

DOCUMENT RESUME

ED 200 075

HE 013 532

AUTHOR Hunter, Jacqueline; And Others
 TITLE CAUSE Grant SER77-06227. Final Report.
 INSTITUTION Xavier Univ. of Louisiana, New Orleans.
 SPONS AGENCY National Science Foundation, Washington, D.C.
 PUB DATE Dec 80
 GRANT NSF-SER-77-06227
 NOTE 194p.: Appendices may not reproduce well.

EDRS PRICE MF01/PC08 Plus Postage.
 DESCRIPTORS *Academic Achievement; *Academic Persistence; Achievement Tests; Biology; Black Colleges; Chemistry; Cognitive Objectives; *College Mathematics; *College Science; College Students Course Content; Critical Thinking; Departments; *Developmental Studies Programs; Educational Assessment; Educational Objectives; Higher Education; *Introductory Courses; Learning Centers (Classroom); Physics; Program Evaluation; Program Implementation; Quantitative Tests; Science Departments; Science Tests; Student Evaluation; Test Construction
 IDENTIFIERS *Xavier University of Louisiana

ABSTRACT

The implementation and evaluation of a project at Xavier University of Louisiana that was designed to increase performance and academic persistence in entry-level mathematics and science courses are described. The University's CAUSE Project was a cooperative effort by the departments of biology, chemistry, mathematics, and physics. Strategies of the project were to: develop a mechanism whereby the department assumed responsibility for choosing content and deciding pacing for entry-level courses; develop detailed prescriptions for and administer final exams to assess progress from year to year; and develop a set of alternate pathways for learning content objectives. Each of four departments have developed and refined student handbooks containing content objectives, related sample problems, and a list of alternate learning aids for each topic; developed common final course examinations; developed and field tested at least five Piagetian-based laboratory experiments designed to promote analytical thinking skills; and jointly planned, renovated, and furnished a multidepartmental Alternate Pathway Learning Center. Among the results of the project are that the chemistry and physics departments increased the percentage of students completing both semesters with a grade C or better. Results for the other departments are also presented. A detailed outline of implementation activities and extensive appended materials on the project are included. (SW)

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Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125, TELEPHONE 504/486-7411

STANDARDS WITH SYMPATHY APPLIED: An Executive Summary of CAUSE Grant SER77-06227

OVERVIEW: Xavier University of Louisiana is a small, predominantly-Black institution located in the heart of New Orleans. The University has both a strong commitment to a liberal arts education and to increasing the number of Black Americans who obtain careers in science-related fields. Over the past two years approximately 140 students have gained admission into natural science-related graduate or professional schools. In the fall of 1980, more than 900 of the approximately 2000 students at Xavier were majoring in a mathematical, natural, or health science. This is 50% higher than the enrollment in these fields four years ago. A major factor in XU's success in providing Black Americans access to science-related fields has been the University's commitment to an institutional philosophy of "standards with sympathy"-- coupling high academic expectations with mechanisms which allow disadvantaged students to attain success.

XU's CAUSE Project was a direct extension of the philosophy of "standards with sympathy." Its primary objective was to increase performance in and reduce attrition from entry-level mathematics and science courses so as to maximize the number of students who graduate in the sciences. The project was conceived and implemented as a cooperative, multidisciplinary effort by the Departments of Biology, Chemistry, Mathematics, and Physics. The basic strategies chosen to achieve the stated objective were for the four departments to work cooperatively so each could

- 1) develop a mechanism whereby the entire department, not individual instructors, assumed responsibility for choosing content and deciding appropriate pacing for entry-level courses,
- 2) develop detailed prescriptions for and administer common final exams so as to improve ability to determine success in transmitting prespecified content from year to year, and
- 3) develop a comprehensive set of "alternate pathways for learning" each set of content objectives in each entry-level course and to establish a joint facility (the Alternate Pathway Learning Center--APLC) for using alternate pathways.

This particular approach was chosen because a) it increases the ability of the departments to provide assistance to inexperienced faculty, b) adherence to a common content framework makes it possible to establish cooperatively (within a department) a much more extensive system of "alternate pathways" than any one faculty member could support alone, and c) a joint, multi-departmental approach to development makes it possible to implement and sustain activities at the least possible cost.

(over)

SUMMARY OF ACTIVITIES COMPLETED: Xavier's CAUSE Project progressed extremely well with only minor deviation from the development outlined in the original proposal. Each of the four departments have:

- ...Developed, field-tested, evaluated, modified, refined, etc. "handbooks" for use by students in each of the entry-level courses for science majors at Xavier. The handbooks contain the departmentally-specified content objectives, related sample problems and/or tests, and a list of alternate learning aids for each topic.
- ...Designed and begun to administer common final examinations in each section of each course every semester.
- ...Developed and field-tested a minimum of five Piagetian-based laboratory experiments designed to promote analytical thinking skills. In addition, Chemistry has developed an entire two-semester sequence of such experiments and now uses them for all general chemistry courses.
- ...Jointly planned, renovated, and furnished a multi-departmental Alternate Pathway Learning Center (APLC) a semester ahead of schedule.

PROGRESS IN ACHIEVING STATED OBJECTIVE: The modification of entry-level course and development of the APLC has resulted in significant progress in obtaining the stated objectives of reducing attrition from and improving performance in entry-level mathematics and natural science courses for science majors as noted:

- ...Biology increased the percentage of "off-semester" students who successfully completed Biology 123-124 from 25% to 50% as a result of CAUSE. In addition, there was a 24 percentile increase in performance on the CLEP General Biology Exam.
- ...Chemistry increased the percentage of students completing the first semester of general chemistry with a "C" or better from 60% to 74% and increased percentage completing both semesters with a "C" or better from 45% to an average of 58% while, at the same time, increasing level of performance on finals in both semesters.
- ...Mathematics increased the percentage of students completing both Precalculus and Calculus I with a "C" or better while noting slight increases in level of performance.
- ...Physics increased the percentage of students completing both semesters of Physics with a "C" or better from 53% before CAUSE to an average of 75.5% after CAUSE while, at the same time, increasing the level of performance on the second semester final from an average of 51 to 63.

In addition to obtaining the specific objectives of increasing performance in and reducing attrition from entry-level biology, chemistry, mathematics, and physics courses for science majors, XU's CAUSE Grant also significantly increased the ability of the four departments to evaluate their programs from year to year. Each department now administers common final exams written from departmentally-prepared "prescriptions" and has implemented systematic collection and comparison of performance from year to year for evaluation purposes.

For additional information, contact JW Carmichael, Director, CAUSE Project SER77-06227. Prepared 12/15/80.

TABLE OF CONTENTS

for

Final Report for CAUSE Grant SER77-06227

I.	Overview of Xavier University of Louisiana.....	1
II.	Overview of the Progress of XU's CAUSE Grant	
	Specific Objectives.....	3
	Basic Thrust.....	3
	Premises.....	3
	Historical Development.....	4
	Management.....	4
	Specific Accomplishments.....	5
III.	Detailed Description of the Implementation of XU's CAUSE Project	
	Activities of a General Nature Implemented Via CAUSE.....	7
	Activities Implemented by the Biology Department Via CAUSE.....	13
	Activities Implemented by the Chemistry Department Via CAUSE.....	19
	Activities Implemented by the Mathematics Department Via CAUSE.....	26
	Activities Implemented by the Physics Department Via CAUSE.....	33
IV.	Evaluation	
	Formative Evaluation.....	37
	Summative Evaluation	
	General.....	40
	Biology.....	41
	Chemistry.....	44
	Mathematics.....	48
	Physics.....	51
	On-Going Evaluation.....	54
V.	Dissemination.....	55
VI.	Summary.....	59
VII.	A Footnote (XU Included in Study of Impact of CAUSE).....	61

(over)

Appendices

- I--Enrollment Statistics for Natural Sciences at XU 1970-80
- II--Brief Overview of CAUSE-sponsored Workshop on Problem-Solving
- III--An Overview of Project SOAR
- IV--Schedule & Consultant's Report for Biology, 1978
- V--Schedule & Consultant's Report for Biology, 1979
- VI--Schedule & Consultant's Report for Chemistry, 1978
- VII--Schedule & Consultant's Report for Chemistry, 1979
- VIII--Schedule & Consultant's Report for Mathematics, 1978
- IX--Schedule & Consultant's Report for Mathematics, 1979
- X--Schedule & Consultant's Report for Physics, 1978
- XI--Schedule & Consultant's Report for Physics, 1979
- XII--A Prescription for the Common Final in Mathematics 103
- XIII--Statistical Data For the Common Precalculus Final, 1978
- XIV--Program from NSTA Meeting Indicating Presentation by Hunter
- XV--Program from NSF CAUSE Seminar Indicating Presentation by XU
- XVI--Statistics for Usage of Alternate Pathway Learning Center
- XVII--Program from SREB Science Instruction Seminar
- XVIII--Schedule & Consultant's Report for Overall CAUSE Project, 1980
- XIX--Program for International Conference for Individualized Instruction
- XX--Continuation Plans for Biology
- XXI--Continuation Plans for Chemistry
- XXII--Continuation Plans for Mathematics
- XXIII--Continuation Plans for Physics
- XXIV--Article from Journal of Developmental & Remedial Education re CAUSE
- XXV--Article from Journal of Chemical Education re CAUSE-Chemistry at XU
- XXVI--Article from American Biology Teacher re Project SOAR at XU
- XXVII--Article from Journal of Reading re Project SOAR at XU
- XXVIII--Program from 6th Biennial Conference on Chemical Education re XU Chem.
- XXIX--Overview of XU's Math Project from Handout at 4th Intern. Congress on Mathematical Education, San Francisco, August, 1980
- XXX--Persons Requesting Information About XU's CAUSE Project

I. Overview of Xavier University of Louisiana

Xavier University of Louisiana is a small, predominantly Black institution located in the approximate geographic center of the city of New Orleans. In the fall of 1980, its total enrollment is the largest ever--2,003--of which approximately 925 students are natural, health or mathematical science majors (see Appendix I for enrollment statistics for the past eleven years). The University's primary mission is to provide educational opportunities to Black Americans with emphasis on residents of the Gulf South. Xavier's institutional philosophy might be summarized as "standards with sympathy"--a commitment to accept appreciable percentages of students with discernible academic weaknesses, coupled with an equally strong commitment to demand a high standard of performance for graduation. It is possible to do both simultaneously only because the University provides extensive support services, especially at the freshman level.

Xavier's past performance is best exemplified by the outstanding success of its alumni who include:

The Honorable Ernest "Dutch" Morial, Mayor of the City of New Orleans the first Black American to be elected to that position.

Ms. Mary Munson Runge, President of the American Pharmaceutical Association, the first Black and first female to hold that position and member of President-Elect Reagan's Advisory Committee for Science and Health.

Mr. Joseph Hall, President of the National Pharmaceutical Association. (With Mr. Hall's election, Xavier became the only institution to have alumni simultaneously serve as presidents of the two major pharmaceutical associations.)

Dr. Claude Organ, M.D., Chairman and Professor of the Department of Surgery at Creighton Medical School.

Dr. Joseph Henry, Jr., D.D.S., Associate Dean, Harvard School of Dental Medicine, the first black to hold such a position at Harvard.

Dr. Norman C. Francis, President of Xavier University, President (1980) of the Southern Association of Colleges and Schools, Past-President of the College Entrance Examination Board, Member of the Pontifical Commission on Justice and Peace, and Member of President Carter's Advisory Committee for HEW.

The extent to which the sciences continue the University's record of achievement is indicated by the following representative statistics from more recent years:

1. In the past six years, 85 of 100 XU students who applied to medical or dental school gained admission. This acceptance rate, 85%, is more than twice that national average for either minority or majority students during that period.

2. During the past two years alone (1978-79 + 1979-80), Xavier placed approximately 125 students into medical, dental, pharmacy, or science-graduate schools. Further, the students gained admission into some of the nation's most prestigious schools including Harvard Medical School, Stanford Medical School, University of California--San Francisco Medical School, Tulane Medical School, etc.
3. Xavier's College of Pharmacy is the only such facility in southern Louisiana. Over the past three years (the only ones during which the State has provided comprehensive feedback), XU graduates have a higher pass rate on the Board than do non-XU graduates.
4. In 1977-78, a Chemistry graduate from Xavier was the only student from a Louisiana institution to receive a prestigious Danforth Fellowship for graduate study.

II. Overview of the Progress of XU's CAUSE Grant

Specific Objectives:

CAUSE Grant SER77-06227 to Xavier University of Louisiana funded a multi-departmental effort by Biology, Chemistry, Mathematics, and Physics to further develop the entry-level science and mathematics courses for science majors in an effort to make science careers more accessible to the minority students whom Xavier serves. The specific objectives of the grant were:

1. To reduce attrition from entry-level mathematics and natural science courses for science majors.
2. To increase the level of performance by students in those same courses.
3. To develop mechanisms for each department to use in objectively comparing level of performance of students in entry-level courses from year to year.

Basic Thrust:

The basic thrust of the CAUSE Grant at Xavier was to develop "departmental" entry-level courses which would make it possible to:

1. More objectively compare student performance from year to year.
2. Provide better and more specific assistance to new or part-time faculty.
3. Establish a uniform educational base on which upper-level instruction could be developed.
4. Provide a common framework for instruction so as to facilitate the use of alternate pathways for learning with emphasis on those beneficial to the educationally-disadvantaged.

Premises:

As a framework within which to cast anticipated curriculum development, each of the four participating departments agreed to a basic set of premises before initiating the CAUSE proposal. They were:

1. A department, not an individual instructor, should determine the content of entry-level courses.
2. It is possible to integrate activities to assist the educationally disadvantaged within regular entry-level courses without adversely affecting quality of instruction--i.e., "sympathy" and "standards" are not incompatible.
3. All development must occur within the context of the University as a whole with particular emphasis on constant consideration of what Xavier can afford to support financially after the grant period.

4. Evaluation must be a constant and ongoing part of the project if it is to gain true departmental acceptance and have long lasting impact.
5. A cooperative, multi-departmental effort is most likely to have the desired impact on entry-level courses because this approach allows departments to benefit from each other's experiences and promotes the development of activities across departmental lines which will be academically reinforcing.

Historical Development

The CAUSE Project at Xavier was a direct outgrowth of a systematic consideration of what had been successful in the individual departments in the past and a commitment to well-defined departmental goals to improve entry-level courses as a means of increasing the number of Black Americans graduating in science-related fields.

Planning for the activities undertaken in the CAUSE Grant began in the spring of 1976 when representatives from the entire Division of Natural Sciences met at the request of the University Dean, Sr. Mary Veronica Drawe, to review past efforts to improve education in the entry-level courses in the Division and to discuss future plans for doing so. As a result of that meeting, each department appointed a representative to a committee empowered to a) review the past efforts at Xavier and elsewhere in more detail, b) make recommendations for future development, and c) pending approval by the participating departments, seek funds to implement the development needed.

