unpublished Ph.D. dissertation, New York University, 1961). (Dissertation Abstracts, No. 62-1404.)

> should have imparted to them a coherent perspective about some fundamental ideas of contemporary science. They should understand what scientists do, and about the ways in which science interacts with the rest of society.[10]

The 1967 C.U.E.B.S. report on "Biology for the Non-Major," brings into clear focus the wide range of current practices in teaching the general education courses in science.[11] However, the report concludes that likely there is no *one* course or content appropriate for biology courses directed toward a non-major. This appears to be an important point, and has been reinforced by several other authors.[12] Cox, for example, is of the opinion that content for such an area is dependent on the facility of the individual biology department. Since no two biology departments are alike, each must set its own educational objectives, in keeping with the needs of its students and the mission of the institution.

What ultimately is needed, according to Cox, is a student who will continue to update his biological education, realizing that science is both open-ended and cumulative.

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[10]F. Reif, "Science Education for Non-Science Students," *Science*, 164 (May, 1969), 1032.

[11]J. J. Baker, ed., "Biology for the Non-Major," C.U.E.B.S., Publication No. 19, 1967.

[12]Donald Cox, "Goals of Biological Education," *BioScience*, 21, No. 23 (1971), 1172; and Gairdner B. Moment, "Challenge and Response in Freshman Biology," *C.U.E.B.S. News*, 7, No. 2 (1970), 6-8.

If the student has not developed a high degree of self-reliance in learning, he will find it impossible to keep up with the rapidly changing status of the discipline.

Individual course revisions.--Ideas which result in new approaches to certain subject matter find their way only rarely into the curriculum for the major.[13] However, the courses offered for the non-major are occasionally the focus for imaginative thinking.[14] Most of the journal reports of such course modifications only indicate general changes in approach or philosophy. In fact, hard data are rarely included in these articles. Nevertheless, the changes that were reported seemed always to indicate an improvement of the particular course in question.[15]

One recent example is an experimental course developed at Oklahoma State University.[16] Entitled "Man in the Environment," this three credit hour course was described as being a student-involved course in environment. The objectives of the course were to develop in the student an awareness and understanding of the environmental crises,

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[13]Hope Ritter, *op. cit.*, pp. 1-3.

[14]J. J. Baker, "The State of Biology in Liberal Education," *C.U.E.B.S. News*, 5, No. 2 (1968), 4.

[15]*Ibid.*

[16]Jerry Wilhm, "Man In The Environment," *American Institute of Biological Sciences News*, 1, No. 1 (1972), 6-9.

to become acquainted with individuals or groups concerned with population or pollution problems, and to have first-hand experiences with environmental problems.

Seventy students were enrolled in the above course, and given opportunity to become involved in a variety of projects. While no tests were given, the student earned points through project work, class attendance, class discussion, and field trip participation.

At the end of their course, the students received an opinionnaire, asking their feeling on certain apsects of the course, such as:

1. Should tests be given in this course?
2. Should point system be used?
3. How many semester hours is this course worth?
4. Rank the various course objectives according to their usefulness.
5. Was sufficient time given to the various topic areas?
6. Knowing what you now know about this course, would you sign up for this course again?

The author of this article stated that the course objectives were generally met with a course of this nature. The fact that the lecture-only approach was replaced by discussion format, allowed the student to become an active participant. The student also became involved in the project which allowed him to meet and hear from community citizens working with the environmental problems.

Creager also has recently reported on an experimental, and somewhat unplanned revision of a general biology course designed for a diverse student population.[17] The course, which began as a traditional three hour lecture, and three hour laboratory approach, was challenged by several of the students in the class. The result was that the professor went to a rather unstructured approach, allowing more initiative in the class. The new objectives, which were set up for the experimental approach were: pick a topic of interest, explore the topic, and be able to present to the class the important ideas found. The student would also prepare a two page summary of this project. In conjunction with the summary, the student included five short answer questions covering important points in the report.

The final exam in this course consisted of fifty questions selected from the different summary reports. One-half of the final grade in the course was derived from the report, the other half from the final exam.

In Table 2.1, the summary of findings compared the experimental approach to the traditional. To each objective, the sixteen students responded by choosing either the experimental or traditional approach to the class format.

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[17]Joan Creager, "Why Do We Have To Learn All This Crap?" *C.U.E.B.S. News*, 6, No. 3 (1970), 12.

Table 2.1. Comparison of attributes of traditional vs. experimental approach in biology course

Objectives of Course	Preference of Students	
	Traditional	Experimental
Learning factual material	11	5
Relating facts from different sources	2	14
Learning to work in lab	10	6
Seeing relationships of science to problems of society	4	12
Preparing for further college courses	7	9
Learning to tackle problems	2	14
Learning to think for yourself	2	14
	(n = 16)	

Certainly, the Creager and Oklahoma State University surveys are only limited examples of what can be done in individual course revisions. In addition, Postlethwait and others have reported on the success of courses in which the lecture approach has been replaced by an independent study method.[18] The audio-tutorial (A-T) method has been applied to courses for both the biology major and non-major.

Kieffer, in his article, described the success of such an approach on a beginning level biology course. The

[18]Sam Postlethwait, *The Audio-Tutorial Approach To Learning* (Minneapolis, Minn.: Burgess Publishing Co., 1969), pp. 16-17; and George Kieffer, "Toward a Biological Awareness," *C.U.E.B.S. News*, 6, No. 4 (1970), 1-7.

primary objective of this course was the development of an awareness in the student, and to inculcate responsible action as a future citizen. According to this author, the independent study (A-T) approach contributed to this goal, since the method insists that the student assume responsibility for his own education. Further, this approach encourages maximum student independence and expression.

The scheme of this biology course is well outlined by Kieffer in his report.[19] In general, it focuses on man and his relationship to the biological world. The theory operating here, according to Kieffer, is by keeping man in the forefront, the student interest is maintained.

In addition to the previous approaches, several restructured courses have taken on an interdisciplinary tack. This has been applied to the benefit of both beginning and upper level courses. The basic idea for such an approach has been outlined by Reif, at Berkeley.[20] He reports that there is a need to select a few themes, basic ideas of great significance, to serve as the structural skeleton of the course. In the biology course at Berkeley, these structural themes, illustrated and elaborated with pertinent facts and examples, are always kept in the forefront. They give coherence to discussion and facilitate learning by the students. They also help emphasize that science is more

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[19] *Ibid.*, p. 2.

[20] F. Reif, *op. cit.*, p. 1033.

than a collection of observations and gadgets, and that it aims to organize knowledge and to formulate concepts to great generality.

A second recent example of interdisciplinary approach was undertaken at Hope College. Here, the course was designed as an upper-level one in biochemistry.[21] The purpose was to restructure and design a course in which the concepts of contemporary biochemistry and molecular biology could be presented in an integrated form to a group of junior-senior level students with diverse interests and backgrounds. Among the 32 students enrolled for the first semester of the course, 5 were biology majors, 13 were pre-medicine or pre-dentistry, and 14 were chemistry majors. The article outlined the content of the interdisciplinary course on a week-to-week basis. These authors concluded that the course had been a worthwhile addition to the curriculum, and that interdisciplinary cooperation could result in the presentation of an effective biochemistry-molecular biology course.

<u>A multifaceted approach to biology curriculum</u>.--In 1958, a survey was completed on the Adelphi College biology curriculum.[22] In this study, the current biology course

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[21] Jerry Mohrig and Nancy Tooney, "Biochemistry in the Undergraduate Curriculum," *Journal of Chemical Education*, 46 (1969), 33-35.

[22] Brenowitz, *op. cit.*

offerings were examined and projections made about the appropriateness of the curriculum for the students. Several of the data sources included in this study were:

1. A student questionnaire
2. Interviews with select graduates from the college
3. Interviews with medical school representatives
4. Examination of graduate school requirements
5. Examination and study of the Biology Department's offering, compared with other liberal arts colleges, and
6. A selected survey of local industrial and public health job opportunities in the biological sciences.

Following the data interpretation, recommendations were made to the Adelphi College Biology Staff, and to a Committee on Instruction. The Adelphi study represents an example of the need and usefulness of a multifaceted approach to gaining insight into curriculum problems. The questionnaire to the students served as a needed feedback on each and every course offering. Furthermore, the interviews with the various individuals allowed a variety of viewpoints on the value of the curriculum. Particularly important, were the responses from the various employers.

Graduate students who had gained a perspective on their college courses now were also able to give some recommendations. Those graduates entering the health professions are good examples of needed feedback. More surveys are required which examine the health sciences curriculum and determine the need in such areas as kinds and quality of courses best suited for entering advanced science training, such as medicine and the para-medical fields.[23]

In addition to the interviews of persons outside the institution, the Adelphi study questioned the Biology Faculty of the College. It was observed that for the most part, course content was determined by three factors:

1. the instructors experience
2. the departmental tradition
3. limitations imposed by the course title.

A particularly important observation concerning course objectives was brought out through the study at Adelphi. While a large population of the students were aware of the individual course objectives, almost 30 percent of the students reported they did not believe that the objectives had been met.

As a result of the study at Adelphi, a number of new biology courses were developed. Likewise, a few of the courses were dropped from the curriculum, and some were changed in their content and method of presentation.

Much of the critical look which was done on the Adelphi curriculum still has supreme value today. The

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[23]Thomas B. Roos, "Preparation in Biology for Education in the Health Sciences," *BioScience*, 20, No. 3 (1970), 164-168.

cross-section of opinion and analysis allowed for valuable suggestions to be made to the faculty. Ultimately, these data were valuable because the faculty acted to make the necessary changes where they seemed indicated.

CHAPTER III

DESCRIPTIVE FEATURES OF THE STUDY

Presented in this chapter are: (1) the general objectives and design of the student questionnaire, (2) a description of the courses sampled, (3) a summary table of numbers of students sampled in each course, (4) the method of interviewing the biology faculty, (5) the method of selected sampling of professional personnel from the local area, (6) the manner in which the data were treated, and (7) a summary.

General objectives and design of student questionnaire.--This portion of the study was designed to investigate the various demographic aspects of the student and his particular reaction to the biology curriculum at this campus. Special interest was focused on: content, skills and application of material as found in the particular courses taken by the student. For those students who had taken previous courses, the questionnaire also asked the same questions with regard to their previous courses and the sequence of such courses. In addition, questions were asked which attempted to evaluate the value of the laboratory associated with each biology course. The questionnaire was administered to all biology courses near the term end.

Selection and description of students.--The students involved in this study were 360 students in attendance at the Fort Wayne campus during the Spring term, 1971. During the last week of classes, the student questionnaire was administered to each class of biology. The purpose and use of the questionnaire was briefly explained to the students at the time of distribution.

Partial description of the demographic background of each student included the fact that the local campus draws a large portion of its 7,000 students from the immediate area. Table 3.1 shows how the percentage was distributed.

Table 3.1. Source of student residence

	Student Residence			
	Ft. Wayne	25 Mile Radius	More Than 25 Miles	Out of State
Percent occurrence	55%	20%	16%	9%

The fact that this campus serves the local student population is evident in the fact that 75 percent of the students lived within 25 miles of the campus. Since the campus does not have housing facilities, students from outlying areas must find apartments for the duration of their attendance at this campus.

Further information regarding the nature of the student was obtained from the breakdown on age groups. Table 3.2 shows that of the students in the biology courses, 73 percent were between the ages of 17-21. In addition, about the same percentage were also unmarried, and 85 percent of this sample were registered as full-time students.

Table 3.2. Percent of students in four age groups

	Student Age			
	17-19	20-21	22-24	Over 24
Percent occurrence	51%	22%	10%	17%

Description of biology courses sampled.--Following are listed the courses in which student samples were taken for the questionnaire. In addition to the course description from the University Catalog, each biology faculty member contributed a synopsis of his course. A brief statement of each follows the catalog description.