In subsequent meetings in the spring of 1976, the committee determined that first efforts should be directed toward a) investigating new ways of improving problem-solving skills with emphasis on Piagetian-based activities, b) mutual auditing of each of the entry-level courses so that the representatives could determine extent of overlap and areas where cooperation was likely to be possible, and c) establishing a mechanism for meeting on a regular basis for considering further developments.

During 1976-77, the same committee a) audited each other's courses, b) met on a regular weekly basis for one hour to develop the ideas which they eventually wrote into the CAUSE proposal, c) began efforts to develop Piagetian-based materials, and d) conducted the first of a series of special summer programs which function, to a large degree, as a place where new ideas can be tested without the content and grade constraints of the academic year.

In summary, the CAUSE Project at Xavier was a direct outgrowth of extensive planning and past development at the University on the part of the faculty within the departments to whom the grant was awarded.

Management:

The CAUSE Project at Xavier was implemented by the "CAUSE Committee". The initial members of the committee were the same group of faculty, one from each of the participating departments and a director, who had completed the previous planning and had written the proposal. Subsequent efforts to expand the membership of the committee in an effort to ensure that development was truly

departmental were extremely successful. Two other faculty voluntarily joined the committee even though doing so meant an extra one-hour weekly meeting, six became sufficiently involved so as to assume, for all practical purposes, "associate membership," and essentially all of the remainder of the faculty in the departments (approximately 12) were actively involved in the development and evaluation a number of times. Of particular note was the successful integration of new faculty into the project as they were hired by the University. The following lists the membership of the CAUSE Committee during the grant period:

Original Representatives: Jacqueline Hunter, (Biology), Mary Ann Ryan (Chemistry), Lester W. Jones (Mathematics), Harold Vincent (Physics), and JW Carmichael, Jr. (Director, Chemistry)

Voluntary Additions: Sr. Grace Mary Flickinger (Biology), Bill Irlbeck (Mathematics), and Sr. Joanne Bauer (Chemistry)

Associate Members: Deidre Labat (Biology), Donald Robinson (Chemistry), Sr. Rosemarie Kleinhaus (Mathematics), Winston Brown (Mathematics), and Douglas Ruby (Biology)

Specific Accomplishments

Xavier's CAUSE Project progressed extremely well with very little deviation from the proposed developed outlined in the original proposal. The specific accomplishments of the grant were as follows:

1. All four departments specified content objectives for both semesters of the entry-level lecture courses for science majors (Biology 123 & 124, Chemistry 101 & 102, Mathematics 103 & 104, and Physics 201 & 202). Development has been particularly significant in Biology and Mathematics. Biology chose this opportunity to initiate an entire year of introductory general biology to replace a semester of general biology and a semester of zoology. Mathematics, in an equally important move, modified Pre-Calculus (Mathematics 103) so as to greatly increase emphasis on practical skills and developed a completely new survey of Calculus (Mathematics 104) designed to serve as either a terminal course for those students who need only one semester or the first semester of a three-semester sequence for those who need more Calculus.
2. All four departments developed, field-tested, evaluated (by departmental, divisional, and outside consultants), modified, etc. "handbooks" for use by students in each course. The handbooks contain the content objectives, sample problems and/or tests, references to alternate pathways for learning, etc. The materials are used by all faculty teaching in a given course and are available in the University bookstore at a fee only slightly above cost so that each student has an individual copy without placing undue financial strain on the University.

3. All four departments completed development of specifications for the finals in their respective entry-level sequences and Biology, Chemistry, and Mathematics have found standardized exams to use so that student performance from year to year can be more easily compared in the future.
4. All four departments developed and field-tested a minimum of five Piagetian-based laboratory experiments designed to promote analytical thinking skills. Chemistry further developed an entire two-semester sequence of such materials and now uses the experiments in its general chemistry laboratory courses. Biology and Physics have developed approximately ten such experiments each and are field-testing them in entry-level courses at present.
5. Representatives from all four departments attended a series of "hands-on" workshops designed to acquaint the faculty with the Tektronix and Apple II computers available and to provide the opportunity for discussion of their use in entry-level courses. Mathematics and Physics have now integrated their use into their courses to some extent.
6. The departments planned, renovated, and furnished a multi-departmental Alternate Pathways Learning Center (APLC) an entire semester ahead of schedule. Further, the facility, which is located in the University Library, has enjoyed overwhelming popularity. It averages more than 12,000 entries per month (an actual head-count by electronic means). A permanent University Committee consisting of one representative from each department, the Director of the Library, and the University Dean has been established to oversee usage of the area in the future. As indicated by its name, the facility serves primarily as a base for offering "alternate pathways" (to lecture and text) for learning.
7. Each department had its progress reviewed by an outside consultant during each of the first two years of the grant and there was an overall evaluation of the project by an outside consultant in the third year.
8. Finally, and undoubtedly most important from the point of view of long-term impact of the project, constant formative evaluation was used to gain wide support for the project throughout the entire Division of Natural Sciences. This was accomplished via a series of workshops to which all members of the Division were invited (with University-funded refreshments as an incentive to attend), weekly meetings of the CAUSE Committee, interminable departmental meetings to discuss content and teaching approaches, a great deal of hard work on the part of the departmental representatives, and a faculty who are very receptive to new ideas if they have potential for helping students.

III. Detailed Description of the Implementation of XU's CAUSE Project

The four participating departments agreed upon a general plan for development before beginning the project and continually worked, through the CAUSE Committee, to exchange ideas and implement activities jointly as much as possible since receiving the CAUSE Grant. However, because the different departments had had differing opportunities to undertake course development in the past, the various components of the CAUSE Project were implemented at varying rates by the departments over the grant period. The specific activities instituted, both intra- and inter-departmentally, are listed on the following pages in chronological order.

Activities of a General Nature Implemented Via CAUSE:

The CAUSE Committee met regularly for a minimum of one-hour per week during the entire grant period to discuss implementation of the project and to plan joint activities. In addition, the same committee had met in the same manner for the entire year preceding the awarding of the grant. Because of this continued close association over a long period of time, the committee was extremely successful both in communicating what was happening within a given department and in conducting joint activities. In addition to the weekly meetings, the committee also sponsored the following joint activities during the grant period.

Summer, 1977

CAUSE Grant Awarded

Fall, 1977

Representatives from Biology, Chemistry, Mathematics, and Physics met with the University Dean and the Director of the Library to work out details for the renovation and subsequent use of the new, combined learning center for the sciences, the APLC (Alternate Pathways Learning Center). A permanent committee was appointed to shepherd the development of the center. It consisted of one representative from each of the four departments, the University Dean, and the Director of the Library. In addition, the Director of the CAUSE Grant served on the committee temporarily until the facility actually opened. The members of the APLC Committee were: Sr. Grace Mary Flickinger (Biology), Dr. Mary Ann Ryan (Chemistry), Mr. Winston Brown (Mathematics), Dr. Harold Vincent (Physics), Mr. Lester Morris (Director of the Library), and Sr. Mary Veronica Drawe (University Dean). The committee was chaired by Dr. Carmichael, temporary member as director of the grant, until the opening of the APLC in the spring of 1979. At that time, he resigned from the committee and Sr. Grace Mary Flickinger assumed chairmanship. The committee met regularly during the past two years as the space was renovated, furnished, and ultimately used in the spring of 1979.

Fall, 1977

Dr. Carmichael attended a CAUSE Director's Meeting sponsored by NSF in Washington. The meeting provided the opportunity to discuss various components of XU's project with directors from projects awarded the previous year.

- Fall, 1977 The CAUSE Committee sponsored a PSI (Personalized System of Instruction) Workshop which was attended by nine faculty from the Division of Natural Sciences (Lester Jones, Gail Jones, Linda Tillman, Harold Vincent, Steven Welsh, Jacqueline Hunter, Mary Ann Ryan, Douglas Ruby, and Croscina Crockett). The workshop was designed to provide an overview of PSI and why a faculty member might choose such an individualized system for instruction. The Workshop was conducted by three XU faculty who had had experience teaching PSI courses: Dr. Carmichael, Dr. Ann Olivier (Philosophy), and Dr. Frank Brotherton (Psychology).
- Spring, 1978 The CAUSE Committee conducted a Workshop on Science Teaching and the Development of Reasoning using materials by the same name by Karplus, et. al., Lawrence Hall of Science, U.C., Berkeley, for high school teachers and XU faculty. All CAUSE representatives had completed the same workshop and had received Continuing Education Credit for doing so at a special workshop sponsored by the NSTA at its spring meeting in Cincinnati in 1977. Since there were no materials for Mathematics, Lester Jones, Mathematics's CAUSE representative, developed special modules to supplement the materials available for the sciences.
- April, 1978 The CAUSE Committee sponsored a workshop for the entire Division of Natural Sciences and the College of Pharmacy in order to provide the opportunity for faculty to scrutinize the first draft of materials developed under CAUSE. More than 30 faculty (about 70%) of those invited attended. At the workshop, faculty systematically considered and evaluated every objective for Biology 123, Biology 124, Chemistry 101, Chemistry 102, Mathematics 103, and Physics 201. The workshop was three hours in length on a Friday afternoon. A combination of dedication and promise of refreshments accounted for the high percentage of faculty who chose to attend.
- Summer, 1978 The Workshop on Science Teaching and the Development of Reasoning was repeated for approximately 25 high school mathematics and science teachers from metropolitan New Orleans. There was no charge for participation.
- Summer, 1978 The CAUSE Committee conducted the second special summer program for pre-freshmen. To a large extent, the program served as a place to field-test ideas which had been under discussion during the academic year without the constraints imposed by the need to cover given content or assign grades. The program, entitled Project SOAR (Stress On Analytical Reasoning), has gained national recognition in its own right as indicated by its inclusion in the 6th Report on Teaching published by Change Magazine in August, 1978.

- Summer, 1978 Dr. Carmichael attended a conference (by invitation) at the University of Nebraska-Lincoln for representatives from college-level, Piagetian-based programs. The programs represented are discussed in a publication entitled Multidisciplinary Piagetian-based Programs for College Freshmen published by one of the programs, ADAPT. The publication may be obtained by writing ADAPT, 213 Ferguson Hall, University of Nebraska--Lincoln, Lincoln, NE 68588.
- Fall, 1978 Harold Vincent, Jacqueline Hunter, and JW Carmichael discussed Project SOAR via a presentation entitled "Can Piaget + Interdisciplinary Cooperation = Enhanced Problem-Solving?", at the NSTA meeting in New Orleans.
- January, 1979 The CAUSE-funded, combined learning center for the sciences, the APLC, opened one-semester ahead of schedule at which Sr. Grace Mary Flickinger (Biology) assumed chairmanship of the committee. Dr. Carmichael had chaired the committee during the planning and development of the facility. The APLC was instantly popular, more than 50,000 persons used it during the first six months it was open. Appendix XVI contains a record of usage.
- Spring, 1979 The CAUSE Committee sponsored a "How I do it workshop" for high school mathematics and science faculty from New Orleans. 37 high school teachers and 14 XU faculty attended.
- Spring, 1979 Faculty from the Division of Natural Sciences attended a CAUSE-sponsored, "hands-on" introduction to the capabilities of the Tektronix and Apple Computers which had been purchased with CAUSE funds. This "workshop" consisted of ten hours of supervised experience spread over four weeks so as to allow all participants to actually use both computers. Those attending were: Jacqueline Hunter (Biology), Harold Vincent (Physics), Mary Ann Ryan (Chemistry), Sr. Eileen Benton (Mathematics), Bill Irlbeck (Mathematics), and Winston Brown (Mathematics). In addition, the entire Chemistry faculty (Sr. Mary Carl Malmstrom, John Sevenair, Warren Ray, Leonard Price, Donald Robinson, Mary Ann Ryan, Sr. Joanne Bauer, and Bernie O'Brien) participated in a similar activity as one part of their departmental CAUSE workshop later in the spring. Both activities were supervised by JW Carmichael. All faculty from either group who expressed an interest in further use of the terminals were given copies of the user's manuals. A number of the Mathematics faculty spent additional time experimenting with the use of the computers during the spring and summer.

- Spring, 1979 The CAUSE Committee sponsored a workshop by Dr. Arthur Whimbey, author of Intelligence Can Be Taught (Innovative Sciences) and Problem-Solving and Comprehension: A Short Course in Analytical Reasoning (Franklin Institute Press), as a means of stimulating discussion of possible mechanisms for improving student performance on standardized exams. A brief overview of the workshop and a list of the 25 participants is given in Appendix II.
- Spring, 1979 The CAUSE Committee submitted a document discussing Project SOAR for consideration for publication in The American Biology Teacher. It was published in March of 1980. (See Vol. 42, No. 3, pages 169-173.) See Appendix XVI.
- May, 1979 The Workshop on Science Teaching and the Development of Reasoning was repeated for high school teachers from New Orleans and for faculty anticipating working in Project SOAR during the summer. The workshop was conducted by Donald Robinson, Lester Jones, and Jacqueline Hunter.
- May, 1979 The workshop discussing mechanisms for improving scores on standardized exams, with emphasis on the use of "cognitive therapy"--the principal idea in Problem-Solving and Comprehension, was repeated by Dr. Whimbey for high school faculty from New Orleans and faculty anticipating working in Project SOAR.
- Summer, 1979 The CAUSE Committee conducted the third version of Project SOAR, the special summer program for pre-freshmen entering Xavier with a major in the sciences. An overview of the program is given in Appendix III.
- Summer, 1979 The CAUSE Committee submitted an article discussing the "cognitive therapy" portion of SOAR to The Journal of Reading. It was published in October of 1980. (See Vol. 24, No. 1, pages 5-10). A copy is in Appendix XVII.
- Fall, 1979 The CAUSE Committee submitted an article describing the "bridge" nature of SOAR (between high school and college) to the Louisiana Journal of Science. The article has been accepted and should be published in 1980-81.
- Fall, 1980 The CAUSE Committee compiled a list of audio-visual (science related) materials in the University Library and provided a copy to all science and mathematics faculty as a means of promoting usage of the APLC. The list was designed to be used in one's office and thus supplement the card catalog of such materials.
- Fall, 1980 Two Division-wide workshops were conducted in early fall (9/14 and 9/21). The first provided the opportunity for all faculty to comment on the content of entry-level courses after two years of work. The second was a forum for sharing

ideas about providing the "sympathy" (mechanisms for assisting the educationally-disadvantaged) which makes it possible to maintain "standards" in the science departments. ("Standards with Sympathy" is often used to describe what Xavier, and particularly the sciences, attempt to provide in educational endeavors.)

- Fall, 1979 The CAUSE Faculty provided assistance to the Southern Regional Educational Board at a conference in New Orleans. Both Dr. Vincent and Ms. Hunter made presentations at the conference. A copy of the program is in Appendix XVII.
- Fall, 1979 Sr. Grace Mary Flickinger (Biology) expanded orientation workshops for Biology tutors to include tutors (and faculty) from the other three departments. The joint approach to training peer tutors was promoted by the availability of the APLC, the joint learning center. It was, as expected, very successful. (Please note that this endeavor, like the entire CAUSE project at XU, was a generalization of an idea which worked for one department to others as facilitated by cooperative efforts.)
- Spring, 1980 Dr. Vincent, Ms. Hunter, and Sr. Grace Mary made presentations about SOAR and XU's CAUSE Project at a Science Instruction Seminar sponsored by Southern Regional Education Board in Durham, NC.
- Spring, 1980 An overall evaluation of XU's CAUSE Project was conducted by Dr. Bobby Irby, Chairman of the Department of Science Education at the University of Southern Mississippi. See Appendix XVIII for his report.
- Spring, 1980 A Workshop on Science Teaching and the Development of Reasoning and one on the Cognitive Skills Approach to problem-solving was conducted for high school teachers from New Orleans and for faculty chosen to work in Project SOAR during the summer. Ms. Hunter, Mr. Jones, and Ms. Barbara Wells (McMain Magnet Secondary School, New Orleans) conducted the two.
- Spring, 1980 All four departments work cooperatively to develop plans for the continuation of CAUSE-developed activities after expiration of the grant. See Appendices XX-XXIII for details for each.
- Spring, 1980 An IDSE (NSF) proposal was prepared by the CAUSE Committee with Dr. Vincent providing leadership as a means of more widely disseminating information about techniques found successful at XU to local junior and senior high schools. It was funded in early fall.

- Spring, 1980 Dr. Jones, Dr. Vincent, and Ms. Hunter discussed Project SOAR at a conference on Reasoning, Piaget, and Higher Education in Denver, Colorado.
- Summer, 1980 The fourth version of Project SOAR was conducted by a combination of XU faculty and mathematics and science teachers from local high schools. Ms. Hunter (Biology), Dr. Jones (Mathematics); Ms. Barbara Wells (Chemistry-- on leave from McMain Magnet Secondary School), and Dr. Carmichael worked in the program in 1980.
- Fall, 1980 The CAUSE Committee becomes the "IDSE Advisory Committee" and even though the CAUSE Grant has expired and there is no monetary or release-time compensation continues to meet for one hour weekly to discuss and implement cooperative multi-departmental activities.
- Fall, 1980 The IDSE Advisory Committee sponsored a workshop for Biology teachers from local Junior and Senior High Schools designed to promote use of innovative ideals to make science more accessible to the educationally-disadvantaged.
- Fall, 1980 The IDSE Advisory Committee planned a workshop for high school chemistry teachers in conjunction with the Combined SE/SW Regional Meeting of the American Chemical Society in New Orleans. Eighty-eight area teachers attended.

SPECIAL EVENTS

In the fall of 1978, XU and the CAUSE Committee hosted a visit by Dr. James Rutherford, Director of the Science Education Directorate of the National Science Foundation.

In the spring of 1980, the University hosted a visit from Dr. Robert Menefee, Program Manager for NSF's CAUSE Program.

Activities Implemented by the Biology Department Via CAUSE:

Before receiving the CAUSE Grant Biology had had the opportunity to carry out some experimentation with different laboratory formats (including the Piagetian-based learning cycles developed by Ms. Hunter as a part of Project SOAR) and had established an outstanding peer tutorial service (courtesy of Sr. Grace Mary Flickinger). However, the CAUSE Grant provided funds, for the first time, to do in-depth analysis and revision of the entire sequence of entry-level courses. The effort over the past three years has been exceptionally fruitful. In the departmental-wide discussions at the beginning of the project, the faculty in the department decided to change entry-level Biology from a semester of General Biology and a semester of Zoology to a year of General Biology. Subsequent development of materials under CAUSE and their use in the new sequence resulted in an average increase of 20 percentile points on the CLEP General Biology Examination. Development of Biology materials was effected primarily by Sr. Grace Mary Flickinger (Departmental Chairperson) and Ms. Jacqueline Hunter (CAUSE Representative) with considerable assistance from the remainder of the faculty in the department--particularly Dr. Deidre Labat, Dr. Douglas Ruby, and Mr. Charles Ballard. A chronological sketch of Biology's activities during the grant period are as follows:

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| Summer, 1977 | The CAUSE Grant was awarded. |
| Fall, 1977 | The entire Biology Department met and, after extensive discussion over a period of weeks, finally decided to change from one semester each of General Biology and Zoology to one year of General Biology. |
| Fall, 1977 | Sr. Grace Mary Flickinger, conducted a three-hour workshop for Biology peer tutors and organized the Department's tutorial service for the fall. |
| Fall, 1977 | Ms. Hunter attended the CAUSE-sponsored workshop to familiarize faculty with individualized instructional systems with emphasis on PSI. |
| Fall, 1977 | The five Piagetian-based learning cycles developed by Ms. Hunter during the previous year were modified and improved on the basis of experimentation with their use in the summer of 1977 in Project SOAR. |
| January, 1978 | Sr. Grace Mary organized the Biology peer tutorial service for the spring semester, continuing to set an example for the other departments. |
| Spring, 1978 | Content objectives for both semesters of Biology 123 (the first semester) were developed. |
| Spring, 1978 | A draft of a "handbook" for Biology 123 and a laboratory manual for Biology 123L was developed. The handbook included content objectives, related sample problems, and alternate pathways for mastering the content. |

- Spring, 1978 Content objectives for both Biology 123 and 124 were evaluated by faculty from the Division of Natural Sciences and the College of Pharmacy at a CAUSE-sponsored workshop.
- Spring, 1978 Ms. Hunter assisted the other members of the CAUSE Committee in conducting a Workshop on Science Teaching and the Development of Reasoning for mathematics and science faculty from local high school (and XU).
- Spring, 1978 Dr. John Ruffin, Department of Biology at North Carolina Central University, served as an outside consultant to evaluate content of the entry-level Biology sequence. He was on campus for two days and submitted the formal report in Appendix IV.
- Spring, 1978 The CLEP General Biology Examination was administered to a randomly-selected group of students in order to obtain base-line for measuring performance of pre-CAUSE courses.
- Spring, 1978 A common final was administered in all sections of students completing General Biology.
- Spring, 1978 Sr. Grace Mary Flickinger, Ms. Jacqueline Hunter, Dr. Douglas Ruby, and Mr. Charles Ballard met for two days to conclude refinement on the basis of consideration of comments of faculty from the other departments and the outside consultant.
- May, 1978 Ms. Hunter assisted in conducting a Workshop on Science Teaching and the Development of Reasoning for local high school teachers of mathematics and science with emphasis on those who would be teaching in Project SOAR in 1978.
- Summer, 1978 Materials for Biology 123 and 123L were refined, typed, and prepared for use in the fall.
- Summer, 1978 Ms. Jacqueline Hunter conducted the Biology portion of the pre-freshman summer program for science students using the five Piagetian-based learning cycles she had previously developed. One purpose of the program was to experiment with such materials to determine the extent to which they might be appropriate in regular entry-level courses. She was assisted by Ms. Wanda Harris, Biology teacher from McDonogh #35 Senior High.
- August, 1978 Sr. Grace Mary conducted a three-hour workshop for Biology tutors and organized the peer tutorial service for the fall.
- Fall, 1978 Sr. Grace Mary Flickinger joined the CAUSE Committee.

- Fall, 1978 Ms. Hunter was one of three persons (JW Carmichael and Harold Vincent were the other two) discussing Project SOAR at the NSTA meeting in New Orleans.
- Fall, 1978 Biology 123 and 123L materials were field-tested in all four sections of General Biology. Faculty teaching the courses were: Sr. Grace Mary, Dr. Deidre Labat, Dr. Douglas Ruby, and Ms. Jacqueline Hunter.
- Fall, 1978 Sr. Grace Mary, Ms. Hunter, Dr. Labat, and Dr. Ruby met biweekly for one hour to coordinate activities associated with teaching the entry-level courses and to plan further refinement. This activity continued in the spring.
- Fall, 1978 Development of Biology 124 materials was completed by Sr. Grace Mary and Ms. Hunter with extensive input from other members of the Biology Department.
- January, 1979 With the opening of the APLC, the Biology tutorial service moved to that facility and expanded its AV holdings with funds provided by CAUSE. The service continued to be excellent.
- Spring, 1979 Biology 124 materials were field-tested in all three sections of General Biology. Faculty teaching the courses were: Ms. Hunter, Dr. Ruby, and Dr. Labat.
- Spring, 1979 Ms. Hunter attended the CAUSE-sponsored workshop to acquaint faculty with the use of Tektronix and Apple computers with emphasis on possible application in computer-based instruction.
- Spring, 1979 Ms. Hunter discussed XU's CAUSE Project at the NSTA meeting in Atlanta.
- Spring, 1979 Dr. Labat, Ms. Hunter, and Sr. Grace Mary Flickinger (Chairperson) attended a three-hour, CAUSE-sponsored workshop by Dr. Arthur Whimbey to consider methods of teaching so as to promote the problem-solving skills needed to perform well on standardized examinations.
- Spring, 1979 Ms. Hunter presented her knives-and-forks simulation of Meiosis and Mitosis at the "How I Do It Workshop" sponsored by the CAUSE Committee for mathematics and science teachers from local high schools.
- Spring, 1979 Dr. John Ruffin, Department of Biology at North Carolina Central University, spent two days at Xavier evaluating CAUSE materials and discussing ways of further improving the entry-level Biology courses. His report appears in Appendix V.

- Spring, 1979 The CLEP General Biology Examination was administered to a randomly-selected group of students completing Biology 124 on an option basis without advance warning and with only minimal reward for good performance--i.e., in a manner similar to that used at the equivalent time in 1978.
- Spring, 1979 Common final examinations were given to students completing both Biology 123 and 124.
- Spring, 1979 Sr. Grace Mary Flickinger, Ms. Hunter, Dr. Ruby, and Mr. Ballard met in a two-day workshop to complete the year-long process of evaluating and modifying materials which had been field-tested in General Biology in 1978-79.
- May, 1979 Ms. Jacqueline Hunter co-directed (with Mr. Robinson and Mr. Jones) a Workshop on Science Teaching and the Development of Reasoning for mathematics and science teachers from local high schools and faculty who would be working Project SOAR in 1979.
- Summer, 1979 Ms. Jacqueline Hunter conducted the Biology portion of the third version of Project SOAR, the special summer program for pre-freshmen science majors. The five Piagetian-based laboratory experiments she had developed and revised earlier were used as textual material. Ms. Wanda Harris, Biology teacher from McDonogh #35 Senior High, assisted her in this endeavor.
- July, 1979 After a short orientation session, Sr. Grace Mary Flickinger (Chairperson) began using the Tektronix graphic terminals in the APLC for data reduction of the sort needed for the on-going evaluation of General Biology planned in the future.
- Summer, 1979 Sr. Grace Mary Flickinger and Ms. Jacqueline Hunter received acceptance notices for papers they had submitted for presentation at the upcoming meeting of the National Association of Biology Teachers. The meeting will be held in New Orleans. Sr. Grace Mary's two presentations will consider her dermatoglyphic research and the Biology portion of XU's CAUSE Grant. Ms. Hunter's two will cover Project SOAR and her novel simulation of Meiosis and Mitosis.
- Summer, 1979 CAUSE-developed materials for the General Biology sequence were refined, duplicated, and prepared for use by all students in the sequence in 1979-80.

- October, 1979 Sr. Grace Mary Flickinger (Chairman, Biology) conducted a workshop for all peer tutors working in the APLC. This was the first time the four departments had conducted joint tutorial training sessions.
- October, 1979 Sr. Grace Mary Flickinger discussed XU's CAUSE Project at the International Congress on Individualized Instruction in Athens, Georgia. A copy of the program is included in Appendix XIX.
- October, 1979 Ms. Jacqueline Hunter presented a paper entitled "Mitosis and Meiosis with Knives, Forks and Spoons" at the National Association of Biology Teachers in New Orleans.
- October, 1979 Ms. Jacqueline Hunter presented a paper entitled "Project SOAR: A Multidisciplinary Summer Program for Pre-Freshmen" at the National Association of Biology Teachers in New Orleans.
- October, 1979 Sr. Grace Mary Flickinger presented a paper on the Biology portion of XU's CAUSE Grant at the National Association of Biology Teachers in New Orleans.
- November, 1979 Ms. Jacqueline Hunter discussed Project SOAR (along with Dr. Vincent) at the Science Instruction Seminar sponsored by the Southern Regional Education Board in New Orleans. See Appendix XVII for a copy of the program.
- November, 1979 Sr. Grace Mary Flickinger discussed the APLC (Alternate Pathways Learning Center) at XU at the Science Instruction Seminar sponsored by Southern Regional Education Board.
- December, 1979 Common final exams were given in all four sections of Biology 123.
- Spring, 1980 Biology 124 lab materials were field-tested.
- April, 1980 Ms. Jacqueline Hunter discussed Project SOAR (along with Dr. Jones and Dr. Vincent) at the National Conference on Reasoning, Piaget and Higher Education in Denver.
- April, 1980 Ms. Hunter discussed Project SOAR at the Science Instruction Seminar sponsored by the Southern Regional Education Board in Durham, North Carolina.
- April, 1980 Sr. Grace Mary Flickinger discussed the Alternate Pathways Learning Center at XU at the Science Instruction Seminar sponsored by the Southern Regional Education Board in Durham, North Carolina.

- Spring, 1980 The Biology Department completes plans for continuation of CAUSE-developed activities after the grant expires. See Appendix XX for details.
- May, 1980 The CLEP General Biology Examination was administered to a randomly-selected group of students completing Biology 124.
- May, 1980 Common final examinations were given to students completing both Biology 123 and 124.
- June, 1980 Ms. Jacqueline Hunter co-directed (with Dr. Jones) a Workshop on Science Teaching and the Development of Reasoning for mathematics and science teachers from local high schools and faculty who would be working in Project SOAR in 1980.
- Summer, 1980 Ms. Jacqueline Hunter conducted the biology portion of the fourth version of Project SOAR.
- Summer, 1980 Ms. Jacqueline Hunter, Dr. Deidre Labat, and Dr. Douglas Ruby modified the Biology 123 and 124 materials on the basis of input from faculty during the spring semester.
- Summer, 1980 CAUSE-developed materials were duplicated and prepared for use by students in all Biology 123 and 124 sections in 1980-81.
- Fall, 1980 Ms. Hunter continued to meet with the CAUSE Committee-turned-IDSE Advisory Committee for one hour weekly.
- October, 1980 Ms. Hunter discussed "Mitosis and Meiosis with Knives, Forks and Spoons" at the IDSE-sponsored workshop for Biology teachers from local junior and senior high schools.