> MICROBIOLOGY 220. A course designed to introduce the student to the isolation, growth, structure, functioning, heredity, identification, classification, and ecology of microorganisms; their role in nature and significance to man. Pre-requisite:

One year of general chemistry and one semester of life science. Class 2, Lab. 2, Rec. 1, Credit 3 hours.[1]

In the foregoing microbiology course, the one semester offering is made up of several sections. Usually these would be taught by different instructors. As a service course, it has the bulk of students from the various pre-nursing programs. But in addition, other allied health students such as Dental Hygienists make up a portion of the class.

ZOOLOGY 109. Introduction to structure, functioning, heredity, development, classification, and evolution of animals, and their interactions with the environment. No prerequisites. Class 2, Lab. 4, Credit 4 hours.[2]

This Zoology offering serves both Indiana University students and Purdue University students. Indiana University offers the course as a pre-medical requirement, while Purdue directs its pre-vet and agricultural majors into this course.

MAN AND THE BIOLOGICAL WORLD (L-100). This course includes the principles of biological organization from molecules through cells and organisms to populations. Emphasis is on processes common to all organisms. Not designed for the professional biology student. No prerequisite. Class 3, Lab. 3, Credit 5 hours.[3]

While listed in both college's catalogs, the above course has different numbers and names in each. It is a

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[1]Purdue University Bulletin, Fort Wayne Campus, "Announcements, 1971-1972," p. 79.

[2]*Ibid.*

[3]*Ibid.*

service course, in that it helps fill the needs of non-science majors who must have a minimum number of hours in some science. However, a number of the students take this course in order to meet the State of Indiana's requirements for elementary school teachers.

> BIOLOGY OF MAN 204. Second semester of a two semester course. Introduction to human biology with emphasis on anatomy and physiology. No prerequisite. Class 2, Lab. 2, Credit 3 hours.[4]

This is a basic course in integrated physiology and anatomy. Both Purdue pre-nursing technology and a local hospital with a nursing program use this course as part of the required college credits. In great part, it is a service course. Several other groups of students are part of its population: Mental Health Technology is one such group. Since the course does not have a prerequisite, non-majors of biology seem to be directed into the course by certain counselors. However, since the course will not apply in the pre-medical program of either university, this type of student is generally not in the course.

> PHYSIOLOGY (P-215). Introduction to physiology of blood, circulation, respiration, digestion, metabolism, excretion, endocrines, muscle, nerve, special senses and central nervous system. No prerequisite. Class 3, Lab. 2, Credit 5 hours.[5]

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[4] *Ibid.*

[5] *Ibid.*

This Physiology 215 is primarily for the I.U. students. The course requires no prerequisites, but it is often taken following a semester of general anatomy. Students consist primarily of I.U. pre-nursing and Medical Technologists, pursuing a B.S. program.

> NATURE STUDY (B-214). An introduction to natural science, with emphasis on biological aspects of living things; interrelationships between plants and animals. Field and museum studies; identification and classification of plants and animals; life history, characteristics of living world in water, field and woodland. No prerequisite. Class 1, Lab. 2, Credit 2 hours.[6]

Also intended for the I.U. student, this is a second course elected by elementary education majors as filling their science needs.

> DEVELOPMENTAL ANATOMY (Z-215). A comparative study of structure and development of vertebrates, including man. Prerequisite: An introductory biology course. Class 2, Lab. 6, Credit 5 hours.[7]

Here again, the Developmental Anatomy serves predominately the I.U. student. The pre-medical major and allied health sciences student make up the bulk of the class.

> ENVIRONMENTAL BIOLOGY 285. Concerns adaptation and competition, and the relationship of organisms to their physical environment. Natural selection and other aspects of evolution; origin

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[6] *Ibid.*

[7] *Ibid.*

> and integration of species and communities, ecosystems. Prerequisites: A year of a life science and a year of general chemistry. Class 2, Lab. 3, Credit 3 hours.[8]

This Biology 285 is part of the Purdue "core" for its biology major. However, some of the biology majors from the I.U. program tend to take this course as an elective. It appears in both catalogs, but with different numbers and name.

> AGRICULTURAL GENETICS 430. Includes the transmission of heritable traits, probability, genotype-environmental interactions; chromosomal abberations; polyploidy; gene interactions; genes in populations; the structure and function of nucleic acids; biochemical genetics; molecular genetics. Prerequisites: Biology 108 or 109. Class 3, Credit 3 hours. Lab may be taken for one additional credit.[9]

This genetics course has typically appealed to the Purdue agricultural major at this campus. I.U. has the course listed in its catalog, and currently enrolls a larger percentage of the students in the course.

Student numbers from each sampled course.--Sampling of the student questionnaire was done in 10 biology courses offered during the Spring term. The following Table 3.3 represents the breakdown of students.

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[8] *Ibid.*

[9] *Ibid.*

Table 3.3. Sampled courses with number of students from each course

Biology Course	Catalog Number	Sample	Total
Microbiology	220	60	132
Zoology	109	42	67
Botany	108	33	56
Man in Biol. World	L-100	39	65
Biology of Man	204	96	162
Physiology	P-215	21	35
Nature Study	B-214	34	34
Developmental Anatomy	Z-215	18	32
Environmental Biology	285	8	13
Agricultural Genetics	430	9	22
Total		360	618

Interviews of selected faculty and professionals.--In addition to the student questionnaire, which forms the quantitative portion of this study, faculty and professional personnel from the area were interviewed.

Each faculty member of the Biology Department was interviewed for approximately 45 minutes. A pre-determined set of questions was asked regarding the particular instructor's view on his course. Specific attention was given to the following considerations:

1. level of material presented
2. appropriate sequence of the course, when taken as part of a required series

3. appropriateness of laboratory experience
4. importance of course to various student groups in the course
5. potential changes for the course
6. rationale for present course format.

Finally, a series of informal taped interviews was held with local professionals. These were people who were identified as working in various areas of science, who might function as resource personnel. Included in this sample were: (a) the Section Chairman of the Purdue nursing program on the Fort Wayne campus, (b) the directors from two nursing schools in the vicinity, (c) pathologists and laboratory supervisors in two local hospitals, (d) the supervisor from Fort Wayne's City Health Department, (e) the coordinator of the State Medical Education Program, and (f) several employed graduates from the Purdue B.S. program of the Regional Campus.

Except for the graduate group, the general questioning and discussion with the professionals included the following:

1. Do you, or have you used our students in your organization?
2. If so, is he meeting the requirements of the job?
3. Do you feel he has the proper training and education to fill your job needs?

4. Do you see further need for more formal training as the job description changes?
5. Are you planning any expansion of your program?
6. Will you be requiring a greater number of trained individuals?
7. Do you see any new programs for which you would need differently trained individuals?

Operational measures.--The student questionnaire served as the prime instrument in gathering data on the individual student, his background, and his perception of the biology course(s) in which he was enrolled. Of the questionnaires distributed, approximately 60 percent were returned completely answered. It was assumed that the returned questionnaires were a representative sample from each course polled. Cross-tabulation was done with the various questions from the instrument. Frequency distribution and chi-square were run on these, and the level of significance determined at the .05 level.

The faculty sample consisted of all the biology faculty currently teaching, which was ten members. Those professional members from the local community were those people who conceivably would be utilizing the graduates from the various programs in the biology department. It was assumed that the judgment of these professionals and the faculty was an honest response to the questions posed to them.

<u>Design of the study</u>.--Both predictive and descriptive data were included in the experimental design. The closed-ended, or multiple choice nature of the student questionnaire lent itself well to cross-tabulation of the various dependent and independent variables. Several of the questions were designed to simply gather information for frequency analysis.

Perceptions of both faculty and selected professionals were obtained through the individual interviews. Reports of type and function of the courses, amount and kind of education needed, was reported on at that time.

<u>Testable hypotheses</u>.--On the basis of the questionnaire and interviews, research hypotheses were formulated for the curriculum now being offered by the Biology Department on this campus. The general hypothesis from which the following were derived stated that the nature of the student and the nature of the classes would significantly relate to the needs of the student being met by the curriculum.

H_o1: *There will be no difference in the perceived relevance of the biology course between the biology major and the non-major.*

H_o2: *There will be no difference in the perceived relevance of the present course, regardless of the high school background of the student.*

H_o3: There will be no difference in the perceived relevance of the course, regardless of the grade point average of the student.

H_o4: There will be no difference in the perceived relevance of the course between the professionally oriented student and the non-science major.

H_o5: There will be no relationship between the range of course concepts and the perceived relevance of course concepts.

H_o6: There will be no relationship between the range of course skills and the perceived relevance of that course.

H_o7: There will be no relationship between the range of course application and the perceived relevance of that course.

H_o8: There will be no relationship between the perceived relevance of the course and the student's evaluation of the difficulty of that course.

H_o9: There will be no difference in the perception of the value of the laboratory experience between the science major and the non-science major.

H_o10: There will be no relationship between the perceived value of a previous biology course and the relevance of the present biology course.

Analysis of data.--All data from the questionnaire were coded and placed on data coding forms by the writer. The coding transformed all responses to numerical form. Then, trained personnel at Purdue University Computer Center were employed to transfer the coded data to key punch cards and verify the results. Computer personnel were also used to adapt existing programs to the needs of the researcher, and submit data to the Control Data Corporation 3600 and 6500 computers for analysis.

Analysis of the data involved tabulation, cross-tabulation of selected questions from the instrument, and frequency distribution and percentage. Chi-square and Phi coefficient were applied to each hypothesis. The program used for this study was modified from the Bio-Med 8, developed by the Health Sciences Unit of the University of California at Los Angeles, in 1966.

Personal interviews were done to determine the faculty and professional's general attitudes toward the usefulness of present courses and need for improvements. The results of the selected questioning and taped conversations are itemized in general form in Chapter IV.

Summary.--Data relevant to the student, his view on the particular biology course currently taken, and any which he had already taken, was collected via the student questionnaire. In this instrument, each course was viewed for its contribution in the areas of conceptual ideas and content, skills, and application of course material.

These data were coded and transferred to key punch cards for tabulation by CDC 3600 and 6500 computers. Hypotheses concerning the student's perception of the value of the courses were analyzed. In addition to percentage and frequency analysis, various dependent variables were cross-tabulated with the independent variables from the questionnaire. The chi-square test of independence and a Phi coefficient were run to determine the level of correlation. A minimum of .05 level of significance was employed in all cases.

The data and responses of the faculty and professional group were summarized and ranked as part of the descriptive data of this study.

CHAPTER IV

ANALYSIS OF RESULTS

The purpose of this chapter is to present the results from the questionnaire used to collect the student data, as well as the display of the summary of the responses by the faculty and local professional group.

The first of the tables which follow (Table 4.1) represent the percentage and frequency analysis from both the dependent and independent variables. Next are presented the selected cross-tabulation of the ten independent variables with the several dependent variables.

Finally presented are the feedback data from the interviews with the faculty from the Biology Department and selected professional people from the area. These data were gathered by taped interview, and summary statements made from these.

A summary of the findings from this chapter is included at the end.

The first independent variable illustrates variety of reasons why students were currently enrolled in a given biology course.

Table 4.1. Summary of students' reasons for taking a particular biology course

Course Number	Major-Minor	Only Course Needed	Required by Other Major	Elective Course
430	1	--	5	3
220	--	11	49	--
109	10	6	24	2
108	5	2	22	4
100	--	13	16	10
203	4	12	80	--
P-215	2	3	14	2
B-214	--	4	15	15
Z-215	6	--	12	--
285	7	--	--	1
Total	35 (9.5%)	51 (14%)	237 (66%)	37 (10.5%)
		n = 360 (100%)		

Table 4.1 illustrates four categories under which a student might be enrolled in a particular course. Within the four columns, the category of major-minor in biology has only approximately 10 percent of the total students. Approximately another 10 percent are found under the heading of elective courses. The 14 percent represented under the column of "only course needed," are students such as dental hygienists, mental health technologists and elementary education students. The largest group are those under "other major," and constitute students who are in pre-medical studies under the Indiana University enrollment,

the pre-nursing students, certain education majors, and a variety of others. Table 4.1 further indicates that the bulk of students who find themselves in a particular biology course usually are there to satisfy requirements other than those of a biology major.

Table 4.2. Summary of students' high school science background

Course No.	Had No Courses	1-2 Courses	3 or More Courses
430	--	3	6
220	4	32	24
109	1	16	25
108	--	16	17
100	2	26	11
203	3	47	46
P-215	--	12	9
B-214	--	31	3
Z-215	1	5	12
285	--	1	7
Total	11 (3%)	189 (52%)	160 (45%)
		n = 360 (100%)	

Table 4.2 represents the distribution of students with various amounts of high school science courses. This was the second independent variable from the questionnaire. Of the 360 student sample, 52 percent had 1-2 science courses in high school. Forty-five percent indicated they had three or more such courses in high school. Only

3 percent of the total student sample indicate they had no high school science.

Independent variable number 3 from the questionnaire asked the student his scholastic average. Table 4.3 represents the student groups according to grade average.

Table 4.3. Summary of college grade average in represented courses

Course No.	B Average or Better	C Average	Below C	Average Not Known
430	1	7	1	--
220	12	39	4	5
109	8	26	3	5
108	2	24	2	5
100	4	29	4	2
203	18	65	1	12
P-215	1	18	2	--
B-214	9	20	5	--
Z-215	1	15	2	--
285	3	5	--	--
Total	59	248	24	29
		n = 360 (100%)		

In Table 4.3 grade point averages were translated into letter grades. Of the sample, 69 percent showed a "C" average, while approximately 16 percent indicated a "B" or better average. Eight percent of the sampled group did not know their present average.

Table 4.4 represents the sampled student population grouped into either science or non-science fields. Independent variable number 4 asked about the professional interests of the students.

Table 4.4. Summary of students according to science or non-science related fields

Course No.	Science or Science Teaching	Other Teaching or Non-Science Profession
430	5	4
220	53	7
109	14	28
108	6	27
100	2	37
203	74	22
P-215	14	7
B-214	1	33
Z-215	13	5
285	4	4
Total	186 (52%)	174 (48%)
	n = 360	

Table 4.4 indicates that if all categories of science-oriented curricula are grouped together, the sampled population under this heading was 52 percent, while teaching and other professions accounted for 48 percent of the students.

Independent variable 5 was listed in the following question form: "How great a range of ideas (concepts) was covered in the present course?"

In Table 4.5, a summary of the range of course concepts is presented. Seventy-seven percent of the sampled students indicated their course as having a great range of such concepts. Twenty-one and five-tenths percent reported that their course had moderate concepts or ideas presented, leaving only 1.5 percent who indicated the course had little or no concepts presented.

Table 4.5. Summary of results regarding presentation of range of ideas in each biology course

	Range of Concepts in Course		
Course No.	Great	Moderate	Little or None
430	8	1	--
220	53	7	--
109	28	12	2
108	26	7	--
100	33	6	--
203	67	28	1
P-215	18	2	1
B-214	24	9	1
Z-215	14	4	--
285	7	1	--
Total	278 (77%)	77 (21.5%)	5 (1.5%)
		n = 360	

Independent variable 6 concerned the number of skills presented in the biology course. Table 4.6 lists the data.

Table 4.6. Summary of range of skills presented in present biology course

	Range of Skills in Course		
Course No.	Great	Moderate	Little or None
430	1	6	2
220	22	37	1
109	7	30	5
108	4	22	7
100	6	18	15
203	11	46	39
P-215	1	10	10
B-214	1	21	12
Z-215	1	15	2
285	4	4	--
Total	58 (16%)	209 (58%)	93 (26%)
		n = 360 (100%)	

Table 4.6 presents a summary of the range of course skills as interpreted by the students. Sixteen percent of the sampled students felt that their course had a great range of skills presented. Of the students sampled, 58 percent were of the opinion that the course contained a moderate number of skills, while 26 percent felt that little or no skills were offered.

Data on independent variable 7 is shown in Table 4.7 below.

Table 4.7. Summary of application of material in each biology course

	Range of Application		
Course No.	Great	Moderate	Little or None
430	6	3	--
220	35	24	1
109	16	22	4
108	14	18	1
100	12	27	--
203	48	38	10
P-215	13	7	1
B-214	11	22	1
Z-215	7	11	--
285	5	2	1
Total	167 (46.2)	174 (48.5%)	19 (5.3%)
		n = 360	

A summary of the range of course application is presented in Table 4.7, where 46 percent of the students felt that the range of course application was great. However, better than 48 percent felt that there was only moderate range of course application. Five percent were of the opinion that there was little or no application.

Independent variable number 8 asked about the difficulty of the courses measured in terms of the concepts, skills, and application. The following three tables (Tables 4.8, 4.9, and 4.10) summarized the student responses.

Table 4.8. Summary of student response to difficulty of concepts presented in present biology course

	Difficulty of Concepts		
Course No.	Great	Moderate	Little or None
430	1	8	--
220	10	46	4
109	1	25	16
108	3	27	3
100	10	25	4
203	35	59	2
P-215	2	19	--
B-214	--	15	19
Z-215	3	13	2
285	--	5	3
Total	65 (18%)	242 (67%)	53 (15%)
		n = 360	

Table 4.8 represents the student's opinion of the difficulty of concepts in their course. Eighteen percent felt that there was great difficulty to the concepts, while 67 percent expressed the opinion that there was only moderate difficulty to the concepts. Fifteen percent felt that little or no difficulty was present.

Table 4.9. Summary of difficulty of skills presented in each course in biology

	Difficulty of Skills		
Course No.	Great	Moderate	Little or None
430	--	7	2
220	5	44	11
109	1	23	18
108	3	20	10
100	4	23	12
203	14	49	33
P-215	1	10	10
B-214	--	13	21
Z-215	1	11	6
285	--	6	2
Total	29 (8%)	206 (57%)	125 (35%)
		n = 360	

Table 4.9 represents the distribution of student opinion concerning difficulty of course skills. Eight percent felt that the skills presented were of great difficulty. Fifty-seven percent responded to the question by saying only moderate difficulty was seen. Thirty-five percent felt little or no difficulty to the skills presented in their course.

Table 4.10. Summary of difficulty in application of material presented in each biology course

Course No.	Difficulty in Application: Great	Moderate	Little or None
430	--	7	2
220	8	43	9
109	2	24	16
108	4	21	8
100	6	25	8
203	23	50	23
P-215	2	12	7
B-214	--	11	23
Z-215	--	11	6
285	1	6	2
Total	46 (12%)	210 (58.5%)	104 (29.5%)
		n = 360	

The question concerning difficulty in application of course material is illustrated in Table 4.10. Twelve percent of sampled students had great difficulty in application of material presented in their course. While 58 percent of the students sampled had only moderate difficulty only 29 percent had little or no difficulty in the application of the course material.

Independent variable number 9 is the same as independent variable 4, concerning professional aspirations. In variable 9, the population of students had been divided

divided into three groups: medical-paramedical, science teaching, and non-science. These groups were identified in order that later cross-tabulation could be made with certain of the dependent variables. These results are presented in Table 4.11

Table 4.11. Summary of student population professional aspirations, when divided into three groups

Course No.	Medical-Paramedical	Science Teaching	Non-Science
430	5	--	4
220	56	--	4
109	10	3	29
108	3	3	27
100	1	1	37
203	74	--	22
P-215	11	3	7
B-214	--	1	33
Z-215	12	1	5
285	2	2	4
Total	174 (48.5%)	14 (4%)	172 (47.5%)
		n = 360	

In Table 4.11 is represented a summary of the three categories of professional aspirations presented on the student questionnaire. Forty-eight percent of the sampled students placed themselves under the heading of medical and paramedical. Only 4 percent were under the category of science teaching, and approximately 48 percent were listed as non-science majors.

The last independent variable related to the sequence of biology courses the student may have had, and their value to the present course in which the student was enrolled. In this variable only a fraction of the students could reply, since a number of them had no previous courses on which to draw.

Table 4.12. Response to value of sequence of biology courses

	Help to Present Course			
Course No.	Great	Slight	No Help	No Previous Biology
430	5	3	1	--
220	19	30	8	3
109	12	12	--	18
108	12	10	3	8
100	--	1	--	38
203	46	41	7	2
P-215	11	3	--	7
B-214	9	8	2	15
Z-215	10	6	--	2
285	3	3	1	1
Total	127 (35%)	117 (33%)	22 (6%)	94 (26%)
			n = 360	

The student response concerning the value of the sequence of biology course(s) to present course is presented in the above table. Thirty-five percent were of the opinion that the sequence of courses helped in their present biology courses. Thirty-three percent felt that the sequence was only of slight help to the present course. Of the sampled students 26 percent did not have previous courses from which to make a decision.

Dependent variables of the hypotheses.--Presented below are the tables of the dependent variables. Three of these variables were used in nine of the independent variables, and dealt in terms of the student's perception of the relevance of the various biology courses. These were measured as: relevance of content, relevance of skills, and relevance of application. The fourth dependent variable surveyed the value of the laboratory experience in each of the courses.

Dependent variable number 1 asked: "In your current course, how relevant were course concepts (content) to your area of educational need?"

Table 4.13. Summary of relevance of course concepts

Course No.	Course Very Relevant	Course Only Moderate or Little
430	4	5
220	24	36
109	26	16
108	10	23
100	14	25
203	48	48
P-215	12	9
B-214	19	15
Z-215	9	9
285	2	6
Total	168 (47%)	192 (53%)
	n = 360	

Table 4.13 is a summary of student opinion concerning relevance of course concepts to student's need. Forty-seven percent of the students responded by saying that the course was very relevant. However, 53 percent were of the opinion that the course had only moderate to little relevance to their area of need.

Dependent variable number 2 asked: "How relevant to you were the skills learned in your present biology course?"

Table 4.14. Summary of relevance of course skills

Course No.	Skills Learned: Very Relevant	Skills Learned: Moderate or Little
430	1	8
220	15	45
109	16	26
108	9	24
100	4	35
203	22	74
P-215	8	13
B-214	6	28
Z-215	8	10
285	1	7
Total	90 (25%)	270 (75%)
	n = 360	

Table 4.14 is a summary of opinion concerning relevance of course skills to student's area of need. Twenty-five percent responded by saying that the course skills had great relevance, while 75 percent were of the opinion that course skills had only moderate to little relevance in the area of need of the student.

Dependent variable number 3 asked: "In your present biology course, was there relevance in the application of material?"

Table 4.15. Summary of relevance of course application

	Material Presented	
Course No.	Very Relevant	Moderate or Little
430	5	4
220	26	34
109	22	20
108	14	19
100	14	25
203	51	45
P-215	13	8
B-214	19	15
Z-215	12	6
285	4	4
Total	180	180
	n = 360	

In Table 4.15, the opinion of the students shows that 50 percent of the respondents felt the applications were relevant. Fifty percent were just as convinced that the application had little relevance to their educational needs.

For dependent variable number 4, the student was asked about the value of the laboratory experience: "In terms of clarifying topic material, how do you classify the laboratory associated with the present lecture course?"

Table 4.16. Summary of student response to value of laboratory associated with lecture course

	Amount of Help of Lab				
Course No.	Great	Moderate	Little	Waste of Time	Not In Lab
430	2	5	1	--	1
220	23	25	9	2	1
109	28	11	3	--	--
108	8	12	8	5	--
100	3	8	4	24	--
203	13	38	21	19	5
P-215	3	7	6	5	--
B-214	5	14	10	5	--
Z-215	17	1	--	--	--
285	1	5	1	1	--
Total	103 (28.5%)	126 (35%)	63 (175%)	61 (17%)	7 (2%)
			n = 360		

Table 4.16 displays the summary of response to the value of the laboratory in making topic material clear. Twenty-eight percent of the students felt that the laboratory was of great help in this regard. Thirty-five percent felt that the lab was only of moderate aid. Seventeen percent

were of the opinion that it had only little value, and 17 percent felt the laboratory was a waste of their time. Two percent were not able to respond due to the fact that they were not taking laboratory during this time.

Testing the hypotheses.--The hypotheses tested were related to the students' perceived relevance of the biology course in which he was enrolled. Questions taken from the student opinionnaire were designated as 'independent' or 'dependent' according to whether they treated demographic data or student perceptual data respectively.