Activities Implemented by the Chemistry Department Via CAUSE:

Chemistry had opted for departmentally-determined content for general chemistry in 1972 and had spent numerous hours determining and refining its idea of what that content should be in the five years preceding the CAUSE Grant. Further, the department had developed the sort of "handbook" proposed for the other departments via CAUSE at that time and had had five years of actual use of the materials in an individualized, self-paced format (PSI modified to including the option of taking an extra semester to complete the course if needed and of repeating finals). This modification had resulted in significant improvement in the level of student performance in the course. The average score on the ACS Cooperative Examination in General Chemistry (a requirement for completion of the sequence at XU) increased more than 20 percentile points for the first attempt at the exam and was slightly above the national average when repeats (on different versions) were considered. In spite of expectations, however, the increased level of performance on shifting to an individualized format was not accompanied by a reduction in attrition from general chemistry. The percentage of persons completing both semesters of the sequence remained about the same as it had been in the traditional courses--slightly more than 50%. Since failure to complete general chemistry is a primary reason why many (if not most) students choose to change from science-related majors, for Chemistry the CAUSE Grant was primarily designed to provide the opportunity to further modify the delivery system so as to reduce attrition WITHOUT decreasing performance. Chemistry's CAUSE-related activities were implemented for the most part by Mary Ann Ryan and JW Carmichael with extensive assistance from Donald Robinson and (in 1978-79) Sr. Joanne Bauer. A chronological list of Chemistry's CAUSE activities during the first two years of the grant period are:

- Spring, 1977 The Chemistry Department met and made suggestions for refinement of general chemistry in the usual yearly manner. At this time, the decision was made to adopt Chemistry: The Central Science by Brown and Lemay as the textbook in the course for the upcoming year. This was a major change in direction since changing textbooks necessitated changing both the 300+ pages of the handbook and the 128 quizzes used in the course.
- Spring, 1977 All students completing Chemistry 102 took one or more versions of the ACS Cooperative Examination in General Chemistry as a requirement for completing the course.
- Summer, 1977 The CAUSE Grant was awarded to the University.
- Summer, 1977 Mary Ann Ryan and JW Carmichael modified approximately one-half of the first semester of Chemistry 101 and Chemistry 101L in line with decisions reached at the spring meeting of the Chemistry department.

- Fall, 1977 All classes in Chemistry 101 and 101L began to use the newly modified materials while the remaining revision was completed--often only shortly before needed by the students. The lecture handbook consisted of modules with carefully specified objectives, correlated sample problems, and a variety of mechanisms for learning the content including audio tapes, tutoring, etc. The latter are the "alternate pathways" which provided the name for much of the activity associated with the CAUSE Grant at XU. The laboratory manual was composed of a series of Piagetian-based "learning cycles" developed on the basis of experimentation with a RULE/LOCI Grant in 1976-77. Modification/refinement of three-fourths of a year's course while field-testing is not a recommended way of remaining sane.
- Fall, 1977 The prescription for the Chemistry 101 final was refined to fit the newly modified course.
- Fall, 1977 Mary Ann Ryan attended the first portion of an NSF Chautauqua-type short course entitled "Patterns of Problem-Solving" at the University of Maryland--Baltimore.
- Fall, 1977 Dr. Carmichael conducted a CAUSE-sponsored Workshop designed to acquaint XU faculty with PSI (Personalized System of Instruction). Dr. Ryan attended.
- Spring, 1978 Chemistry 101 and 102L materials modified via CAUSE were field-tested while final modification and refinement was completed.
- Spring, 1978 Dr. Ryan attended the second portion of the NSF Chautauqua-type short course, Patterns of Problem Solving, at the University of Maryland.
- Spring, 1978 Dr. Ryan attended a Guided Design Workshop conducted by the University on campus.
- Spring, 1978 Content objectives for both Chemistry 101 and 102 were evaluated by faculty from the Division of Natural Sciences and the College of Pharmacy at a CAUSE-sponsored workshop.
- Spring, 1978 Dr. Carmichael and Dr. Ryan assisted the remainder of the CAUSE Committee in conducting the Workshop on Science Teaching and the Development of Reasoning for high school and XU faculty. Donald Robinson attended as a participant and earned one Continuing Education Unit from the University for doing so.
- Spring, 1978 Dr. Theodore Brown, Chairman of the Department of Inorganic Chemistry at the University of Illinois and author of the text used in general chemistry at XU (Chemistry: The Central Science), served as an outside consultant to evaluate the content of the general chemistry sequence. He was on campus for two days and submitted the formal report in Appendix VI.

- Spring, 1978 The question bank for Chemistry 101 was completed. It consists of ten questions for each of the seventy types of questions chosen for the prescription for the Chemistry 101 final.
- Spring, 1978 The ACS Cooperative Examination in General Chemistry was administered to all students completing Chemistry 102. The CLEP (College-Level Examination Program by ETS) General Chemistry exam was also administered to one laboratory section. The students were not told in advance that they would be required to take the examination. Instead it was sprung on the students unexpectedly as they walked into laboratory and described as a method of obtaining a few (unspecified) "extra points".
- Spring, 1978 The entire Chemistry faculty (Sr. Mary Carl Malmstrom, Joyce Corrington, JW Carmichael, Monty Herr, Leonard Price, Warren Ray, Mary Ann Ryan, Donald Robinson, and John Sevenair) attended a two-day workshop to conclude the in-depth consideration and refinement of materials for Chemistry 101 and 102 on the basis of comments made by faculty in other departments at the Division-wide workshop CAUSE had sponsored earlier in the spring.
- May, 1978 Donald Robinson and JW Carmichael assisted the other members of the CAUSE Committee in conducting (once again) the Workshop on Science Teaching and the Development of Reasoning for high school teachers and faculty who would be working in Project SOAR in 1978.
- Summer, 1978 Materials for Chemistry 101, 102, 101L, and 102L were refined, typed, and duplicated for use in the fall.
- Summer, 1978 Donald Robinson conducted the Chemistry portion of the pre-freshmen summer program (Project SOAR) for science majors using the five Piagetian-based learning cycles previously developed by Mary Ann Ryan and JW Carmichael. He was assisted in this effort by Ms. Georgilyn Andry, Chemistry teacher at McDonogh #35 Senior High in New Orleans. Dr. Carmichael directed the same program.
- Fall, 1978 CAUSE-refined materials for Chemistry 101 and 101L are used for the second time. In addition, increased emphasis was placed on the introduction of new elements to encourage students to remain in the course.
- Fall, 1978 JW Carmichael was one of three CAUSE Committee members (Harold Vincent and Jacqueline Hunter were the other two) to discuss Project SOAR at the NSTA meeting in New Orleans via a paper entitled "Can Piaget + Interdisciplinary Cooperation = Enhanced Problem-Solving?"

- Fall, 1978 Dr. Carmichael attended the Networks National Conference in San Francisco as one of three panelists invited to discuss "Sympathy versus Standards in the Sciences: Overcoming Student Deficiencies". Dr. Ryan also attended the conference using University funds.
- January, 1979 With the opening of the APLC, Chemistry moved its AV materials, reference texts, tutorial service, etc. into that area and began using it for the numerous activities sponsored as a part of the effort to improve retention in General Chemistry. The latter included systematically teaching notetaking skills to those who needed it (all were required to turn in notes to determine who these were), teaching all students what a definition is and how to write a good one, increasing emphasis on learning general problem-solving skills, etc.
- Spring, 1979 Sr. Joanne Bauer joined the Chemistry faculty with primary responsibility in the problem-solving drills associated with General Chemistry and began to work with Mary Ann Ryan, Donald Robinson, and JW Carmichael as CAUSE-related activities were implemented.
- Spring, 1979 Dr. Ryan attended an NSF-sponsored conference for institutions which had had MISIP Grants as an invited speaker to discuss the success in increasing performance in General Chemistry at Xavier as discussed in the beginning of this section. The conference was held in Washington.
- Spring, 1979 CAUSE-refined Chemistry 102 and 102L materials were used for the second time with added emphasis on features to promote retention in the course.
- Spring, 1979 Dr. Carmichael conducted the CAUSE-sponsored workshop to investigate the usage of the Tektronix and Apple computer terminals purchased with CAUSE funds and located in the APLC. Dr. Ryan attended the workshop.
- Spring, 1979 Dr. Sevenair, Sr. Mary Carl Malmstrom (Chairperson), and Dr. Ryan attended the CAUSE-sponsored workshop on problem-solving and increasing scores on standardized exams which was conducted by Dr. Whimbey. See Appendix II for a description.
- Spring, 1979 Dr. Arthur Whimbey, Visiting Professor in Mathematics at Xavier and author of Intelligence Can Be Taught (Innovative Sciences) and Problem-Solving and Comprehension: A Short Course in Analytical Reasoning, served as a consultant for two days. His primary purpose was to evaluate the delivery mechanism used in the General Chemistry sequence and to suggest ways of reducing attrition from the courses. His report is included in Appendix VII.

- Spring, 1979 The CLEP General Chemistry examination was administered to a portion of the General Chemistry class in a manner such that it could be counted as a final examination if desired. It should be noted that this was considerably different than in 1978 when it was administered unexpectedly to one laboratory section. The decision to administer it in this fashion arose from the desire to attempt to determine the degree of correlation between the CLEP and ACS General Chemistry examinations. The latter was desirable because Xavier has recently decided to accept CLEP credits but has no real feel for what the various scores mean with respect to the courses taught on campus.
- Spring, 1979 The ACS Cooperative Examination in General Chemistry was administered to a large majority of students completing Chemistry 102 (the remainder took the CLEP mentioned above). Since the ACS examinations have been given in a similar manner for a number of years, it is possible to compare performance before and after the grant period.
- Spring, 1979 All Chemistry faculty (Sr. Mary Carl Malmstrom, Dr. Ryan, Dr. Carmichael, Dr. Price, Dr. Sevenair, Reverend Ray, Mr. Donald Robinson, and Sr. Joanne Bauer) met for two days in a workshop designed to acquaint the participants with the capabilities of the Tektronix and Apple computers located in the APLC. This activity was a culmination of CAUSE-sponsored consideration of refinement of General Chemistry for the year.
- Spring, 1979 Donald Robinson co-directed (with Lester Jones and Jacqueline Hunter) a Workshop on Science Teaching and the Development of Reasoning) for high school and XU faculty with emphasis on those planning to teach in Project SOAR in 1979.
- Summer, 1979 Donald Robinson conducted, with assistance from Ms. Georgilyn Andry who teaches Chemistry at McDonogh #35 Senior High, the Chemistry portion of Project SOAR, the special summer program for pre-freshmen interested in the sciences. It should be noted that this is the third such summer the program has been offered and that an overview of it is contained in Appendix III.
- Summer, 1979 Further modification and refinement of the General Chemistry materials was completed and materials were duplicated for distribution (at a cost) to students in the fall. A detailed description of the General Chemistry sequence at present has been compiled into a document which has been submitted for publication.

- Fall, 1979 An article describing XU's CAUSE-developed General Chemistry course was submitted to the Journal of Developmental and Remedial Education. It was accepted and published in the Winter, 1979 issue. See Appendix XXIV.
- Fall, 1979 An article describing XU's Piagetian-based (and CAUSE-developed) General Chemistry Laboratory program was submitted for publication to the Journal of Chemical Education. It was published in September, 1980 (Vol. 57, No. 9, pages 642-645. See Appendix XXV for a photocopy.
- December, 1979 Dr. Carmichael was an invited speaker at a Networks Conference held in Washington, DC. He discussed SOAR and the CAUSE-related activities at XU.
- December, 1979 The American Chemical Society Cooperative General Chemistry Examination was administered to all students completing Chemistry 102. All students completing Chemistry 101 were administered variations of the final developed from the prescription arrived at via SOAR.
- December, 1979 Plans for continuing CAUSE-related activities in General Chemistry were completed. Appendix XXI contains a copy.
- Spring, 1980 The American Chemical Society standard exams and prescription finals were administered for all students completing Chemistry 102 and 101, respectively.
- Summer, 1980 Ms. Barbara Wells, high school chemistry teacher from McMinn Magnet Secondary School, and Ms. Georgilyn Andry, high school chemistry teacher from McDonogh #35 High School, conducted the Chemistry portion of SOAR.
- Summer, 1980 CAUSE-developed materials were refined, duplicated and prepared for use in the fall.
- Summer, 1980 Dr. Carmichael, Ms. Barbara Wells (a high school teacher from McMinn Magnet Secondary School on leave at XU teaching chemistry in 1979-80), and Sr. Joanne Bauer made presentations at the 6th Biennial Conference on Chemical Education in Rochester, NY. See Appendix XXVIII for details.
- Fall, 1980 JW Carmichael became a member of the IDSE Advisory Committee (along with the other members of the former CAUSE Committee) and continued to meet weekly with counterparts from Biology, Mathematics, and Physics.
- Fall, 1980 Sr. Joanne Bauer conducted a special 2-day workshop for the two new faculty who would be working in the General Chemistry program in 1980-81. (Sr. Joanne has taken temporary leave to complete graduate work at the University of New Orleans.)

Fall, 1980

JW Carmichael organized, as one part of his duties on the IDSE Advisory Committee, a workshop for high school teachers in conjunction with the Combined SE/SW Regional Meeting of the American Chemical Society here in New Orleans.

Activities Implemented by the Mathematics Department Via CAUSE:

The CAUSE Grant at Xavier provided funds to improve Mathematics 103 (Precalculus) and Mathematics 104 (Calculus I), the two college-level courses required of most science majors. This sequence was developed as a means of providing exposure to calculus to the health science students. The latter is desirable since many of them latter consider graduate programs which require calculus for admittance. (Most institutions do not require that health science students take calculus. Instead, they take statistics and algebra or trigonometry. Xavier has chosen to require Precalculus/Calculus I for most science students as one part of its effort to encourage its graduates, Black Americans, to aspire to high career goals and to prepare them for doing so.) Precalculus is a three credit-hour course which contains components of both algebra and trigonometry. Calculus I is both the terminal course for most students and, because XU is small, the first semester of a three-semester calculus sequence for others. A student may enter the sequence only upon either a) passing the University's Mathematics Placement Examination or b) successfully completing a non-degree credit course, Mathematics 100. Because of the obvious complexity of attempting to develop two courses which may be entry-level for some students while intermediary for others and terminal for some while merely the first of a sequence for others, implementation of the Mathematics portion of the CAUSE Grant has been extremely time-consuming. During the grant period, the Mathematics Departments has met weekly for a minimum of one hour to discuss not only Mathematics 103 & 104 but also the developmental course which precedes it and the Calculus courses which follow. This concentrated effort to considered the entire set of courses in concert, has resulted in the development of a skills-oriented Precalculus course and an intuitive one-semester survey of Calculus, both of which emphasize practical applications. While both of these courses appear to be in line with what innovative educators are advocating, at present they differ significantly from what is actually offered at most other institutions. The Mathematics Department therefore appears to have provided another instance in which Xavier's unique challenges has produced a unique solution. A list of the activities of the CAUSE-related activities of the Mathematics Department follows:

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| Summer, 1977 | The CAUSE Grant was awarded. |
| Fall, 1977 | The Mathematics Department began holding weekly one-hour meetings for the purpose of discussing the content, delivery mechanism, and the relationship of Mathematics 103 and 104 to other Mathematics courses. The meetings have continued throughout the entire two-year period and, on occassion, have been supplemented by more extended brain-storming sessions. All faculty in the Department have attended the meetings regularly. |
| Fall, 1977 | Mr. Clarence Inniss organized and conducted the Mathematics Peer Tutorial Service for the semester. |
| Fall, 1977 | Mr. Lester Jones, Ms. Gail Jones (part-time faculty), and Ms. Linda Tillman (part-time faculty) attended the CAUSE-sponsored PSI Workshop on XU's campus. |

- Fall, 1977 The five Piagetian-based learning cycles developed by Mr. Jones and used in the previous summer's special summer program, Project SOAR, were revised. Although Mathematics has no formal laboratory courses, the experimentation in SOAR has provided a number of ideas for improvement of lecture courses as the Department has moved toward a practical approach to entry-level science majors Mathematics courses.
- December, 1977 The specification of content objectives for Mathematics 103 (Precalculus) was completed.
- Spring, 1978 Mr. Inniss continued to organize and direct the Department's peer tutorial service for the spring semester.
- Spring, 1978 The first draft of the Precalculus Handbook was developed.
- Spring, 1978 Content objectives for Precalculus were evaluated (individually) by members of the Division of Natural Sciences and the College of Pharmacy at a joint CAUSE-sponsored, three-hour workshop.
- Spring, 1978 Dr. Solomon Garfunkel, Associate Director, UMAP, and member of the Mathematics Department, the University of Connecticut, Storrs, spent two days at XU as a consultant evaluating the course content of Pre-Calculus and discussing mechanisms for improving performance in the course. His report is included in Appendix VIII.
- Spring, 1978 Seven of the eight Mathematics faculty (Mr. Jones, Sr. Rosemarie Kleinhaus, Dr. Fontova, Dr. Irlbeck, Mr. Innis, Mr. Brown, and Ms. Nelson) attended a two-day workshop to conclude the refinement of Mathematics 103 materials with special consideration given to comments from other faculty during the Division-wide evaluation workshop.
- Spring, 1978 Mr. Jones assisted the remainder of the CAUSE Committee as they conducted a Workshop on Science Teaching and the Development of Reasoning for high school and XU faculty. He developed materials specifically for Mathematics to be used in this effort to supplement those available for science from Karplus, *et. al.*, Lawrence Hall of Science, U. of California, Berkeley.
- Spring, 1978 The CLEP Precalculus Examination was administered to all students completing Precalculus in the spring. It was not given as a final, but rather as an option activity for which the students received some small number of extra credit points.
- Spring, 1978 The Mathematics Departments prepared and administered a common final in all sections of Precalculus for the first time.