Originally developed by U.C.L.A. Health Sciences Computing Facility in 1966, the Bio-Med 8 program used here, accomplished cross-tabulation of the independent and dependent variables as previously described.

The research hypotheses which follow are stated as relationships, not in the null form. Further, it should be noted that each of the hypotheses measures the criteria of relevance in terms of content, skills, and application.

Hypothesis 1

The biology major will perceive his current biology course as being more relevant in terms of content, skills, and application, than will the non-major in the same course.

Tabulated with this were the three dependent variables: relevance of content, relevance of skills, and relevance of application.

Table 4.17. Relevance of content to academic major

Content	Student Major	
	Biology	Other
Relevant	23 (66%)	145 (45%)
Little or none	12 (34%)	180 (55%)
Total	35 (100%)	325 (100%)
Chi-Square = 5.62	Significance @ .02	
Degrees of freedom = 1		

In the above table of cross-tabulation, students were grouped as to whether they intended to major in biology, versus majors other than biology. The results associated with the table show a significantly larger percentage of the biology majors interpreting their course content as having more relevance than did the major from fields other than biology.

Table 4.18. Relevance of skills to academic major

Skills	Student Major	
	Biology	Other
Relevant	16 (46%)	74 (23%)
Little or none	19 (54%)	251 (77%)
Total	35 (100%)	325 (100%)
Chi-Square = 8.88	Significance @ .01	
Degrees of freedom = 1		

In Table 4.18 above the biology majors versus other majors were cross-tabulated with relevance of any skills presented in their course. The results associated with the table show a significant percentage of the biology majors interpreting their course as having more relevant skills than did the non-biology major in the same course.

Table 4.19. Relevance of application to academic major

Application	Student Major: Biology	Student Major: Other
Relevant	26 (74%)	154 (47%)
Little or none	9 (26%)	171 (53%)
Total	35 (100%)	325 (100%)

Chi-Square = 9.14 Significance @ .01

Degrees of freedom = 1

In the above table the biology majors versus other majors were cross-tabulated with relevance of application of material presented in their course. The results associated with the table show a significantly larger percentage of the biology majors interpreting their course as having more relevant application than did the non-biology major in the same course.

Hypothesis 2

The previous high school science background of the biology student results in a different perception of the course relevance.

In this second hypothesis, the independent variable of high school science background was cross-tabulated with the dependent variables on: relevance of content, skills, and application.

Table 4.20. Relevance of content and science background

	High School Science Courses					
Content	None		1-2		3 or More	
Relevant	7	(64%)	87	(46%)	74	(56%)
Little or none	4	(36%)	102	(54%)	86	(54%)
Total	11	(100%)	189	(100%)	160	(100%)
Chi-Square = 1.31		Significance @ .70				
Degrees of freedom = 2						

In Table 4.20, the high school science background was cross-tabulated with student's perceived relevance of content in their college biology course. Data from the table show no association between high school science background and perceived relevance of content in the biology course.

Table 4.21. Relevance of skills and science background

Skills	High School Science Courses None		1-2		3 or More	
Relevant	3	(27%)	42	(22%)	45	(28%)
Little or none	8	(73%)	147	(78%)	115	(72%)
Total	11	(100%)	189	(100%)	160	(100%)

Chi-Square = 1.64 Significance @ .50

Degrees of freedom = 2

In Table 4.21, the high school science background was cross-tabulated with the student's perceived relevance of skills presented in the college biology course. Data from the table show no association between high school science background and the student's perceived relevance of skills in the biology course.

Table 4.22. Relevance of application and science background

Application	High School Science Courses None		1-2		3 or More	
Relevant	6	(55%)	91	(48%)	83	(52%)
Little or none	5	(45%)	98	(52%)	77	(48%)
Total	11	(100%)	189	(100%)	160	(100%)

Chi-Square = .57 Significance @ .80

Degrees of freedom = 2

In Table 4.22, the high school science background was cross-tabulated with the student's perceived relevance of application of material presented in the course. Data from the table show no association between science background and the student's perceived relevance of application of material in the biology course.

Hypothesis 3

The grade point average of the biology student results in a different perception of course relevance by the biology student.

The third hypothesis crossed the independent variable of grade point average with the dependent variables of: relevance of content, skills, and application. Total number of responses in this table were less than the 360 (n = 331) since some of the students did not know their grade average.

Table 4.23. Student grade average and relevance of course content

Content	Grade Point Average: B or Above	C	Below C Average
Relevant	40 (68%)	105 (42%)	11 (46%)
Little or none	19 (32%)	143 (58%)	13 (54%)
Total	59 (100%)	248 (100%)	24 (100%)

Chi-Square = 12.4 Significance @ .01

Degrees of freedom = 2

Table 4.23 shows the results of cross-tabulation of grade average of student with his perceived relevance of content in the biology course. Data from the table show a significant percentage of students with B or above average grades interpreting their course as having more relevant content than did the students with the lower G.P.A. in the same course.

Table 4.24. Student grade average and relevance of course skills

	Grade Point Average		
Skills	B or Above	C	D or Below
Relevant	20 (34%)	57 (23%)	4 (17%)
Little or none	39 (66%)	191 (77%)	20 (83%)
Total	59 (100%)	248 (100%)	24 (100%)

Chi-Square = 3.92 Significance @ .20

Degrees of freedom = 2

In Table 4.24, the grade average of the biology student was cross-tabulated with the student's perceived relevance of skills presented in the biology course. Data from the table show no significant association between grade average of the student and his perceived relevance of skills presented in the biology course.

Table 4.25. Student grade average and relevance of course application

Application	Grade Point Average B or Above	 C	 D or Below
Relevant	39 (66%)	120 (48%)	11 (46%)
Little or none	20 (34%)	128 (52%)	13 (54%)
Total	59 (100%)	248 (100%)	24 (100%)

Chi-Square = 6.30 Significance @ .05

Degrees of freedom = 2

Table 4.25 shows results of cross-tabulation of grade average of student with his perceived relevance of application of material presented in the biology course. Data from the table show a significant percentage of students with higher grade point averages who interpret their course as having more relevant application than did those students with a lower G.P.A. in the same course.

Hypothesis 4

Professional science students and the non-science oriented students will differ in their perception of the relevance of their current biology course.

In this hypothesis, the independent variable of professional aspiration of the student was cross-tabulated with dependent variables of: relevance of content, skills, and application.

Table 4.26. Student professional aspiration and relevance of course content

Content	Aspiration of Student: Science	Non-Science
Relevant	109 (59%)	59 (34%)
Little or none	77 (41%)	115 (66%)
Total	186 (100%)	174 (100%)

Chi-Square = 22.0 Significance @ .001

Degrees of freedom = 1

In Table 4.26, the professional aspiration of the biology student was cross-tabulated with relevance of content in material presented in their biology course. Data from the table show a significant association between professional aspiration of student and the perceived relevance of course content. Science oriented students interpreted their course as having more relevant content than did non-science oriented students in the same course.

Table 4.27. Student professional aspiration and relevance of course skills

Skills	Aspiration of Student: Science	Non-Science
Relevant	63 (34%)	27 (16%)
Little or none	123 (66%)	147 (84%)
Total	186 (100%)	174 (100%)

Chi-Square = 16.1 Significance @ .001

Degrees of freedom = 1

In Table 4.27, the professional aspiration of the biology student was cross-tabulated with his perceived relevance of the skills presented in the biology course. Data from the table show a significant association between professional aspiration of student and perceived relevance of skills learned in the course. The science oriented students interpreted the skills learned in the course as being more relevant than did non-science oriented students in the same course.

Table 4.28. Student professional aspiration and relevance of course application

	Aspiration of Student	
Application	Science	Non-Science
Relevant	103 (55%)	77 (44%)
Little or none	83 (45%)	97 (56%)
Total	186 (100%)	174 (100%)

Chi-Square = 4.45 Significance @ .05

Degrees of freedom = 1

In Table 4.28, the professional aspiration of the student in the biology course was cross-tabulated with his perceived relevance of the application of material learned in the course. Data from the table show a significant association between professional aspiration of the student and perceived relevance of application of material in the course. The science oriented students interpreted the material learned in the course as being more relevant than did non-science oriented students in the same course.

Hypothesis 5

The student's evaluation of the range of course concepts will be related to their perceived relevance of that course.

Hypothesis 5 cross-tabulated the independent variable about range of concepts with the dependent variables of: perceived relevance of content, skills, and application.

Table 4.29. Course range of concepts and relevance of content

	Range of Concepts		
Content	Great	Moderate	Little
Relevant	144 (52%)	23 (30%)	1 (20%)
Little or none	134 (48%)	54 (70%)	4 (80%)
Total	278 (100%)	77 (100%)	5 (100%)

Chi-Square = 13.1 Significance @ .01
Degrees of freedom = 2

In Table 4.29, the range of concepts presented in the biology course was cross-tabulated with the student's perceived relevance of course content. Data from the table show a significant association between a student's estimate of the range of concepts, and his perception of relevance of content. Those students who felt that a large number of concepts were covered also perceived them as having more relevance than did students who evaluated course as having fewer concepts.

Table 4.30. Course range of concepts and relevance of skills

	Range of Concepts		
Skills	Great	Moderate	Little
Relevant	70 (25%)	19 (25%)	1 (20%)
Little or none	208 (75%)	58 (75%)	4 (80%)
Total	278 (100%)	77 (100%)	5 (100%)

Chi-Square = .075 Significance @ .80

Degrees of freedom = 2

In Table 4.30, the range of concepts presented in biology course was cross-tabulated with the student's perceived relevance of skills learned in the course. Data from the table show no significant association between range of concepts and the student's perceived relevance of skills learned in the course.

Table 4.31. Course range of concepts and relevance of application

Application	Range of Concepts		
	Great	Moderate	Little
Relevant	153 (55%)	26 (34%)	1 (20%)
Little or none	125 (45%)	51 (66%)	4 (80%)
Total	278 (100%)	77 (100%)	5 (100%)

Chi-Square = 12.7 Significance @ .01

Degrees of freedom = 2

In Table 4.31, the range of course concepts was cross-tabulated with the student's perceived relevance of application of material learned in the course. Data from the table show a significant association between a student's estimate of the range of concepts, and his perception of relevance of application. Those students who felt that a large number of concepts were covered also perceived them as having more relevance than did students who evaluated the course as having fewer concepts.

Hypothesis 6

The student's evaluation of the range of course skills will be related to their perceived relevance of that course.

This hypothesis cross-tabulated the independent variable about range of skills with the dependent variables of: perceived relevance of content, skills, and application.

Table 4.32. Relevance of content and range of skills

	Range of Skills		
Content	Great	Moderate	Little
Relevant	30 (52%)	97 (46%)	41 (44%)
Little or none	28 (48%)	112 (54%)	52 (56%)
Total	58 (100%)	209 (100%)	93 (100%)

Chi-Square = .85 Significance @ .70

Degrees of freedom = 2

In Table 4.32, the range of skills presented in the biology course was cross-tabulated with the student's perceived relevance of content of the course. Data from the table show no significant association between range of skills and the student's perceived relevance of course content.

Table 4.33. Relevance of skills and range of skills

	Range of Skills		
Skills	Great	Moderate	Little
Relevant	28 (48%)	58 (28%)	4 (4%)
Little or none	30 (52%)	151 (72%)	89 (96%)
Total	58 (100%)	209 (100%)	93 (100%)

Chi-Square = 38.8 Significance @ .001

Degrees of freedom = 2

In Table 4.33, the range of skills presented in the biology course was cross-tabulated with the student's perceived relevance of those skills. Data from the table show a significant association between the student's estimate of range of skills and his perception of relevance of those skills. Students who felt that a large number of skills were presented also perceived them as having more relevance than did students who evaluated the course as having fewer skills.

Table 4.34. Relevance of application and range of skills

Application	Range of Skills: Great	Range of Skills: Moderate	Range of Skills: Little
Relevant	33 (57%)	96 (46%)	51 (55%)
Little or none	25 (43%)	113 (54%)	42 (45%)
Total	58 (100%)	209 (100%)	93 (100%)

Chi-Square = 3.35 Significance @ .20

Degrees of freedom = 2

In Table 4.34, the range of skills presented in the biology course was cross-tabulated with the student's perceived relevance of application of the course. Data from the table show no significant association between the range of skills and the student's perceived relevance of course application.

Hypothesis 7

The student's evaluation of the range of course application will be related to their perceived relevance of that course.

This hypothesis cross-tabulated the independent variable about range of course application with the dependent variables of: perceived relevance of content, skills, and application.

Table 4.35. Range of application and relevance of content

	Range of Application		
Content	Great	Moderate	Little
Relevant	104 (62%)	61 (35%)	3 (16%)
Little or none	63 (38%)	113 (65%)	16 (84%)
Total	167 (100%)	174 (100%)	19 (100%)

Chi-Square = 33.0 Significance @ .001
Degrees of freedom = 2

In Table 4.35, the range of application of material presented in the biology course was cross-tabulated with the student's perception of the relevance of the course content. Data from the table show a significant association between the student's estimate of range of application, and his perception of the relevance of course content. Students who felt that a large number of applications were presented also perceived the content as having more relevance than did students who evaluated the course as having fewer applications.

Table 4.36. Range of application and relevance of skills

Skills	Range of Application: Great		Moderate		Little	
Relevant	57	(34%)	32	(18%)	1	(5%)
Little or none	110	(66%)	142	(82%)	18	(95%)
Total	167	(100%)	174	(100%)	19	(100%)

Chi-Square = 15.4 Significance @ .001
Degrees of freedom = 2

In Table 4.36, the range of application of material presented in the biology course was cross-tabulated with the student's perceived relevance of the skills learned. Data from the table show a significant association between the student's estimate of range of application of material and his perception of relevance of course skills. Those students who felt that a large number of applications were presented also perceived the skills as having more relevance, than did students who evaluated the course as having fewer applications.

Table 4.37. Range of application and relevance of application

Application	Range of Application		
	Great	Moderate	Little
Relevant	119 (71%)	58 (33%)	3 (16%)
Little or none	48 (29%)	116 (65%)	16 (84%)
Total	167 (100%)	174 (100%)	19 (100%)

Chi-Square = 58.4 Significance @ .001

Degrees of freedom = 2

In Table 4.37, the range of application of material presented in the biology course was cross-tabulated with the student's perception of the relevance of the application of the course. Data from the table show a significant association between the student's estimate of range of application and his perception of the relevance of the application. Those students who felt that a large number of applications were presented, also perceived them as having more relevance, than did students who evaluated the course as having fewer applications.

Hypothesis 8

The student's evaluation of the difficulty of the course will be related to their perceived relevance of that course.

Hypothesis number 8 cross-tabulated the independent variable about difficulty of course concepts with the dependent variables of: perceived relevance of content, skills, and application.

Table 4.38. Difficulty of course and relevance of content

Content	Difficulty of Biology Course		
	Great	Moderate	Little
Relevant	22 (34%)	114 (47%)	32 (60%)
Little or none	43 (66%)	128 (53%)	21 (40%)
Total	65 (100%)	242 (100%)	53 (100%)

Chi-Square = 8.31 Significance @ .02

Degrees of freedom = 2

In Table 4.38, the evaluation of difficulty of present biology courses was cross-tabulated with the student's perception of the relevance of course content. Data from the table show a significant association between the student's estimate of course difficulty and his perception of the relevance of course content. Those students who felt that the course was least difficult also perceived the course content as having more relevance than did students who evaluated the course as being more difficult.

Table 4.39. Difficulty of course and relevance of skills

Skills	Difficulty of Biology Course		
	Great	Moderate	Little
Relevant	11 (17%)	69 (29%)	10 (19%)
Little or none	54 (83%)	173 (71%)	43 (81%)
Total	65 (100%)	242 (100%)	53 (100%)

Chi-Square = 4.91 Significance @ .10
Degrees of freedom = 2

In Table 4.39, the evaluation of difficulty of the present biology course was cross-tabulated with the student's perception of the relevance of course skills. Data from the table show no significant association between difficulty of the course and the student's perception of a relevance of course skills.

Table 4.40. Difficulty of course and relevance of application

Application	Difficulty of Biology Course		
	Great	Moderate	Little
Relevant	24 (37%)	125 (52%)	31 (58%)
Little or none	41 (63%)	117 (48%)	22 (42%)
Total	65 (100%)	242 (100%)	53 (100%)

Chi-Square = 6.23 Significance @ .05
Degrees of freedom = 2

In Table 4.40, the evaluation of difficulty of the present biology course was cross-tabulated with the student's perceived relevance of course application. Data from the table show a significant association between the student's estimate of course difficulty and his perception of the relevance of the course application. Those students who felt that the course had moderate to little difficulty also perceived the course as having more relevant application than did students who evaluated the course as very difficult.

Hypothesis 9

The para-medical, science teaching and non-science students will differ in their perception of the value of the laboratory experience in clarifying lecture material.

In this hypothesis, the independent variable on the professional aspiration of the student was cross-tabulated with the dependent variable on student's perception concerning value of laboratory experience.

Table 4.41. Value of laboratory experience to the professional aspiration of the student

	Professional Aspiration	
Value of Lab	Science	Non-Science
Great help	59 (32%)	44 (26%)
Moderate help	70 (37%)	56 (33%)
Little help	31 (18%)	32 (19%)
Waste of time	23 (13%)	38 (22%)
	183 (100%)	170 (100%)

Chi-Square = 6.97 Significance @ .10

Degrees of freedom = 3

In Table 4.41, the professional aspiration of the student was cross-tabulated with his perceived value of the laboratory experience which accompanied the lecture. Data from the table show no significant association between aspiration of student and his perception of value of the laboratory experience.

Hypothesis 10

The student's evaluation of the value of content in a previous biology course in the understanding of the present biology course will be positively related to the perceived relevance of the present course.

In this hypothesis, the independent variable concerning value of previous course is cross-tabulated with the dependent variable of perceived relevance of the current biology course, in terms of: content, skills, and application.

Table 4.42. Value of previous course to relevance of present course content

	Previous Course Value					
Present Biology Content	Great		Slight		No Use	
Relevant	79	(62%)	43	(37%)	6	(27%)
Little or none	48	(38%)	74	(63%)	16	(73%)
Total	127	(100%)	117	(100%)	22	(100%)

Chi-Square = 19.0 Significance @ .001

Degrees of freedom = 2

In Table 4.42, the evaluation of the previous biology course was cross-tabulated with the student's perceived relevance of present course content. Data from the table show a significant association between the student's estimate of value of his previous biology course and his perception of the relevance of present course content. Those students who felt that the previous course was of great help to the understanding of present course, also perceived the present course as having more relevant content than did students who evaluated the previous course as being of little use.

Table 4.43. Value of previous course to relevance of present course skills

Present Biology Skills	Previous Course Value: Great		Slight		No Use	
Relevant	38	(30%)	26	(22%)	5	(23%)
Little or none	89	(70%)	91	(78%)	17	(77%)
Total	127	(100%)	117	(100%)	22	(100%)

Chi-Square = 2.00 Significance @ .50

Degrees of freedom = 2

In Table 4.43, the evaluation of the previous biology course in terms of understanding the present biology course was cross-tabulated with the student's perceived relevance of the present course skills. Data from the table show no significant association between value of previous course to present course, and the student's perception of the relevance of the present course skills.

Table 4.44. Value of previous course to relevance of present course application

Present Biology Application	Previous Course Value: Great		Slight		No Use	
Relevant	80	(63%)	53	(45%)	9	(41%)
Little or none	47	(37%)	64	(55%)	13	(59%)
Total	127	(100%)	117	(100%)	22	(100%)

Chi-Square = 9.16 Significance @ .02

Degrees of freedom = 2

In Table 4.44, the evaluation of the previous biology course, in terms of understanding present biology course, was cross-tabulated with the student's perceived relevance of present course application. Data from the table show a significant association between the student's estimate of the value of his previous biology course and his perception of the relevance of present course application. Those students who felt that the previous course was of great help to understanding the present course also perceived the present course as having more relevant application than did students who evaluated the previous course as being of little use.

Faculty interviews.--In this section, portions of faculty comments and summary statements are included from the taped interviews. The questions asked for feelings and opinions on the following:

1. level of material presented in course.
2. sequence of particular course, when part of a required series such as core.
3. appropriateness of laboratory associated with the course.
4. how course appeals to various student groups in the course.
5. any plans for course changes.
6. rationale for present course format.

Each faculty member was identified by alphabetical notation, and taught one or more of the courses surveyed earlier in this chapter. Therefore, his comments usually serve to identify his course.

Faculty member "A" was responsible for the last of the "core" courses in the biology program--a genetics course. Since this represents the cap-stone of the core at Purdue, it has minimal number of students, and they are usually the biology major. In the interview, faculty member "A" was of the opinion that the course was currently being taught at the appropriate level to meet the needs of that population of students. His statement was that he personally felt happy about the content of the course, but had some concern about the laboratory associated with it. Particularly, this faculty member saw the need for an assistant in the laboratory, so that an increase could be made in the number of assigned genetics problems. This member felt that the laboratory experience could also serve to increase the number of skills a student might learn. Currently, he felt that the laboratory did not do this, since the students were involved in only four experiments during the term.

Faculty member "B" was responsible for several different courses in the biology department. As the instructor in the Botany 108, he responded by saying the material in that course was generally not relevant in his opinion. While there were several sub-groups in a typical class, the course was described as being more appropriate for the forestry major. Yet, this type of student was said to be a minority in the class. The sequence of this course was described as not important, since Botany 108 did not build from any previous course. In several ways it served as a terminal course, therefore few biology majors tended to enroll in it. This faculty member was of the opinion that since the non-major tended to predominate the enrollment, the laboratory experience was not useful. Rather, a better plan might include small discussion and recitation sessions. No such changes were planned for Botany 108 in the near future. Generally, the reasons for offering this course were: needed by certain Indiana University students, and used as an elective for certain non-science majors.

Faculty member "B" was also responsible for teaching Man in the Biological World, B-100. In this course the material was a particular challenge to the student. Particularly important was the fact that the present text was very heavy in chemistry. The professor felt that more emphasis was needed on man, and less on the many aspects of biological chemistry. Indeed, fewer and better selected examples of processes could be undertaken in the course changes.

The laboratory was described by faculty "B" as being open for possible innovation or enhancement as he chose.

Since this course was basically a terminal course, there was no sequence, and care had to be used not to "overkill" the student with all the information available. The basic change for this course would be to replace the present text with a simpler one. Since the text was said to dictate much of the course content, no changes in the course could be made until this had taken place.

Faculty member "C" was responsible for Zoology 109. This member felt the level of material was right for the student population, which was certain non-majors and the Indiana University pre-medical student. Furthermore, since Zoology 109 was not a part of the biology core, sequence was not stressed. In fact, the opinion was expressed by the faculty member that Zoology could easily be taken before the Botany 108.

The laboratory associated with this course was described as one in which the student did work-up drawings of different animals, and when possible, viewed live specimens. Taxonomic relationships were stressed and scientific names learned.

Faculty member "C" felt some possible course changes might be made, including the insertion of field work and addition of ecological principles. The amount of time spent at the tissue level also might be reduced, but currently, the laboratory format is governed by a space problem. Specifically, back-to-back laboratories leave little time for proper lab preparation and practical exams.

Faculty member "C" also had the responsibility for teaching Environmental Biology 285. The faculty member was convinced that the level of material for this course was entirely appropriate, since this course comprised the fourth term of the sequence of core courses for the biology major at Purdue.

The laboratory associated with this course was felt to have a wide range of learning experiences, and appropriate for this level of student. Further discussion brought out the possible problem concerning limit of time needed to cover what was felt to be a wide range of topic material. Faculty member "C" was uncertain, but felt that the course needed more credit hours. He also felt that certain skills were needed by the student in this course. Since the course was an attempt to expose the student to the environment, the content ranged from astronomy to pollution biology. Included also were the experimental method and statistical sampling.