- May, 1978 Mr. Jones assisted other XU science faculty to conduct a Workshop on Science Teaching and the Development of Reasoning for high school and XU faculty with emphasis on those who would be teaching in Project SOAR in 1978.
- May, 1978 Modifications were made to the materials in the Precalculus Handbook previously developed on the basis of refinement effected by the Mathematics faculty in the two-day workshop conducted earlier and the materials were duplicated for use in the summer.
- Summer, 1978 Sr. Rosemarie Kleinhaus and Dr. Bill Irlbeck field-tested the Mathematics 103 materials for the first time.
- Summer, 1978 Mr. Jones conducted the Mathematics portion of Project SOAR, the special summer program for science students, using the five Piagetian-based learning cycles he had previously developed and refined. He was assisted in this effort by Mr. Calvin Cognevich from McMinn Magnet Senior High. This effort, as noted previously, provided an opportunity to try out ideas under consideration for inclusion in entry-level courses with the constraints of teaching content and giving grades.
- Summer, 1978 Mr. Jones began development of audio-tapes to be used by students in Precalculus, Mathematics 103. This was one of the "alternate pathways" chosen by the Mathematics Department in the weekly meetings conducted in 1977-78.
- Summer, 1978 The Precalculus materials were further modified and refined on the basis of the pilot use by Sr. Rosemarie and Bill Irlbeck in summer school. The new materials were then duplicated and assembled for distribution to all Precalculus students the following fall.
- Fall, 1978 Dr. Bill Irlbeck joined the CAUSE committee as a regular member.
- Fall, 1978 Mathematics 103 materials were used by all faculty teaching Precalculus. The group consisted of Mr. Jones, Mr. Brown, Dr. Fontova, Dr. Irlbeck, and Sr. Rosemarie Kleinhaus (Chairperson).
- Fall, 1978 Mr. Winston Brown assumed responsibility for the Mathematics Peer Tutorial program for the year.
- Fall, 1978 Mr. Jones completed the audio tape "alternate pathway" in time for use as needed during the semester.

- Fall, 1978 The Mathematics Department continued to meet weekly for a minimum of one hour as the Department considered development of Mathematics 104 and extensive revision of the developmental mathematics courses. During this semester, the Department reached the decision to use an intuitive approach to the first semester of Calculus (Mathematics 104) and to make the course a survey.
- Fall, 1978 The prescription for the common finals to be administered in Precalculus was completed.
- Fall, 1978 A common final examination was administered to all Mathematics 103 sections. The five faculty teaching sections, and participating in the administration of the common exam, were: Winston Brown, Esther Fontova, Bill Irlbeck, Lester Jones, and Sr. Rosemarie Kleinhaus.
- January, 1979 With the opening of the APLC, the Mathematics Tutorial Service moved to that facility along with the Department's expanded AV holdings which had been purchased with CAUSE funds. Mr. Brown continued to direct the tutorial program. More than 50,000 individuals used the APLC during the first six months it was open.
- January, 1979 Dr. Arthur Whimbey, author of Intelligence Can Be Taught (Innovative Sciences) and Problem-Solving and Comprehension: A Short Course in Analytical Reasoning (Franklin Institute Press), joined the Mathematics Department as a Visiting Professor on a short-term basis. Dr. Whimbey was specifically hired to work in the developmental Mathematics program as one part of the effort to improve it and thus provide a better foundation for Mathematics 103.
- Spring, 1979 Content objectives were specified for Calculus I (Mathematics 104) and a "handbook" for the course was developed.
- Spring, 1979 Dr. Irlbeck, Mr. Brown, Dr. Fontova, and Sr. Eileen Benton attended the CAUSE-sponsored workshop to acquaint faculty with the capabilities of the Tektronix and Apple computer terminals which had been purchased with CAUSE funds. All attended as a result of an interest in experimenting with computer-based instruction in Mathematics and all spent considerably more time with the computer than the ten hours officially sponsored by the CAUSE Committee.
- Spring, 1979 Mr. Jones, Sr. Rosemarie (Chairman), Dr. Fontova, Sr. Eileen Benton, and Dr. Bill Irlbeck attended the 3-hour, CAUSE-sponsored workshop by Dr. Whimbey to consider ways of teaching so as to promote the development of the problem-solving skills needed to perform well on standardized exams.

- Spring, 1979 Dr. Raymond Coughlin, author of Applied Calculus and member of the Mathematics Department at Temple University, visited XU for two days as a consultant to evaluate the Precalculus/Calculus I materials and to make suggestions for improvement. His final report is included in Appendix IX.
- Spring, 1979 The CLEP Precalculus examination was given to all students completing Mathematics 103 in the spring.
- Spring, 1979 A common final examination was given in Mathematics 103 (Precalculus) for the third consecutive semester.
- Spring, 1979 Sr. Rosemarie Kleinhaus, Mr. Jones, Sr. Eileen Benton, Dr. Irlbeck, Dr. Fontova, and Mr. Brown attended a two-day workshop to complete the refinement of Calculus I materials on the basis of comments by the consultant, Dr. Coughlin.
- May, 1979 Dr. Bill Irlbeck and Dr. Arthur Whimbey attended a conference discussing the current status of Mathematics Education. The meeting was held at Jackson State University in Jackson, Mississippi.
- May, 1979 Mr. Jones co-directed (with Ms. Hunter and Mr. Robinson) a Workshop on Science Teaching and the Development of Reasoning for high school teachers and faculty who anticipated working in Project SOAR in 1979.
- Summer, 1979 Mr. Lester Jones and Sr. Kathleen Bahlinger (Mathematics teacher from St. Joseph's Academy) conducted the Mathematics portion of the third version of Project SOAR, the special summer program for pre-freshmen science majors. The five Piagetian-based learning cycles which Mr. Jones had developed earlier were used in the program.
- Summer, 1979 Sr. Rosemarie Kleinhaus and Dr. Bill Irlbeck piloted Mathematics 104 materials with Dr. Irlbeck completing the last phases of development in time for usage in classes.
- Summer, 1979 Two papers were accepted for presentation at the American Mathematics Association of Two-Year Colleges' national meeting in San Diego in the fall. One is a panel discussion by Sr. Rosemarie, Dr. Irlbeck, Mr. Jones, and Mr. Brown concerning Xavier's Mathematics-CAUSE materials and their use at XU; the other considers the Mathematics portion of Project SOAR and its implications for teaching Mathematics.
- Summer, 1979 A common final was given in Mathematics 104 using the prescription which had been developed as the Calculus I objectives and handbook were completed.

- Summer, 1979 Both Mathematics 103 and Mathematics 104 materials were refined, duplicated, and assembled for use in all sections of both courses in academic 1979-80.
- October, 1979 Mr. Lester Jones presented a paper about Project SOAR at the American Mathematics Association of Two-Year Colleges' national meeting in San Diego. Dr. Irlbeck, Mr. Brown, and Mr. Jones presented a panel discussion at the same meeting on the Mathematics portion of the CAUSE project at Xavier and its impact on the entire freshman-level mathematics program.
- Fall, 1979 Dr. Bill Irlbeck and Mr. Lester Jones used the Mathematics 1040 materials in all three sections of Calculus I and made final revisions. Common module exams were given throughout the course as well as a common final.
- Fall, 1979 The common final was again administered in Mathematics 1030.
- January, 1980 The mathematics faculty participated in the Math/Science Olympiad.
- February, 1980 Several members of the Mathematics faculty participated in Dr. Irby's evaluation of the CAUSE Project at Xavier.
- May, 1980 Mr. Jones and Dr. Vincent from the Physics Department served as consultants at Tougaloo College with regard to their attempts to implement a developmental mathematics program at Tougaloo.
- Spring, 1980 Common module exams and common finals were given in all five sections of Mathematics 1030 and also in all five sections of Math 1040.
- May, 1980 The CLEP exam in College Algebra-Trigonometry was administered to all students enrolled in Mathematics 1030.
- May, 1980 The CLEP exam in Calculus was administered to all students enrolled in Mathematics 1040.
- May, 1980 Dr. Irlbeck organized the files of exam questions for Mathematics 1030 and 1040. He also collected data on grade distributions for the past three years in all freshman level mathematics courses.
- Spring, 1980 Plans for continuation of the CAUSE-developed activities in Mathematics were finalized. A copy is included in Appendix XXII.

- Summer, 1980 Mr. Jones completed his dissertation!!
- Summer, 1980 Dr. Jones, Ms. Joyce Harvey, Mr. Alfred Randazza, and Mr. Gibson Chighizola conducted the Mathematics and Computer Science portions of Project SOAR.
- Summer, 1980 The CAUSE-developed mathematics materials were refined and prepared for use in the fall by Dr. Bill Irlbeck.
- Fall, 1980 Dr. Lester Jones, Mathematics' representative on the CAUSE Committee, began serving on the IDSE Advisory Committee and the weekly one-hour meetings with Biology, Chemistry, and Physics continued as in the past.
- Fall, 1980 Dr. Anthony DuRapau discussed XU's CAUSE-developed Mathematics Program at the 4th International Congress On Mathematical Education in San Francisco. See Appendix XXIX for an overview of his presentation.

Activities Implemented by the Physics Department Via CAUSE:

At Xavier most science students take Physics during their sophomore or junior year after having completed at least one, and probably all three, of the other entry-level courses being revised under CAUSE. Therefore, the entry-level courses in the other departments serve, to a large degree, as "filters" for Physics. As a result, the enrollment in Physics is lower than that in the other three courses and students who enter Physics are generally better prepared than are those entering the entry-level courses in the other departments. In spite of the "weeding-out" which has occurred in Biology, Chemistry, and Mathematics beginning courses, many students entering Physics still lack sufficient problem-solving skills to do well in the course. Therefore, Physics, like the other departments, is actively seeking ways of improving retention and level of performance in the entry-level Physics sequence taken by most science majors, Physics 201 and 202. In spite of laboring under two disadvantages not shared by the other three departments (little opportunity to develop courses in the past and a greater share per person of the burden of administering a department as a result of fewer faculty among whom to spread the work), the Physics Department made as much (and maybe more) progress as the other departments. Under the CAUSE Grant, Physics acquired its first comprehensive set of AV materials, had its first chance to investigate the use of computer-based instructional aids, established its first tutorial service (it had no space to do so formerly), and developed materials for students for both semesters of lecture and laboratory. Further, the materials have been piloted once, have been refined, and will be used for the third time in the fall of 1980. It should be noted this development is extremely important since it provided a base for the additional development which will be needed as Physics 201-202 changed from two four-credit hour courses to two three-credit hour ones in 1979-80. The activities effected by Physics in reaching the present state of development are listed below:

- | | |
|--------------|---|
| Summer, 1977 | The CAUSE Grant was awarded. |
| Fall, 1977 | The members of the Physics Department met and began specification of content objectives. |
| Fall, 1977 | Dr. Harold Vincent attended the CAUSE-sponsored workshop to acquaint faculty with the advantages (and disadvantages) of an individualized delivery system such as PSI. |
| Fall, 1977 | The five Piagetian-based learning cycles developed by Dr. Vincent in the previous year were modified and improved on the basis of experimentation with their use in the summer of 1977 in Project SOAR, the special summer program for pre-freshmen majoring in the sciences. |
| Fall, 1977 | A comprehensive final examination was given to all students completing Physics 201. |
| Spring, 1978 | Content objectives for Physics 201 were completed. |
| Spring, 1978 | Content objectives for Physics 201 were evaluated by faculty from the Division of Natural Sciences and the College of Pharmacy at a CAUSE-sponsored workshop. |

- Spring, 1978 Course materials for both Physics 201 and 201L were developed. Those for the former included listings of content objectives, related sample problems, and sample exams. The laboratory materials included some Piagetian-based experiments developed as a result of the experience of using similar activities in the Physics portion of Project SOAR.
- Spring, 1978 Dr. Vincent assisted the remainder of the CAUSE Committee in conducting a Workshop on Science Teaching and the Development of Reasoning for high school and XU faculty.
- Spring, 1978 Dr. Charles Picketts, Chairman of the Department of Chemistry and Physics at Mississippi Valley State University, served as an outside consultant to evaluate the content of Physics 201 and discuss what should be in Physics. He spent two days on campus in this endeavor and submitted the formal report in Appendix X.
- Spring, 1978 An examination comparable to that administered in 1977 was given as the final in Physics 202.
- Spring, 1978 All members of the Physics Department (Harold Vincent, Juliette Ioup, Agustin Guitart, and Douglas Verrette) met as a group in a two-day workshop for the conclusion of in-depth consideration of the comments of faculty from other departments concerning Physics 201 materials and additional refinement.
- May, 1978 Dr. Vincent assisted Mr. Jones, Ms. Hunter, and Dr. Carmichael in conducting a Workshop on Science Teaching and the Development of Reasoning for high school science and mathematics teachers with emphasis on those who would be teaching in Project SOAR in 1978.
- May, 1978 Final revisions were made on Physics 201 and 201L materials and they were prepared for use in summer school.
- Summer, 1978 Dr. Vincent taught the General Physics sequence using the materials which he had developed the previous year.
- Summer, 1978 Dr. Vincent provided supervision to Ms. Helen Kerley (Carver Senior High) and Dr. Robert Perry (a self-employed physicist) as they conducted the Physics portion of Project SOAR. The five Piagetian-based learning cycles Dr. Vincent had developed previously were used in the program. Considerable emphasis was placed on additional experimentation so as to determine future use in regular entry-level courses.

- Fall, 1978 Dr. Vincent was one of three persons (with Carmichael and Hunter) who presented a paper discussing Project SOAR at the NSTA meeting in New Orleans.
- Fall, 1978 Physics 201 and 201L materials were revised on the basis of feed-back from the field-test conducted during the summer of 1978.
- Fall, 1978 Some parts of the Physics 201 and 201L materials were used in the first half of General Physics as a means of field-testing the newly revised materials.
- Spring, 1979 With the opening of the APLC, Physics established a tutorial service for the first time and moved into its space in the facility. CAUSE provided funds to purchase a wide variety of AV materials for use there.
- Spring, 1979 Dr. Vincent attended the workshop to familiarize faculty with the Tektronix and Apple computer terminals which was sponsored by the CAUSE Committee.
- Spring, 1979 Dr. Vincent attended the three-hour, CAUSE-sponsored workshop by Dr. Arthur Whimbey which was devoted to a consideration of methods of teaching to develop problem-solving skills with emphasis on those needed to perform well on standardized exams.
- Spring, 1979 Dr. Vincent directed the "How I Do It Workshop" for science and mathematics faculty from local high schools (and XU).
- Spring, 1979 Dr. Jack Lochhead, Director of the Cognitive Development Project and member of the Department of Physics at the University of Massachusetts--Amherst, served as a consultant for two days. He spent considerable time both discussing the content of Physics 201-202 and ways of improving performance in them (see Appendix XI for report).
- Spring, 1979 Materials for Physics 202 and 202L were developed by Dr. Vincent with repeated input from other members of the Physics Department.
- Spring, 1979 Final examinations similar to those used in previous years were administered to students completing the Physics sequence.
- Spring, 1979 Dr. Vincent, Dr. Verrette, and Dr. Guitart met in a two-day workshop to complete the year-long process of evaluating and modifying materials for the General Physics sequence.
- Spring, 1979 At the request of a number of departments, Physics agreed to reduce the credit hours for Physics 201 and 202 from four credit hours each to three credit hours each.

- Summer, 1979 Dr. Vincent supervised Ms. Helen Kerley (Carver Senior High) and Mr. Oliver Vital (O. Perry Walker Senior High) as they conducted the Physics portion of Project SOAR, the summer program for pre-freshmen interested in the sciences.
- Summer, 1979 Dr. Vincent taught Physics 201, 201L, 202, 202L using materials which had been developed the past two years with CAUSE funds.
- Summer, 1979 Further refinement of materials were effected on the basis of the field-test during summer school and materials were prepared for use by all students in both Physics 201 and 202 in 1979-80.
- Fall, 1979 Dr. Vincent discussed Project SOAR (along with Ms. Hunter) at the Science Instruction Seminar sponsored by the Southern Regional Education Board in New Orleans. See Appendix XVII for a copy of the program.
- Fall, 1979 Plans for the continuing to use CAUSE-developed Physics materials were completed. Details are in Appendix XXIII.
- April, 1980 Dr. Vincent discussed Project SOAR at the Science Instruction Seminar sponsored by the Southern Regional Education Board in Durham, North Carolina.
- Spring, 1980 Dr. Vincent discussed Project SOAR (along with Ms. Hunter and Mr. Jones) at the National Conference on Reasoning, Piaget and Higher Education in Denver, Colorado.
- Spring, 1980 Dr. Vincent wrote a proposal for the dissemination of information about XU's activities re making science more accessible to the educationally-disadvantaged to local junior and senior high teachers. The project was submitted to the NSF under IDSE. It was funded in the fall of 1980.
- Summer, 1980 Dr. Vincent refined and duplicated materials in preparation for use in the summer and fall of 1980.
- Summer, 1980 Dr. Vincent taught Physics 201 and 202 using CAUSE-developed materials.
- Fall, 1980 Oriented Dr. Akundi Murty, new Physics faculty member, in the use of CAUSE-developed materials.
- Fall, 1980 Dr. Vincent directed the IDSE Grant with CAUSE Committee members assuming a supportative role as an IDSE Advisory Committee. Dr. Vincent initiated a newsletter for local junior and senior high science teachers which monthly disseminates information as well as organized (or helped do so) workshops for local Biology and Chemistry teachers.

IV. Evaluation

From its inception, formative evaluation during the development and field-testing of materials, summative evaluation at the end of the grant period, and on-going evaluation after the grant expires were integral components of XU's CAUSE Project. Although closely related in many areas, the three are discussed separately in this document for sake of clarity.

Formative Evaluation:

Formative evaluation of the CAUSE Project at Xavier was a constant process coordinated by the regular weekly meetings of the CAUSE Committee. It consisted of three, sometimes overlapping, phases: evaluation by other faculty within a given department, evaluation by faculty from other science departments at Xavier, and evaluation by at least one outside consultant per department per year. Each is described briefly below:

1. Formative Evaluation within a given department: Since XU is a small institution offering a limited number of upper-level courses, it is likely that most faculty in a given department will teach some part of the entry-level sequence during an academic year. Therefore, long-term acceptance of a "departmental" course necessarily requires that the entire department, not just the CAUSE representatives, be involved in the curriculum development undertaken. For this reason, great effort was expended in systematically seeking input from all members of each department as the project progressed. The effort to develop a truly departmental course was very successful. The materials developed are now used, willingly, by all faculty in each department when teaching the pertinent courses. The basic procedure by which this was accomplished follows.

Before beginning development--All four departments had had considerable opportunity to discuss plans for development before the proposal was submitted and during the time-lag while waiting to hear NSF's reaction to it. Upon receiving notification of the grant award, each department scheduled further meetings for all faculty to re-examine past decisions. In both Biology and Mathematics these meetings extended over a considerable period of time and, ultimately, resulted in drastic changes in both the content and approach taken in entry-level courses in the two departments.

During development--During development there was constant consideration of specific items at departmental meetings, especially in Biology and Mathematics where a relatively large group of faculty (approximately eight in each) were making their first attempt to reach a consensus as to what to exclude from the new departmental courses. (They had long since recognized that it would be impossible to teach everything that all of them had originally thought should be in the entry-level courses.)

After development, evaluation by other faculty at XU, and evaluation by outside consultants--After development, materials were evaluated by faculty from other departments and by outside consultants. Subsequently, an average of 75% of the faculty of the four departments met (by department) each year for two days immediately following spring finals to further refine the materials.

Continuing formative evaluation within a department--All four departments now conduct regular meetings each semester for those faculty teaching in the entry-level courses for the purpose of coordinating activities and considering further joint improvements. Completion of the specifications for the common finals during the last year of the grant will contribute significantly to the department's ability to perform year by year comparisons.

Revision of materials on a continuing basis after each step--After each step of the formative evaluation, time was taken to make modification and/or refinements suggested. As a result, the materials now in use truly represent a "departmental" effort rather than merely the view of one or two faculty who did the actual work. This effort, while very time consuming, was well worthwhile since the materials now developed are used willingly by all faculty within the four departments with no reservations.

2. Formative Evaluation by Other XU Mathematics and Science Faculty:
Most science majors at Xavier must take a number of courses in science departments other than that in which they are majoring. Therefore, it is very important that members from other departments also have input in curriculum development in service courses, especially at the entry-level. The regular weekly meetings of the CAUSE Committee served as a major source of formative evaluation from other departments on a continuing basis as the curriculum development was implemented. In addition, in order to obtain even broader input, in the spring of 1978 approximately 70% of the faculty from the Division of Natural Sciences and College of Pharmacy (more than 30 total) attended a three-hour workshop (on Friday afternoon yet!!!) and systematically evaluated all course objectives for the four entry-level sequences. Subsequently, a number of individuals voluntarily met with the various departments for more extensive discussions. This activity not only proved to be extremely valuable in terms of gaining a better perspective of what other departments expected from the entry-level courses in one's own area, but also opened the door for continued communication. It is now much more common to have inter-departmental communication about content and teaching techniques than previously. The success of the first such workshop led to a repeat performance in the fall of 1979 after refinement and modification had been made on the basis of previous evaluation. This workshop, like the first, was very successful.

3. Formative Evaluation by Outside Consultants: In order to ensure that course modification did not result in course content which deviated significantly from that expected in similar courses elsewhere, both years each department sought an outside consultant who spent two days at XU reviewing and evaluating the course materials, and in some cases, delivery system. The outside consultants were:

	<u>1977-78</u>	<u>1978-79</u>
Biology	Dr. John Ruffin Biology Department North Carolina Central University, Durham	Dr. John Ruffin Biology Department North Carolina Central University, Durham

Chemistry	Dr. Theodore Brown Author of <u>Chemistry: The Central Science, the chemistry text at XU</u> Professor of Chemistry University of Illinois Urbana	Dr. Arthur Whimbey Author of <u>Intelligence Can Be Taught & Problem- Solving and Comprehension: A Short Course in Analytic Reasoning</u> Guest Lecturer, XU
Mathematics	Dr. Solomon Garfunkel Associate Director, UMAP Mathematics Department University of Connecticut Storrs	Dr. Raymond Coughlin Author of <u>Applied Calculus</u> Mathematics Department Temple University
Physics	Dr. Charles A. Pickett Chairman, Department of Chemistry & Physics Mississippi Valley State University, Itta Bena	Dr. Jack Lochhead Director, Cognitive Develop- ment Project Department of Physics University of Massachusetts Amherst

Their official reports are contained in Appendices IV-XI.

In addition, at the end of the three-year grant period, Dr. Bobby Irby, Chairman of the Department of Science Education at the University of Southern Mississippi, evaluated the entire project. His report is included in Appendix XVIII. His report concludes with the following statement...

"Progress toward meeting these objectives has been excellent, and where objectives are not yet fully addressed, significant mechanisms have been established that will result in advancement toward meeting them. In short the CAUSE project has been successful."

Summative Evaluation:

The ultimate success of the project must be judged on how well it achieves the stated objectives of decreasing attrition from and improving performance in entry-level courses for science majors at Xavier. The following sections of this report indicates that all four of the departments had success in obtaining these goals. The overall success of the program is substantiated by the report submitted by Dr. Bobby Irby, Chairman of the Department of Science Education at the University of Southern Mississippi after visiting XU as the final, overall evaluator. His report is contained in Appendix XVIII.

Biology

All majors in Biology, Psychology, Medical Technology, Pre-Pharmacy, and Premedicine/pre-dentistry are required to take a year-long entry-level Biology course for science majors. There are no prerequisites for enrollment and no placement exams are given. All departments, however, require that their students make a grade of "C" or better in the course.

The Biology Department made particularly significant progress in improving the course under the CAUSE Grant. In departmental-wide discussions at the beginning of the project, the decision was reached to change entry-level Biology from a semester of General Biology and a semester of Zoology to a year of General Biology. Following this decision, materials for the new first semester lecture and laboratory courses, Biology 123 and 123L, were developed in 1977-78 and field-tested in 1978-79. Those for the second semester, Biology 124, were developed and field-tested in 1978-79. (In order to avoid confusion, the new course has new numbers. The old ones had been Biology 113 and 114.) The development and use of CAUSE-funded materials has made it possible for the Biology Department to make good progress toward reducing attrition and outstanding progress in increasing performance as outlined below.

1. Success in Reducing Attrition (Increasing Attrition)--Biology

For all practical purposes a science major who makes lower than a "C" in any science or mathematics course is unlikely to be able to obtain his or her career objectives. In addition, most departments at XU who require science-major entry-level Biology require that the student obtain a "C" in order to use the credit for graduation. It therefore appears that the percentage of students who complete the entry-level courses with a "C" or better is a suitable measure of retention in the sequence (and in science majors at XU). It should be noted that entry-level Biology is only one of the four sequences modified via CAUSE which does not have a prerequisite for entering it and it is therefore unlikely that retention in this sequence will ever reach that hoped for in the other entry-level courses. (Both Precalculus/Calculus I and General Chemistry require that a student pass all or some part of the University's Mathematics Placement Examination or complete a developmental Mathematics course before enrolling in those sequences. Physics requires that students complete Precalculus with a "C" or better before enrolling in entry-level Physics.) The following table contains pertinent data for the entry-level Biology sequence for the past three years.

	Biology 123		Biology 124		Through-put (% pass in yr = $\frac{d}{a} \times 100\%$)
	(a) Number Entering	(b) Number Pass w/"C"	(c) Number Entering	(d) Number Pass w/"C"	
Fall, 1977 (pre-CAUSE)	182* (100%)	116* (64%)			
Spring, 1978 (pre-CAUSE)	68* (100%)	19* (28%)	119** (100%)	89** (75%)	49%
Fall, 1978 (CAUSE)	162 (100%)	81 (50%)	27** (100%)	24** (89%)	35%
Spring, 1979 (CAUSE)	84 (100%)	43 (51%)	99 (100%)	88 (88%)	54%
Fall, 1979 (CAUSE)	185 (100%)	109 (59%)	45 (100%)	41 (90%)	48%
Spring, 1980 (CAUSE)	79 (100%)	41 (52%)	108 (100%)	87 (81%)	47%

*Biology 113 **Biology 114

From the data above, it is obvious that there has been significant progress toward increasing retention in (reducing attrition from) entry-level Biology courses for science majors. Specific observations which are noteworthy are:

1. The percentage of students completing the "off-semester" course in Biology 123 (i.e., in the spring rather than in the fall) has increased dramatically--from approximately 25% to above 50% after implementation of CAUSE. This is particularly significant because off-semester sections have higher percentages of students with known academic deficiencies upon entering the University and correspondingly lower probability of completing a degree program in the sciences. The course modification undertaken via CAUSE is particularly noteworthy, therefore, to the educationally-disadvantaged, the exact group for whom the development was aimed.
2. The percentage of students completing both sequences (i.e. "through-put") for the off-semester sequence has increased to the point where it is comparable to that for the sequence which begins in the fall. Again, the CAUSE materials were obviously successful since the less well prepared students were those who benefited.

In summary, the attempt to reduce attrition (increase retention) in the entry-level Biology sequence for science majors is successful since it is increasing the number of students (in off-semester courses) successfully completing the sequence.

2. Success in Increasing Level of Performance--Biology

In the spring of 1978 and again at the same time in 1979 and 1980, a randomly-selected sample of students completing the entry-level Biology courses were administered the CLEP General Biology Examination under similar circumstances-- in laboratory for a few extra points on such short notice that no preparation was possible. The resulting data is presented below:

	<u>Number</u>	<u>Average Score</u>	<u>Standard Deviation</u>	<u>Range</u>	<u>Approximate %-ile for Average</u>
1977-78 (pre-CAUSE)	39	29.0	3.91	32-46	15th
1978-79 (CAUSE)	29	47.6	7.52	36-64	42nd
1979-80 (CAUSE)	31	45.3	5.87	34-63	36th

This data indicates outstanding success in increasing level of performance!!! Specific comments of note are:

1. The average in both 1978-79 and 1979-80 is as high as (or higher than) the highest score in 1977-78 (pre-CAUSE).
2. The percentile rank of the average score has more than doubled what it was prior to implementation of CAUSE. (Alternately, the percentile rank has increased by more than 20 percentile points after CAUSE as compared to before.)