Faculty member "D" was coordinator for the Biology of Man 203-204 sequence. This member's response was primarily directed to the preparation of the student. He felt many of the students in this course lacked the cognate courses to fully appreciate the Biology of Man. During the interview, the impression was made that this course might well be delayed until the student had taken more chemistry and physics courses.

This is a year-long course, with no other sequence required. Two of the three pre-nursing programs at Purdue have students enrolled in this course, but need no background or prerequisite for this course.

Another opinion expressed by this faculty member was the need of coordinated laboratory experience with the material presented in the lecture. This would give the student an opportunity for direct experience in the laboratory with the material referred to in the lecture.

Plans for change in the Biology of Man course were incomplete, but suggestions were for extra laboratory time, or perhaps an additional lecture hour added to the course format. Any changes, according to faculty member "D", would create problems involving re-scheduling by the nursing programs' directors. Little change was expected, since the present format is at the request of the nursing supervisory personnel, and they felt they were already meeting their nursing requirements.

Faculty member "D" also had responsibility for teaching Physiology P-215 course. It was explained that the students in this course were similar to those in the Biology of Man 203-204 sequence, but the level of material in the P-215 was not as general as that in the previous course. This detail is possible since the majority of students in the Physiology had taken the previous term of General Anatomy. However, even though this sequence is recommended, it is not mandatory to have taken the anatomy course before taking Physiology P-215.

Indiana University pre-nursing students were part of the population in these two courses, but other students also were commonly found in each. In particular, the medical technology students are included. No plans were underway for change in the Physiology P-215. Both increased time and space would be needed to upgrade this course, according to the faculty member.

Microbiology 220 was the responsibility of faculty member "E". This course was described as a one semester course with general appeal to the nursing programs and other allied health students. This professor felt the course was very appropriate for the freshman level student.

The content was described as being clinical oriented. But since the course was not a part of a sequence, no attempt had been made to fit this course into the context of other courses taught in the nursing and allied health programs.

The laboratory associated with the microbiology course was used to back up portions of the lecture. In addition, enrichment, such as films and discussion, were included in the lab format. Certain skills were learned in the laboratory, which were said to apply to the allied health student's background. Part of these skills included culture technique, plating, sterilization methods and general immunology. Since the student population in this course was fairly homogenous, the laboratory was considered to be very appropriate.

This professor did not see any upcoming changes in this course, but was interested in possibly increasing the laboratory time. Some incliniation was expressed for making this course into a two-semester one. The audiotutorial approach was mentioned as a possible addition on a limited basis.

Faculty member "F" reported on his Nature Study B-214. This member considered the course to be functioning at the appropriate level for the students in it. This Nature Study B-214 is mainly an appreciation course for the non-science major, and would not build from any sequence. It was said to be a typical elective for the elementary education major.

The format of this course was such that the lecture and laboratory were combined. Usually, meetings were in the laboratory. This professor felt that such an approach allowed him to improve the development of content in the course. In addition, he made attempts to have "field" experience as part of the laboratory work. The function of the laboratory experience was to identify animal and plant specimens.

The opinion of the professor was that this course was important to the elementary education student. It was important to the elementary education student. It was a practical form of education in the sciences, which the professor felt the student could use later in the classroom.

Plans for course change were considered but incomplete. The faculty member had met with the Science Supervisor of the Fort Wayne Schools in preparation for possible changes.

Faculty member "G", responsible for Developmental Anatomy Z-215, considered this course adequate for the second semester sophomore, for whom it was intended. Most of the students were Indiana University enrolled as premedicine, pre-veterinary, pre-dentistry and others. This course usually had Zoology as its prerequisite.

The laboratory procedure in this course dealt with the study of prepared micro-slides and the dissection of the pig and shark. In this manner, the student became familiar with certain anatomical structures. This material usually preceded the lecture content. The faculty member felt that this allowed better understanding of lecture. No plans were anticipated for changes in this course.

A summary of some of the apparent needs of the Fort Wayne Biology Department was given by the Section Chairman. As a member of the department since 1965, he was aware of some of the problems which had arisen during these intervening years. The following were some of the considerations expressed by him:

1. The Biology Department had an excellent program designed for student needs of five years ago.

2. There was a great need for more insightful direction in planning for the department's future.

3. The faculty seemed indecisive about the direction of the Biology Department. They seemed to be waiting for direction to be handed down.

4. Some students' needs appeared to be in the para-medical and ecology fields.

5. Indiana University had responsibility for these para-medical areas, but better coordination was needed.

Interviews with professionals of the area.--The following represents the summary results from interviews of selected local professional people. Choice of people interviewed was, in part, on an "available" basis. All were part of the local population, in that they were employed by local firms, hospitals, and departments. The following points of discussion were included in the interviews:

1. Do you, or have you used the Purdue student in your organization?

2. If so, is he meeting the requirements of the job?

3. Do you feel he has the proper training and education to fill your job needs?

4. Do you see further need for more formal training as the job description changes?

5. Are you planning any expansion of your program?

6. Will you be requiring a greater number of such trained individuals?

7. Do you see any new programs for which you would need differently trained individuals?

Professional "S" was a nursing director at a local hospital. Purdue University provides several service courses for the students who are in training in this hospital. In this situation, the pre-nursing students are used on the hospital wards during the three-year training program. After graduation and registration, the hospital often hires a portion of these graduates.

This director felt that they were selective in their admission policy, and that graduates from their program were very able to meet the requirements for the R.N. degree. However, further training was recommended for the nurse who desired specialty nursing. This post-graduate training was provided by the hospital through special in-service programs.

No expansion of the program was planned at this hospital in the near future. Indeed, the concern was toward a possible saturation in the local area. Nursing graduates were said to find it difficult getting jobs in the immediate area.

Except for the special in-service training program, no different training was predicted for this professional group.

Professional "T", also a nursing director at another hospital in the area, did not use the Purdue campus in their program, but was associated with other teaching institutions in the city. Most of this discussion consisted of a repeat of the experience that professional "S" gave.

Professional "V", a chairman in another nursing program, was part of the Purdue University's two year nursing technology. Students from this program are employed regularly as a product from the Purdue program.

Training in this program was felt to be adequate, but the chairman was in the process of planning additional course work which could be applied to a proposed B.S. degree in nursing. At present, no anticipated growth of the present program or new training was seen.

Professional "W" represents a compilation of opinions of several professional laboratory people. A summary of these indicated that they were using graduates from the Purdue campus. With minor exceptions, the graduates were meeting the job requirements. Some feeling was expressed that an increase of laboratory skills might help. Also, changed content of some of the chemistry courses taught as part of the laboratory technology program might be considered.

Further training was usually expected when hiring most of these graduates. In addition, while there seemed to be a general need for more laboratory technologists, the local hospitals were not in a position to handle an increase in number through the intern training phase of the program. It was expressed that currently there was a demand for various levels of training for laboratory personnel. Special training was said to be necessary for those technologists who were involved in the operation of complex analysis instruments.

Professional "X", who was in the position of personnel director at the local Veterans Hospital, was currently trying to hire part-time help from the students in attendance at Purdue. This professional felt the need for several laboratory aids, who could be given "on-the-job training" for limited laboratory duties. This hospital facility did not have a formal training program for the laboratory technologist.

In addition, while nursing personnel were used in various types of nursing care, this hospital was limited to male patients.

Professional "Y", from the City Health Department, expected only limited use of graduates from the Purdue Biology programs. This department's specialty is microbiology, and it employed persons with degrees in this specialty. Even then, it was said that additional training might be necessary of those hired into this laboratory. This facility is presently expanding its facility and function, but would not presently be increasing the number of personnel; only four professionals were currently being employed.

Professional "Z", an M.D., was currently in the position of coordinator of the Regional Medical Program in the Fort Wayne area. As a newly organized group, this body planned a program to distribute a portion of the State Medical School students to regional teaching and hospital centers for part of their medical training. The attempt would be to reduce the congestion at the main branch of the Indiana Medical School at Indianapolis.

Plans were indefinite, and no tentative data could be projected as to when such a program would be effective in the Fort Wayne area. Neither was it known if the Purdue campus would be involved in a portion of this program.

In addition to the proposed regional medical program plan, this professional was asked about the possible use of the Physician's Assistant program in the State of Indiana. Certification of such trained individuals would be necessary, but according to the professional, Indiana was going slow in this regard. It was felt that at the present time such a program would operate only on a limited basis. Purdue was expected to help in such a training program. Fall, 1972 was expected as a starting date for this program.

Several graduates were interviewed, with the intention of outlining some general points concerning their biology training at the Purdue Regional Campus.

Of the three nursing programs in which the campus is involved, the graduates from two felt that the programs were generally very useful in their jobs. Purdue Nursing Technology, with its loose structure and less formal approach, received less complimentary reviews from the graduates than did the other two programs. The technology approach was said not to enable the student a maximal use of the college portion of the education. Indication from these students was that some improvement should be undertaken in this program.

The medical technologists who were interviewed, felt the following about their training and education:

1. The Purdue biology courses were fairly rigorous compared with other aspects of the medical technology program.

2. Some specific effort should be made to improve the appropriateness of certain biology courses needed in this program.

3. More skills should be included in the laboratory portion of certain courses.

Interviews with the biology majors in the Purdue program indicated a general planning to continue into graduate school or professional school such as medicine. These graduates were of the opinion that the biology program at Purdue was satisfactory. However, for those who intended to use their B.S. as a basis for job qualifications, there was some concern in not having sufficient job skills. Most of the group felt that on-the-job training would have to be part of their education after they were employed.

<u>Professional advisors</u>.--Several times during this study, the Biology Department at Fort Wayne was involved in curriculum meetings which brought in "experts". Dr. Dana Abel, who at the time was on the Commission on Undergraduate Education in the Biological Sciences, was one such person. Ideas evolving from this visit are summarized below:

1. An identity was needed for any biology department, since a unifying theme or program would allow the department to become known for its ability in certain education or training.

2. A department must have freedom in order to carry out any variation in a biology program. Autonomy was necessary to accomplish this.

3. No department could be creative if it must stick to the same course hours and numbers as found on the parent campus.

4. In fact, there should not be an attempt to duplicate offerings as found on the parent campus.

5. Most teaching in many departments consisted of a tyranny to the students.

6. Faculty should learn to make "learning situations" from different experiences.

7. Faculty should not attempt to "lock-step" lecture and laboratory function.

8. Departments should use laboratory facilities in varying ways to better express material content of the course.

9. Departments did not need an expert or specialist to teach each course at the undergraduate level.

10. The popularity contest syndrome should be avoided in any team teaching. Each instructor must be available and involved in the entire course. Coordination must be of high quality.

Summary.--The results of the cross-tabulation of questions from the student questionnaire are presented in this chapter in tabular form. Explanation of the significance of these tables follow. Next are the summarizations of personal interviews with the biology faculty, local professional personnel and graduate students from the local campus. Finally, a short summary is included from a professional advisor, who was considered to be an "expert" on certain aspects of curriculum problems.

The results from the questionnaire indicated the following facts:

1. A large majority of students enrolled in the biology courses were found to be non-biology majors, taking the course as required by another major. This was even true of several courses which were thought to be directed toward the "core" biology major.

2. While the biology major was a small percentage of the total student enrollment, when the medical, para-medical and science teaching students were grouped, the students were about evenly divided into science and those non-science oriented.

3. A great majority of the students questioned, were of the opinion that the courses as a whole had a moderate to great range of ideas (content), skills, and application.

4. A great majority of the students questioned, were of the opinion that the difficulty of ideas, skills, and application was only moderate.

5. Of the students questioned, there was approximately an even division of those who thought their course sequence of great help, compared to those who felt their sequence was only moderate to slight help in their present course.

6. The surveyed students were approximately evenly divided in their opinion as to how relevant the course content was to their educational needs.

7. A great majority of those students questioned, revealed they felt the relevance of skills was only little to moderate help to their educational needs.