In summary, Biology has made phenomenal progress in increasing level of performance in addition to the reduction in attrition discussed in the previous section.

Chemistry

The content of General Chemistry at Xavier has been determined by the entire department (rather than individual faculty teaching various sections) via clearly prescribed content objectives (and finals) for a number of years. Therefore, the Chemistry Department needed less time to consider course content and to develop/modify materials than did the other departments. This, in turn, made it possible to devote more time to refining the existing delivery system. The result is described in "Cognitive Skills Oriented PSI in General Chemistry," Journal of Developmental And Remedial Education, Vol. 3, pages 4-6 (Winter, 1979). A copy of the latter is enclosed in Appendix XXIV. The combination of extensive previous experience in similar activities and an inordinate amount of work during the summer of 1977, yielded sufficient progress in modification/development of new materials to actually begin using them (while completing development one step ahead of need) in the fall of 1977--the first year of the CAUSE grant. While beginning the use of materials before completing development is not recommended for those disposed to ulcers, doing so made it possible for the Chemistry Department to field-test and further refine materials twice during the first two years of the grant. This, in turn, made it possible to make significant progress both toward reducing attrition from and increasing performance in the General Chemistry sequence as detailed in the following.

1. Success in Reducing Attrition (Increasing Retention)--Chemistry

For all practical purposes a science major who makes lower than a "C" in any science or mathematics course is unlikely to be able to obtain his or her career objectives. It therefore appears that the percentage of students who complete General Chemistry with a "C" or better is a suitable measure of the retention in the course. The following table contains pertinent information for the General Chemistry sequence at XU for the past three years.

	<u>Chemistry 101</u>		<u>Chemistry 102</u>		Through-put (% pass in yr = d/a x 100%)
	a--Number Entering	b--Number Pass w/"C"	c--Number Entering	d--Number Pass w/"C"	
1976-77 (pre-CAUSE)	118 (100%)	71 (60%)	69 (100%)	53 (77%)	45%
1977-78 (1st yr. CAUSE)	133 (100%)	91 (68%)	86 (100%)	75 (87%)	56%
1978-79 (2nd yr. CAUSE)	156 (100%)	124 (79%)	105 (100%)	97 (92%)	62%
1979-80 (3rd yr. CAUSE)	109* (100%)	81** (74%)	75 (100%)	61** (81%)	56%

*Enrollment was down because minimum criteria for passing Mathematics Placement Exam at XU, a prerequisite for General Chemistry, was increased. A study in 1979-80 indicated that passing at the higher level made no measureable difference in performance or retention in General Chemistry. Therefore, students with minor deficiencies in math may concurrently enroll in General Chemistry and a one-semester "fast" math review. Those with more serious deficiencies must complete review courses before enrolling in Chemistry.

**A study made in 1978-79 indicated that the refinement of the General Chemistry delivery system had eliminated the need for the "DC = Deferred Credit" Grade which allowed students to take more than one semester to complete a course if necessary. Therefore, the grade was dropped beginning in 1979-80.

From the data above, it is obvious that the attempt to reduce attrition in General Chemistry (to increase retention) was successful. A summary of the data is given in the following:

1. The percentage of students completing Chemistry 101 rose from 60% in 1976-77 (before CAUSE) to an average of 74% after CAUSE-development.
2. The percentage of individuals completing Chemistry 102 rose from 77% before CAUSE to an average of 81% after CAUSE development.
3. The "through-put", the percentage of students who finish both semesters of General Chemistry (a statistic thought to be a good estimate of the percentage who remain in the sciences since General Chemistry is required for almost all science majors at XU) rose from 45% in 1976-77 (before CAUSE) to an average of 58% after CAUSE modification/development.
4. The refinement of the delivery system used in General Chemistry made it unnecessary to retain the "DC = Deferred Credit" Grade which had been used from 1972 to 1979 as a mechanism for allowing poorly prepared students to take more than one semester to complete a given General Chemistry course.

In summary, the attempt to reduce attrition (increase retention) in General Chemistry was an outstanding success. Not only did the percentage of students completing the course with a "C" or better increase for both semester but the refinement completed under CAUSE made it possible to eliminate the "Deferred Credit" grade. Further, the increases in retention occurred at the same time that increases in level of performance were occurring. The General Chemistry sequence at XU, as described in Appendices XXIV and XXV, is a good example of the way in which the University implements "Standards with Sympathy"--coupling high academic expectations with mechanisms which allow the educationally-disadvantaged students to succeed.

2. Success in Increasing Level of Performance--Chemistry

For a number of years, students completing Chemistry 101 have taken an examination whose content and format is very strictly specified by the Chemistry Department as a whole. In addition, students completing Chemistry 102 have been required to take various versions of the American Chemical Society's Cooperative Examination in General Chemistry as a final since 1974. This makes comparison of performance from year to year in the two courses relatively reliable. In making such comparisons, however, it should be remembered that one of the features of the modified PSI courses at Xavier is the opportunity for students to repeat finals (other versions--not the same test) as a means of promoting learning to take standardized exams. The following data summarizes the success of XU's CAUSE Grant with respect to increasing level of performance in General Chemistry.

	<u>Chemistry 101</u>			<u>Chemistry 102</u>			
	<u>Number</u>	<u>Mean*</u>	<u>Std. Dev.</u>	<u>Number</u>	<u>Mean*</u>	<u>Std. Dev.</u>	<u>%-ile of Mean</u>
1976-77 (pre-CAUSE)	76	129	26	58	141	37	51st
1977-78 (1st yr. CAUSE)	111	127	29	84	143	40	52nd
1978-79 (2nd yr. CAUSE)	135	137	26	97	146	29	55th
1979-80 (3rd yr. CAUSE)	99	135	27	69	148	32	57th

*For highest grade on the repeatable final.

The data above indicate that the program was successful in terms of increasing performance in General Chemistry as follows:

1. Performance in Chemistry 101 increased slightly over the time period even as percentage of students who completed the courses increased (see the previous section).
2. Performance in Chemistry 101 also increased as percentage of students who completed the course increased.

In summary, the CAUSE Grant resulted in both reduction of attrition from and increase in level of performance in General Chemistry.

Mathematics

All students entering Xavier are required to take a locally-produced Mathematics Placement Examination which determines whether the student must complete a developmental, non-degree credit Mathematics course (Math 0980) before enrolling in regular college courses. The CAUSE Grant focuses on improvement of the two college-credit Mathematics courses taken by most science majors after passing either the Placement Exam or the developmental course. They are Precalculus and Calculus I. The first of these courses is a combination of elements from Algebra and Trigonometry. The second is both a terminal course for most science majors and the first semester of a three-semester sequence for a much smaller number. Development of these courses under CAUSE has been accompanied (as it must be) with corresponding development (from other sources) of both the developmental courses and the remaining two courses in the Calculus sequence. The Mathematics Department has made significant progress in both reducing attrition (increasing retention) and increasing level of performance as is detailed below.

1. Success in Reducing Attrition (Increasing Retention)--Mathematics

It is unlikely that a science or mathematics major who makes lower than a "C" in a science or mathematics course will successfully obtain a career in one of these areas. For that reason, it appears that the percentage of students who complete entry-level courses with a "C" or better is a suitable measure of the retention in the courses. The following table contains statistics for the Precalculus and Calculus I sequence at Xavier for the past three years. It should be noted that the CAUSE materials for Precalculus were implemented during 1978-79 and those for Calculus I were implemented during 1979-80. The table is arranged to facilitate comparing the statistics from one fall semester against another, and likewise for the spring and summer semesters, since in this way we are comparing more homogeneous groups of students.

Mathematics 1030

Term	(PRE-CAUSE)			(CAUSE 1030)			(CAUSE 1030 & 1040)		
	Year	Number Entering	Number (%) Pass w/"C"	Year	Number Entering	Number (%) Pass w/"C"	Year	Number Entering	Number (%) Pass w/"C"
Fall	'77	155	55 (36%)	'78	215	97 (45%)	'79	181	103 (57%)
Spring	'78	122	50 (41%)	'79	134	51 (38%)	'80	165	77 (47%)
Summer	'78	33	6 (18%)	'79	31	17 (55%)			

Mathematics 1040

Fall	'77	71	24 (34%)	'78	90	45 (50%)	'79	78	30 (38%)
Spring	'78	107	50 (47%)	'79	117	73 (62%)	'80	133	68 (51%)
Summer	'78	43	32 (74%)	'79	44	28 (64%)	'80	47	28 (60%)

From the data on the preceding page, it seems that some progress has been made in reducing the attrition rate in the Precalculus course during the three year span; for example, the percentage completing the course with a "C" or better has increased from 36% in the fall of 1977 to 57% in the fall of 1979. Since the present three class meetings per week in Precalculus does not provide sufficient opportunity for most students to absorb all the algebra and trigonometry needed for Calculus, we expect more improvement in retention when we gain approval to make Precalculus a four semester-hour course.

The increased attrition from Calculus I during 1979-80 seems to be the result of the uniform standards imposed by the modules and common exams. These have led to an increase in content over what many instructors previously included in their Calculus I course and to an increase in expected standards of student achievement by other faculty members. We believe that the attrition rate will decline once all members of the faculty have the opportunity to become accustomed to the new materials.

Physics

Enrollment in entry-level Physics for most science majors (Physics 201 and 202) is lower than in the entry-level courses for the other three departments. Therefore, fewer faculty are involved in teaching the sequence and there are correspondingly fewer problems in coordinating activities associated with the course than there are in Biology, Chemistry, and Mathematics where a sizeable fraction of the faculty are teaching some part of the introductory courses in a given semester. However, course improvement via CAUSE was desirable because many students who enroll in the course, even though better prepared than those entering the other entry-level courses, still have significant deficiencies--especially in problem-solving ability. Materials for Physics 201 were developed in 1977-78 and were field-tested in the summer of 1978. These materials and some part of those for Physics 202 were used in academic 1978-79 as modification and further developed was effected. The full component of CAUSE materials in Physics were used for the first time in the summer of 1979. In the spring of 1979 the decision was made to reduce the number of credit hours in Physics 201-202 from eight to six. Therefore, additional modification was undertaken during the summer of 1979 and during 1979-80 in order to accomodate this change without significantly lowering the quality of the course. Data gather before, during and after the extensive changes which have taken place indicate that the Physics Department has made significant progress both toward reducing attrition from Physics 201-202 and toward increasing level of performance in the courses. The details are presented in the following sections.

1. Success in Reducing Attrition (Increasing Retention)--Physics

In considering retention in Physics 201 and 202, it is assumed that a grade less than a "C" in the course is unlikely to indicate progress toward a degree in a science major. Therefore, the percentage of students who complete the two courses with a "C" or better seems to be a suitable measure of retention for the two. This is the same measure used by the other three departments undertaking course improvement under CAUSE. The following table contains pertinent retention data for Physics 201 and 202 for the past two years.

	<u>Physics 201</u>		<u>Physics 202</u>		<u>Through-put (% pass in yr)</u>
	<u>Number Entering</u>	<u>Number Pass w/"C"</u>	<u>Number Entering</u>	<u>Number Pass w/"C"</u>	
Summer, 1977 (pre-CAUSE)	25 (100%)	23 (92%)	24 (100%)	24 (100%)	
1977-78 (pre-CAUSE)	51 (100%)	30 (59%)	45 (100%)	27 (60%)	53%
Summer, 1978 (CAUSE 201 only)	28 (100%)	19 (68%)	21 (100%)	12 (57%)	
1978-79 (part-CAUSE)	59 (100%)	41 (69%)	63 (100%)	46 (73%)	78%
Summer, 1979 (total CAUSE)	43 (100%)	26 (60%)	28 (100%)	16 (57%)	
1979-80 (total CAUSE)	93 (100%)	61 (65%)	80 (100%)	68 (75%)	73%
Summer, 1980 (total CAUSE)	52 (100%)	33 (64%)	35 (100%)	27 (77%)	

The general hectic pace of summer school and the variation in quality of student who chooses to enroll then makes it impossible to place any faith in observations concerning retention based on comparison of summer school grades. This data is included in the table only to emphasize that materials for both semesters have been developed and field-tested during the grant period. However, the data for academic years indicates the Physics component of XU's CAUSE grant has been successful in reducing attrition as intended.

1. The percentage of persons completing Physics 201 has increased from 59% before CAUSE development (1977-78) to an average of 67% since that development.
2. The percentage of persons completing Physics 202 with a "C" or better has increased from 60% in 1977-78 (pre-CAUSE) to an average of 74% in 1978-79 and 1979-80 (post-CAUSE).
3. The "through-put" in Physics 201-202 in one year has increased from 53% before CAUSE to an average of 75.5% after CAUSE.

In summary, the Physics Department was extremely successful in reducing attrition from entry-level courses as a result of the CAUSE Grant. Further, this is particularly impressive since there was a 25% decrease in lecture hours per week (from eight to six) from 1978-79 to 1979-80. It is obvious that the CAUSE-development was one of the major factors which made it possible to make such a reduction without increasing attrition appreciably.

2. Success in Increasing Level of Performance--Physics

Neither ETS (via CLEP) nor the American Physical Society provide a college-level standardized exam for a non-Calculus based, year-long Physics course. Further, efforts to find a nationally-normed exam from other sources were unsuccessful. Therefore, it was not possible for Physics to obtain direct input concerning level of performance of its students as compared to the national average. However, the department did develop specifications for finals for both Physics 201 and 202 and collected performance data on finals during the grant period. This data is presented below.

	<u>Physics 201</u>			<u>Physics 202</u>		
	<u>Number</u>	<u>Mean on Final</u>	<u>Std. Dev.</u>	<u>Number</u>	<u>Mean on Final</u>	<u>Std. Dev.</u>
AY, 1977-78 (pre-CAUSE)	50	61.8	14.3	44	50.9	13.4
Summer, 1978 (CAUSE 201)	28	71.2	15.6	20	73.0	27.2
AY, 1978-79 (part-CAUSE 201)	59	62.4	15.4	63	62.8	18.3
Summer, 1979 (CAUSE 201 & 202)	43	62.4	14.3	27	64.0	19.7
AY, 1979-80 (CAUSE)	92	63.5	14.8	80	65.2	18.2
Summer, 1980 (CAUSE)	52	63.2	14.3	34	68.2	19.1

Statistics for the summer sessions are included merely to indicate that Physics 201 and 202 materials were developed and used in those courses also. The smaller number of enrollees during the summer and the generally hectic pace of summer school tends to give more variation than noted for the academic year. Therefore, only academic year data is used in the analysis. The comments which may be made are as follows:

1. There was a significant increase in performance on the Physics 202 final after CAUSE-development as compared to before.
2. Changing from an eight semester hour to a six semester hour course (in academic 1979-80) did not result in lessening performance on the finals in either Physics 201 or 202. Since the finals from all three years were developed from the same detailed specifications, they are known to be roughly comparable. Therefore, this lack of change is particularly important.