8. The questioned group was evenly divided on opinion as to relevance of application of the course to their educational needs.

9. Concerning the value of their lab experience, the students ranged in their response, with 28 percent feeling it was of great help, 35 percent feeling it was of moderate help, 17 percent feeling it was of little help, and 17 percent felt it was a waste of their time.

The results of the hypotheses tested with the cross-tabulated questions are summarized as follows:

Hypothesis 1 tested the agreement that biology majors perceived their current biology course as being more relevant than did the non-majors in the same course. The null hypothesis was rejected, indicating that more biology majors felt the current course met their needs than did the non-majors.

Hypothesis 2 tested the agreement that the previous high school science of the student resulted in a different perception of his college biology course. This null hypothesis was not rejected. No difference could be shown between those students with previous high school science and those without. This may indicate that the high school science background is not related to the perceived relevance of the college biology course.

Hypothesis 3 tested the agreement that grade point average of the biology student resulted in a different perception of course relevance. This null hypothesis was rejected, indicating that the student with the better average saw more relevance to the course content and application. No significant association could be shown regarding relevance of skills.

Hypothesis 4 investigated the relationships between the perception of the professionally oriented student to his biology course, compared to the non-science major. This null hypothesis was also rejected, indicating that the professionally oriented student saw more relevance to the course's content, skills, and application.

Hypothesis 5 tested the strength of the relationship between the range of course concepts and the perceived relevance of that course. The null hypothesis was rejected, indicating that there was agreement among students that the range of course concepts increased the course's relevance of content and application. No significant association could be shown regarding skills.

Hypothesis 6 tested the agreement that the evaluation of the range of course skills would show a positive relationship to the perceived relevance of that course. This null hypothesis was not rejected. However, as seen in Table 4.33, there was one significant correlation when range of skills was cross-tabulated with the relevance of skills.

Hypothesis 7 tested the agreement that the evaluation of range of course application would show a positive relationship to the perceived relevance of that course. This null hypothesis was rejected, indicating that there was agreement among students that the range of course application increased their perceived relevance of that course.

Hypothesis 8 tested the agreement that the evaluation of difficulty of a course would be positively related to the student's perception of the relevance of that course. The null hypothesis was rejected. This indicated that there was agreement among students that difficulty of the course increased the perceived relevance of the course's content and application. Again, no correlation was present between skills and course difficulty.

Hypothesis 9 tested the agreement that the paramedical and science teaching majors differed from non-science majors in their perception of the value the laboratory had in clarifying the lecture material. This null hypothesis was not rejected, indicating that no correlation could be shown between professional aspiration of the student and how he felt the laboratory functioned in explaining lecture material.

The last hypothesis tested the agreement that the evaluation of content in previous biology courses related positively to the understanding and perceived relevance of the present course. The null hypothesis was rejected, indicating there was agreement that if the previous course was helpful, the present course seemed more relevant in its content and application. Skills were not found to be correlated with the previous course value.

The results of the interviews indicated that with little exception, most faculty members were planning a "status quo" approach to their courses for the near future. Several members who saw shortcomings in either their lecture or laboratory format, were not able to determine just how changes could be made.

The results from the Curriculum Committee indicated that generally, members became more aware of what their colleagues' courses were about, when discussion of these courses came up. It was recognized that more feedback was necessary from each member, if overlap or omission of certain material was to be avoided.

Several courses not included in this study were the focus of numerous comments by the faculty. A prime example was the beginning course for biology majors, and its function. The Principles of Biology 103-104, intended for such majors, was said to have many non-science majors in it. It was felt that such students would be better off in the Man in the Biological World, B-100. Several members expressed what they felt necessary as course content, and the credentials for any student enrollment.

Faculty members also prepared a list of skills they considered important to the biology major, but no clear way was indicated for their implementation into any courses. One suggested a separate course on instrumentation to fill this need for learned skills.

Response to suggestions made about possible course experimentation was met with the feeling that teaching loads and current research would not allow for such implementation. No attempts were made for freeing any faculty for such needed time.

Most local professional personnel seemed pleased to be approached on the topic of curriculum needs. The para-medical representatives expressed some concern about maintaining those courses intended to service their students. Local, state, and national requirements seemed to dictate a block of material useful for these students.

Credit hours also became a point of discussion. This seemed important to the nursing programs, where changes in contact hours could present a potential problem in scheduling.

The medical technology supervisors were concerned with the overall quality of the college portion of the training program. Several expressed the opinion that part of the core courses, normally taken by such students, was not useful. Some expression of concern was made about chemistry courses for these students. And finally, at least one supervisor was concerned about the need for more skills in the educational program.

Graduates from the local Purdue campus indicated that for the B.S. major, who planned advanced training, the core was satisfactory for their needs. Others, who intended to approach the job market with their B.S. degree, were insecure about what they could do with their particular training and education.

Lastly, the curriculum "expert" who was interviewed advised more variation in the program for the majors in biology. The "lock-step" approach was considered unsatisfactory, and more custom-made curriculum was suggested.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to gather quantitative and qualitative data concerning the biology curriculum currently being taught at the Purdue Regional Campus at Fort Wayne, Indiana. Also under investigation were the select needs of various para-medical programs such as nursing, medical technology, dental hygiene and mental health.

Review of the literature.--A selected review of the literature revealed a lack of specific research in the area under investigation, and established the need for such research. Reported on were general studies of the category including: (a) core biology programs, (b) biology for the non-major, (c) individual biology course revisions, (d) multifaceted approach to revision of the biology courses at Adelphi College.

Design of the study.--The study involved 360 students currently enrolled in one or more biology courses at the Fort Wayne campus. In addition, all full-time faculty in the Biology Department were interviewed, along with select professional groups in the local area. These were individuals associated in some way with the science oriented facilities, such as hospitals, laboratory units and Health Departments.

The instrument used on the student groups was designed to gather data on: (a) background and training of the student, (b) vocational interest of the student, (c) function of a given biology course, and (d) function of all the courses taken in sequence.

The biology faculty were particularly questioned on their own course, with respect to its content, place in the biology curriculum, ideas for improvement, and general concern for the biology programs.

With the professional group, the interviewing was done in connection with: (a) the professional's view of biology courses offered by Purdue, (b) further curriculum needs or changes anticipated, and (c) any further programs planned which might involve the Purdue Biology Department.

These personal interviews of the faculty and professionals were conducted by means of selected questioning and taping of the conversations. The data taken from the student questionnaire was coded by the writer and transformed to key punch cards. Analysis of the data involved tabulation, cross-tabulation and chi-square, using the BioMed-8 program from U.C.L.A. Frequency distribution and percentage were also done. All computation was formulated on the CDC-3600 and 6500 computers.

Hypotheses tested.--A series of hypotheses was tested which related to the general hypothesis that the nature of the student would relate significantly to his course needs and his perception of these needs being met by the curriculum. Furthermore, several hypotheses were tested which related to the general hypothesis that the difference in the nature of the biology courses would relate significantly to the student's perception of his needs being met by the curriculum.

Data for each hypothesis tested were required to show significance at the .05 level for rejection of the hypothesis. In addition to the .05 as the minimum criterion, the .01 and .001 level were reported on several occasions.

Summary of findings.--In an attempt to deal with the curriculum from the student's viewpoint, relevance of the different courses was determined in terms of what the various groups of students felt were their educational needs. In each individual course the focus was on content, skills, and application of the course material.

In the first hypothesis tested, both the biology majors and non-majors found content and application more relevant than they did the skills. However, less than 75 percent of the majors found their courses relevant in any of the three areas.

In the second hypothesis, there was no relationship established between science background of the student and his perceived relevance of a college biology course. There is some indication in Table 4.20, that those students who had several high school science courses were merely bored with their course, while those who had no background may have found the courses more interesting.

Students with a higher grade point average found content and application of their courses relevant to their educational needs. However, it may be that these students were able to develop relevance in their courses due to their own native intellect, in spite of their instructor. Skills were not found to be relevant in hypothesis three.

The majority of science-oriented students felt their course was relevant in all three areas of content, skills, and application. The tables associated with hypothesis four indicated the majority of the non-science students felt their courses to be of little relevance. In fact, 55 percent of the non-majors indicated that their courses had little or no relevance to their professional need. This is direct evidence that most of the courses were geared for the science major. A further comparison of these tables associated with hypothesis four and hypothesis one, indicated a greater percentage of biology majors felt their course was relevant than did the science oriented student. This may be evidence that the courses are not oriented to science, but rather to the biology major. Yet Tables 4.1, 4.4, and 4.11, which indicate why a student might be in a particular course, illustrate the fact that few students are either majoring or minoring in the biological sciences. The question which then arises is: Why are we trying to make biologists of everyone?

When the range of concepts was cross-tabulated with relevance, a positive relationship was found with both content and application. Again, skills did not show a significant correlation.

An indicator of the success of a course might be the number of concepts the average student is able to grasp. Indeed, while nearly 80 percent of the total sample felt there were many concepts presented, only about 50 percent of this smaller sample felt they were relevant.

In testing hypothesis six, no positive relationship was found between range of skills and relevance of content and application. There was a correlation between range of skills and relevance. However, the number of students who felt a great range of skills were present was quite small when compared with the total.

A positive relationship was established between range of application and all three dependent variables indicating relevance.

About 65 percent of the students felt the biology courses were moderately difficult. Those students having little difficulty with the courses perceived them as having more relevance than those who found the courses difficult.

Certainly, with the wide variety of students found in the biology curriculum, the need to determine the success of an accompanying laboratory becomes important. Hypothesis nine tested the relationship of the laboratory experience to those science and non-science oriented students. No correlation was found in this tabulation. However, the percentage of both science and non-science oriented students who thought the lab was of little or no help was quite high. Of the science group, 31 percent were of this opinion. Forty-one percent of the non-science group felt the lab was of little or no benefit.

In the last hypothesis, there was an agreement among the students that if the previous course was generally helpful in understanding the present course, the current course seemed more relevant in content and application.

Discussion and recommendations.--One of the initial purposes of this study was to determine the effectiveness of the Purdue Biology Department in meeting the educational needs of its students. The survey indicated, in most cases, that we are not meeting many of these needs. A number of immediate revisions are called for. Until such time as autonomy and increased space become a reality, the following steps are recommended:

1. Since some students are not being directed into proper courses, advisors should be thoroughly informed concerning course prerequisites and content. For example,

Biology 108-109 shows a greater percentage of students designated as non-science. Yet these courses are listed in the Indiana Catalog as intended for their biology major. Since neither course has a prerequisite, many students other than science or allied health tend to enroll in them to fill part of their science requirement.

2. Reorganize those courses which were under "fire" by the Curriculum Committee. The B-100 Man in the Biological World is a high priority for this recommendation, along with one or more of the core courses. Both the students and the faculty member of B-100 felt the text and the course in general had very difficult content. While not covered by the student questionnaire, the faculty believed the 103-104 Principles course, which initiates the core program, should be abbreviated since it covered much more material than needed.

3. Reorganize the laboratory in such courses as B-100, Biology of Man 203, and Physiology P-215. The associated laboratories ranked particularly low in usefulness to the students as indicated in the questionnaire.

4. Professionally oriented groups, such as the biology majors and the pre-medical students, need to be directed into courses specially designed for their needs, in terms of content skills and application. Others should not have the option of enrolling in these courses. In any course, attempts should be made to get students with more

common academic interests together, thereby maximizing the benefits of a given course.

5. The study also indicates that the needs of the non-science group are not being met. More emphasis and objective planning needs to be developed in several of the courses offered to the non-major.

6. Increase the feedback to each faculty member teaching core courses. Interaction with other biology faculty must be increased if undue overlap and omission are to be reduced.

7. Achievement of necessary feedback should also be derived by conducting another student survey similar to the one just completed. Emphasis should be on the student's evaluation of relevance of the course, its range and difficulty of content.

8. Consider making more functional use of the student's high school background through means of a 'testing out' program. Students could become exempt from certain college biology courses in which they had an appropriate and sufficient backlog of experience.

While the previous suggestions should be implemented immediately, long range planning and coordination should be focused on developing and initiating the following:

1. Improvement in actualizing the recommendations made by the Curriculum Committee, with plans to involve

other science oriented departments, such as chemistry and physics. This would allow for more far-sighted planning and coordination of content and skills through interdepartmental cooperation.

2. Increase participation with certain science oriented concerns, such as hospitals, laboratories, pharmaceutical concerns and the like. Student participation of on-the-job-training and 'real-life' laboratories would increase the relevance of numerous courses now offered.

3. Increase the coordination of existing science programs such as medical technology and nursing.

4. Increase the use of television programs from each of the main campuses. Television and live demonstrations, for example, from the Medical Center in Indianapolis would enrich courses at Fort Wayne.

Conclusions.--The 360 students questioned represented a statistically valid sample of the total enrollment in the Biology Department at this campus. Therefore, the responses and reactions from the students represent a reflection of both the positive and negative aspects of the present curriculum.

Considering the trends and general approaches to learning across the Nation, these students have become an important factor in the future success of any program.

In reviewing the responses and reactions from faculty and local professionals, it was concluded that each of these groups were in agreement with the responses of the students on such matters as relevance of content, skills, and application. However, the students seem to focus on problems in a given course much sooner than did the teaching staff.

Back in 1959, Ruml and Morrison raised the question as to the ability of college personnel to plan respectable curriculum changes at the college level.[1] These writers maintained that generally, college departments were unable to rise above departmental self-interests, to unbiased considerations of what constituted first-rate general education. They stressed further consideration be given to increased study of curriculum questions and the establishment of faculty-trustee curriculum committees, who would have powers to transcend departmental authority.

At this campus, the faculty's lack of awareness of student needs, lack of sufficient space and funds, and low motivation for restructuring existing programs rank high as prime reasons for curriculum deficits.

In the interim since the study was begun, some recommendations from the Curriculum Committee have resulted in minor reorganization of the B-100 and the 103-104 courses.

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[1]Ruml and Morrison, *Memo to a College Trustee* (New York: McGraw-Hill, 1959).

However, no attempt has been made in the area of increasing the skills. Neither has there been any improvement in the course counseling for students.

One of the main responsibilities of the faculty lies in the recognition of the need for continual up-grading and reorganization of curriculum. We must be on the alert for ways of producing educational programs which the students and society find pertinent and useful.

BIBLIOGRAPHY

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Books

A.S.C.D. *Strategy For Curriculum Change.* Washington, D.C.: Association for Supervision and Curriculum Development, 1965, pp. 4-9.

Beauchamp, George A. *Curriculum Theory.* Wilmette, Ill.: The Kagg Press, 1968, pp. 55-76.

Black, Hillel. *The American Schoolbook.* New York: Morrow, 1968.

Bloom, Ben, ed. *Taxonomy of Educational Objectives, Handbook I; Cognitive Domain.* New York: Longmans Green, 1956.

Caswell, H. L. *Emergence of the Curriculum As A Field of Professional Work and Study.* New York: New York Teachers College Press, 1966.

Dressel, Paul. *Undergraduate Curriculum Trends.* Washington, D.C.: American Council on Education, 1969.

________, and L. Mayhew. *General Education: Exploration in Evaluation.* Washington, D.C.: American Council on Education, 1954.

Evans, Luther. *Modern Viewpoints In The Curriculum.* New York: McGraw-Hill, 1964, pp. 1-7.

Gagne, Robert. *The Analysis of Instructional Objectives for the Design of Instruction.* Washington, D.C.: N.E.A., 1965.

________. *The Conditions of Learning.* New York: Holt, Rinehart and Winston, 1967.

Galbraith, J. K. *The New Industrial State.* Boston, Mass.: Houghton Mifflin, 1967.

Goodlad, John I. *The Changing School Curriculum.* N. Y. Fund for the Advancement of Education. New York: The Georgian Press Inc., 1966, pp. 41-43.

Hoopes, Robert. *Science in the College Curriculum.* Conference Report on Oakland University, Oakland University, N.S.F. Grant, Washington, D.C., 1963.

Koopman, Robert G. *Curriculum Development.* New York: Center for Applied Research in Education, Inc., 1966, pp. 25-46.

Kliebard, Herbert. *The Curriculum Field in Retrospect.* New York: New York Teachers College Press, 1968.

Mager, Robert. *Preparing Objectives for Programmed Instruction.* San Francisco: Fearon Press, 1964.

McAshan, H. H. *Writing Behavioral Objectives.* New York: Harper and Row, 1970.

Postlethwait, Sam. *The Audio-Tutorial Approach to Learning.* Minneapolis, Minn.: Burgess Publishing Co., 1969.

Tyler, Ralph. In *Modern Viewpoints in the Curriculum.* New York: McGraw-Hill, 1964, pp. 13-15.

Ruml, Beardsley, and Morrison. *Memo To A College Trustee.* New York: McGraw-Hill, 1959.

Periodicals and Bulletins

Ammons, Margaret. "An Empirical Study of Process and Product in Curriculum Development." *Journal of Educational Research*, 57 (1964), 451-457.

Baker, J. "The State of Biology in Liberal Education." *C.U.E.B.S. News*, 5, No. 2 (1968), 4.

Commission on Undergraduate Education in the Biological Sciences. "Biology For The Non-Major." Publication No. 19, 1967, pp. 5-10.

________. "Content Of Core Curricula In Biology." Publication No. 18, Washington, D.C., 1967, pp. 1-31.

Cox, Donald. "Another Look At The Core Curriculum." *C.U.E.B.S. News*, 7, No. 5 (1971).

Cox, Donald. "Goals of Biological Education." *BioScience*, 21, No. 23 (1971), 1172.

Creager, Joan. "Why Do We Have To Study All This Crap?" *C.U.E.B.S. News*, 6, No. 3 (1970), 12.

Hall, Thomas S. (Chairman, C.U.E.B.S.). "Core Studies For The Undergraduate Major." *BioScience*, 14, No. 8 (1964), 25-29.

Kieffer, George. "Toward a Biological Awareness." *C.U.E.B.S. News*, 6, No. 4 (1970), 1-7.

Mohrig, Jerry, and Nancy Tooney. "Biochemistry in the Undergraduate Curriculum." *Journal of Chemical Education*, 46 (1969), 33-35.

Moment, Gairdner B. "Challenge and Response in Freshman Biology." *C.U.E.B.S. News*, 7, No. 2 (1970), 6-8.

National Academy of Science Report. "Recommendations on Undergraduate Curricula in the Biological Science." Publication No. 578, National Research Council, Washington, D.C., 1958.

Postlethwait, Sam. "Planning For Better Learning." *Current Issues In Higher Education*, American Association for Higher Education, Washington, D.C., 1967, pp. 17-21.

Reif, F. "Science Education for Non-Science Students." *Science*, 164 (May, 1969), 1032.

Ritter, Hope, Jr. "The Changing Role of Biology in the 70's." *C.U.E.B.S. News*, 7 (June, 1971).

Roos, Thomas B. "Preparation in Biology for Education in the Health Sciences." *BioScience*, 20, No. 3 (1970), 164-168.

Shaw, Frederick. "The Changing Curriculum." *Review of Educational Research*, 36 (1966), 343-352.

Wilhm, Jerry. "Man In The Environment." *American Institute of Biological Sciences (A.I.B.S.)*, 1, No. 1 (1972), 6-9.

Other Resources

Brenowitz, A. H. "Reorganization of the Adelphi College Biology Curriculum." Doctoral dissertation, Columbia University, 1958.

Center for Curriculum Studies. University of Minnesota, personal communication, February, 1972.

Curriculum Committee Minutes. Biology Department, Purdue University, Fort Wayne Campus, Ind., November, 1969.

Educational Testing Service. Princeton, New Jersey, personal communication, April, 1972.

Raksaboldej, Bitak. "A Survey of Science Programs In Selected State Teachers Colleges." Doctoral dissertation, New York University, 1961.

Smith, L. D. (Chairman). Annual Report of the Core Committee, Purdue University, Biology Department, LaFayette, Ind., 1972.

Sugrue, Mary. "Structure and Process of Inquiry Into Social Issues in Secondary Schools." Doctoral dissertation, University of Michigan, H.E.W. Grant No. OEC 3-7-061678-2942, 1970.

APPENDIX

STUDENT OPINIONNAIRE

REGIONAL CAMPUS AT FORT WAYNE
BIOLOGY DEPARTMENT

The Biology Department at this campus, in its continuing attempt to meet the needs of its students, is undertaking a critical study of biology course offerings.

We consider student reactions to these offerings as a necessary part of this study. Therefore, information you give on this opinionnaire should be your honest and thoughtful response to the questions. Results of the study will be used to determine the effectiveness of the Biology Department's offerings in meeting your needs. Please make no marks which will identify you.

1. In which course did you receive this questionnaire?

____

2. Your age at nearest birthday?

_____ 17-19

_____ 20-21

_____ 22-24

_____ over 24

3. Sex: _____ male _____ female

4. Marital status:

_____ single

_____ married

_____ divorced

5. Your legal residentce:
   _____ Fort Wayne
   _____ 25 mile radius of Ft. Wayne
   _____ Indiana resident greater than 25 miles
   _____ not residing in Indiana

6. What is your level in college?
   _____ freshman _____ sophomore
   _____ junior _____ senior

7. What is your course load?
   _____ full-time student
   _____ part-time student

8. What is your grade average?
   _____ A average _____ B average
   _____ C average _____ below C average

9. What high school sciences did you have?
   _____ Biology _____ Chemistry
   _____ Zoology _____ Physics
   _____ Botany _____ Other science
   _____ Geology

10. Why are you taking this course in biology?
   _____ I plan a major in biology.
   _____ I plan a minor in biology.
   _____ This is the only biology course in my program.
   _____ This is a required course in another major.
   _____ This is an elective in my major.

11. What professional aspirations do you have?

_____ Medicine

_____ Dentistry

_____ Vet. Medicine

_____ Nursing

_____ College biology teaching

_____ Other college teaching

_____ High school science teaching

_____ Primary science teaching

_____ Other profession (cite)

12. Evaluate your present course in terms of how great a range of ideas were covered:

_____ Great number of concepts covered

_____ Moderate number covered

_____ Little or no concepts covered

13. Evaluate your present course in terms of how difficult were concepts which were presented:

_____ Very difficult

_____ Moderate difficulty

_____ Little or no difficulty

14. Evaluate your present course in terms of how relevant were such concepts to your educational needs:

_____ Very relevant

_____ Moderate relevance

_____ Little or no relevance

15. Evaluate your present course in terms of how great a range of skills were covered:

_____ Great number of skills

_____ Moderate number of skills

_____ Little or no skills present

16. Evaluate your present course in terms of how difficult the skills were which were presented:

    _____ Very difficult to learn

    _____ Moderate difficulty

    _____ Little or no difficulty in learning

17. Evaluate your present course in terms of how relevant such skills were to your educational needs:

    _____ Very relevant

    _____ Moderate relevance

    _____ Little or no relevance

18. Evaluate your present course in terms of how great a range of application was present:

    _____ Great range of application

    _____ Moderate range of application

    _____ Little or no application

19. Evaluate your present course in terms of how great a difficulty there was in application of material:

    _____ Great difficulty in application

    _____ Moderate difficulty in application

    _____ Little or no difficulty in application

20. Evaluate your present course in terms of how relevant the application of material:

    _____ Very relevant

    _____ Moderate relevance

    _____ Little or no relevance

21. What method of material presentation did you like best?

_____ Lecturing

_____ Audio-visual aids

_____ Discussion periods

_____ More than one of above

22. Evaluate the instructor's ability to communicate knowledge, ideas and application of information:

_____ Excellent

_____ Above average

_____ Average

_____ Below average

_____ Poor

23. The laboratory to the present course was:

_____ Great help in understanding topic material

_____ Moderate help to understanding

_____ Interesting, but of little help

_____ Generally a waste of my time

24. Have the sequence of biology courses been helpful in understanding this course?

_____ Great help in present course

_____ Only moderate help in present course

_____ Of no use in present course

_____ No other course in biology