In summary, Physics (like the other three departments) had good success in both reducing attrition from and increasing level of performance in its entry-level courses as a result of XU's CAUSE Grant.

On-Going Evaluation:

One of the primary purposes of Xavier's CAUSE Project was to enhance the ability of the four departments to assess performance of students from year to year in an objective manner and to provide guidance to inexperienced faculty as they attempt to improve teaching techniques. This effort to improve methods of on-going evaluation included a) identifying standardized exams which permit some measure of level of performance locally against that nationally and b) developing detailed specifications for locally-produced, common finals for each of the entry-level courses.

All departments have been successful in the attempt to improve their ability to evaluate both students and faculty involved in entry-level courses. First, Biology, Chemistry, and Mathematics (for Precalculus) identified national exams for the entry-level courses in their respective fields and administered those exams both before and after implementing the course improvement under CAUSE. Second, all four departments completed detailed "prescriptions" for common examinations for their respective entry-level courses. Third, all four departments have agreed to continue to use these exams in the future. A detailed plan for the way in which CAUSE-implemented activities will be continued after the grant period is contained in Appendices XX-XXIII.

In summary, the CAUSE Grant to Xavier was successful in terms of its enhancing the four departments' ability to evaluate courses in the future.

V. Dissemination

In the past, those institutions most likely to possess expertise in treating the special problems of minority or educationally-disadvantaged students (for instance, the predominantly-black institutions such as Xavier) have been least likely to develop mechanisms for disseminating that information. Since this both inhibits development through sharing experiences and prevents such institutions from gaining the recognition they deserve, Xavier's science faculty actively sought to share their experiences re CAUSE and related activities. The following is a summary of the dissemination efforts completed or planned by XU faculty.

General

During the Spring semester of 1978, 1979, and 1980 the CAUSE Committee (Carmichael, Hunter, Jones, and Vincent) sponsored a Workshop on Science Teaching and the Development of Reasoning for local high school teachers. The workshop focussed on Piaget's theory of intellectual development and its implications for science and mathematics teachers. Materials for the workshops were purchased from the Reasoning Laboratory at the Lawrence Hall of Science, University of California, Berkeley.

Dr. Carmichael accepted an invitation to attend a conference for representatives from college-level, Piagetian-based programs held at the University of Nebraska--Lincoln in the summer of 1978. The programs represented are discussed in a publication entitled Multidisciplinary Piagetian-Based Programs for College Freshmen which is available from Dr. Robert Fuller, Director, ADAPT, 213 Ferguson Hall, University of Nebraska, Lincoln, NE 68588.

The CAUSE Committee sponsored a "How I do it Workshop" for high school mathematics and science faculty from New Orleans in the Spring of 1979. 37 high school teachers and 14 XU faculty attended.

The CAUSE Committee sponsored a "hands-on" introduction to the graphic terminals purchased via CAUSE (Tektronix and APPLE II) for XU science and mathematics faculty in the Spring of 1979.

The CAUSE Committee sponsored a workshop by Dr. Arthur Whimbey, author of Intelligence Can be Taught (Innovative Sciences) and Problem-Solving and Comprehension: A Short Course in Analytical Reasoning (Franklin Institute Press) in the Spring of 1979. The workshop was designed to generate interest in the use of Dr. Whimbey's "Cognitive Therapy" as a means of improving student performance on standardized exams.

The CAUSE Committee submitted a document discussing Project SOAR to The American Biology Teacher. It was published in March of 1980 (Vol. 42, No. 3, pages 169-173). A photocopy is included in Appendix XVI.

The CAUSE Committee submitted an article discussing the use of Whimbey's "cognitive therapy" as a means of improving scores on standardized exams to The Journal of Reading. It was published in October of 1980 (Vol. 24, No. 1, pages 5-10). A copy is enclosed as Appendix XVII.

The CAUSE Committee submitted an article discussing the "bridge nature" of SOAR (between high school and college) to the Louisiana Journal of Science. The article has been accepted for publication early in 1981.

The CAUSE Committee provided assistance to the Southern Regional Education Board as that organization sponsored Science Instructional Seminars in New Orleans and Durham, NC, in 1979-80. Dr. Vincent, Ms. Hunter, and Sr. Grace Mary Flickinger made presentations at both Seminars.

Dr. Jones, Dr. Vincent, and Ms. Hunter made presentations re XU's Piagetian-based activities at a conference on "Reasoning, Piaget, and Higher Education" at Denver in the Spring of 1980.

The CAUSE Committee assisted Dr. Vincent prepare a proposal to IDSE (NSF) to disseminate information about new ideas for mathematics and science instruction to local junior and senior high school teachers. The project was funded beginning in the fall of 1980 and is proceeding exceptionally well.

Ms. Hunter and Dr. Carmichael discussed the implications of Piaget's theory of intellectual development for science teachers at the National Science Teachers' Association Meeting in New Orleans in the fall of 1978.

Dr. Carmichael was one of six speakers invited by the National Science Foundation to speak at a CAUSE Information Exchange Seminar at North Carolina State University in August of 1979.

XU's CAUSE Project was featured in the last issue of the Association of American Colleges' Forum for Liberal Education in January of 1980.

Forty-three persons have requested information about XU's CAUSE Project and one, Fayetteville State University (North Carolina) will be using the CAUSE-developed General Chemistry Laboratory materials in the spring of 1981. See Appendix XXX for a list of those asking for information.

Biology

Ms. Hunter discussed XU's CAUSE Project at the NSTA meeting in Atlanta in the Spring of 1979.

Sr. Grace Mary Flickinger discussed the Biology portion of XU's CAUSE Grant at a meeting of the National Association of Biology Teachers in New Orleans in the fall of 1979.

Ms. Hunter discussed Project SOAR, XU's multidisciplinary summer program at the National Association of Biology Teachers meeting in New Orleans in the fall of 1979.

Ms. Hunter presented a paper entitled "Mitosis and Meiosis with Knives, Forks, and Spoons" at the National Association of Biology Teachers in New Orleans in the fall of 1979.

Sr. Grace Mary Flickinger discussed XU's CAUSE Project, and particularly the Alternate Pathways Learning Center, at the International Congress on Individualized Instruction in Athens, Georgia, in the fall of 1979.

Ms. Hunter and Sr. Grace Mary Flickinger made presentations at an IDSE-sponsored workshop for local Biology teachers at Xavier in the fall of 1980.

Chemistry

Dr. Carmichael attended the Networks National Conference in San Francisco as an invited speaker to discuss XU's CAUSE-related activities re "Sympathy versus Standards in the Sciences: Overcoming Student Deficiencies" in the fall of 1978.

Dr. Mary Ann Ryan made a presentation as an invited speaker at an NSF-sponsored conference for institutions which had had MISIP Grants to discuss XU's General Chemistry sequence in Washington in the spring of 1979.

An article describing XU's CAUSE-developed General Chemistry course was published in the Journal of Developmental and Remedial Education in the Winter, 1979, issue. A copy is enclosed in Appendix XXIV.

An article describing XU's Piagetian-based (and CAUSE-developed) General Chemistry Laboratory program was submitted for publication to the Journal of Chemical Education. It appeared in September, 1980 (Vol. 57, No. 9, pages 642-645). See Appendix XXV for a copy.

Dr. Carmichael served as an invited speaker at a Networks Conference held in Washington, DC, in the fall of 1979. Both SOAR and the CAUSE-related activities at XU were discussed.

Mr. Donald Robinson made a presentation re XU's General Chemistry sequence and its special features for educationally-disadvantaged students at the National Meeting of the American Chemical Society in Houston in the Spring of 1980.

Dr. Carmichael served as keynote speaker at a session on "Minorities and Women in Chemistry" at the 6th Biennial Conference on Chemical Education in Rochester, NY in June. Sr. Joanne Bauer and Ms. Barbara Wells made presentations concerning XU's CAUSE-developed lecture and laboratory courses at that same meeting in 1980.

Dr. Carmichael has been invited to speak at a number of upcoming events including a symposium for high school teachers sponsored by the Ouachita Valley (Northern Louisiana) Section of the American Chemical Society; the 1981 SE Regional Meeting of the American Chemical Society to be held in Lexington, Kentucky; the March meeting of the American Association for Higher Education in Washington in March, 1981; and a special workshop for educators from California Universities and Colleges in February, 1981.

Mathematics

Sr. Rosemarie Kleinhaus, Dr. Bill Irlbeck, and Mr. Winston Brown discussed XU's CAUSE-developed mathematics materials at the American Mathematics Association of Two-Year Colleges' National Meeting in San Diego in the fall of 1979.

Mr. Lester W. Jones discussed Project SOAR and the implications of Piaget's theory of intellectual development for mathematics teachers at the American Mathematics Association of Two-Year Colleges in San Diego in the fall of 1979.

Mr. Jones served as a consultant for the developmental mathematics program at Tougaloo College, MS, in May of 1980.

Dr. Anthony DuRapau made a presentation concerning XU's CAUSE-developed Mathematics courses at the 4th International Congress on Mathematical Education in San Francisco in August, 1980.

Physics

Dr. Vincent directed the "How I Do It Workshop" for local science and mathematics faculty (from high schools) in the spring of 1979.

Dr. Vincent discussed the CAUSE-developed Physics materials at the Louisiana Academic of Sciences Meeting in Hammond in the Spring of 1979.

Dr. Vincent served as a consultant for the developmental mathematics and science program at Tougaloo College, MS, in May of 1980.

CAUSE Grant SER77-06227 to the Departments of Biology, Chemistry, Mathematics, and Physics at Xavier University of Louisiana was definitely a success!! In the words of Dr. Bobby Irby, Chairman of the Department of Science Education at the University of Southern Mississippi who served as a final, overall evaluator...

"Progress toward meeting these objectives has been excellent, and where objectives are not yet fully addressed, significant mechanisms have been established that will result in advancement toward meeting them. In short the CAUSE project has been successful."

Appendix I

Enrollment Statistics for the Natural Sciences in Fall Semesters

	1970-71						1971-72						1972-73					
	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot
Biology	3	2	4	11	9	29	7	0	3	5	11	26	8	0	11	4	5	28
Chemistry	12	1	7	10	9	39	10	4	7	6	8	35	20	2	8	4	6	40
Mathematics	6	1	16	12	7	42	10	4	13	12	2	41	11	1	10	11	5	38
Physics	2	1	1	0	0	4	0	1	2	0	0	3	0	0	0	1	1	3
Pre-Engineering	4	4	4	3	0	15	2	2	6	2	0	12	3	0	4	5	0	12
Sub-totals	27	9	32	36	25	129	29	11	31	25	21	117	42	3	33	25	17	120
Medical Tech.							23	5	11	16	14	69	35	5	17	12	14	83
Pre-Pharmacy	20	5	43	--	--	68	20	5	43	--	--	68	41	10	28	--	--	79
Totals							72	21	85	41	35	254	118	18	78	37	31	282
Full-time Undergrad. Enroll.	1308						1351						1341					

	1973-74						1974-75						1975-76					
	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot
Biology	8	1	7	7	3*	26*	8	7	5	8	5	33	5	9	6	3	6	29
Chemistry	33	11	18	5	4	71	26	12	14	11	6*	69*	20	8	22	11	9*	70*
Mathematics	9	5	7	7	6	34	9	6	7	6	7	35	5	3	9	1	4	22
Physics	1	0	0	0	1	2	0	0	1	3	1	5	0	0	0	1	4	5
Pre-Engineering	7	0	1	1	0	9	7	3	3	0	0	13	5	5	2	0	0	12
Sub-totals	58	17	33	20	14*	142*	50	28	30	28	29*	154*	35	25	39	16	23*	138*
Medical Tech.	25	8	19	10	10	72	32	17	13	12	11	85	26	17	19	13	10	85
Pre-Pharmacy	39	15	35	--	--	89	62	28	48	--	--	138	61	27	49	--	--	137
Totals	122	40	87	30	24*	303*	144	73	91	40	40*	377*	122	69	107	39	33*	360*
Full-time Undergrad. Enroll.	*@KWilliams in Med. 1497						*@JAllen in Med. 1652						*@Barnum, Doughty, Green 1555					

	1976-77						1977-78						1978-79					
	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot
Biology	13	3	12	6	6*	40*	29	10	6	7	6	58	37	15	10	6	6	74
Chemistry	31	15	14	17	7*	84*	27	20	22	9	16*	94*	44	20	19	20	9	112
Mathematics	5	3	5	7	1	21	5	2	4	6	3	20	19	10	2	2	3	36*
Physics	0	0	0	0	2	2	0	0	1	0	1	2	0	0	0	2	0	2
Pre-Engineering	4	2	5	2	0	13	16	4	4	2	0	26	13	8	6	1	0	28
Sub-totals	53	23	36	32	16*	160*	77	36	37	24	26*	200*	113	53	38	31	17	252
Medical Tech.	39	10	20	9	13	81	39	21	21	11	9	101	34	26	19	13	14	106
Pre-Pharmacy	65	31	92	--	--	188	48	37	81	--	--	166	55	39	60	--	--	154
Totals	157	64	148	41	39*	429*	164	94	139	35	35*	467*	202	118	117	44	31	512
Full-time Undergrad. Enroll.	*@Duval, Atkinson, Bowie, Harris 1612						*@Thompson 1519						*c/Comp. Science 1615					

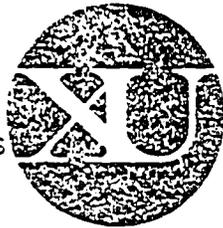
	1979-80						1980-81						1981-82					
	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot	F	AF	S	J	S	Tot
Biology	46		39	14	7	106	47		47	26	19	139						
Chemistry	43		58	20	17	138	38		43	39	35	155						
Math/Comp. Sci.	39		21	5	2	67	41		39	13	2	95						
Physics	1		0	2	1	4	1		0	0	1	2						
Pre-Engineering	25		11	13	--	49	33		21	11	8*	73*						
Sub-totals	154		129	54	27	364	160		150	89	65*	464*						
Medical Tech.																		
Pre-Pharmacy	57		81	--	--	138	56		121	--	--	177						
Totals																		

*Includes 8 in Eng. School

1640

Full-time Undergrad. Enroll.

Appendix II--A brief overview
on increasing scores
of participants.



of CAUSE-sponsored Workshop
on standardized exams and a list

Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125, TELEPHONE 504-486-7411

INTELLIGENCE IS A LEARNED SKILL. IT CAN BE IMPROVED THOROUGH INSTRUCTION.

---so reads the cover of a book entitled Intelligence Can Be Taught by
Dr. Arthur Whimbey.

Are you intrigued?

Did you know that Dr. Whimbey is a part-time faculty member in mathematics
at XU this semester?

Did you know that he is also the co-author of a workbook designed to be
used in TEACHING problem-solving ability?

Would you be interested in learning more?

Plan to attend a special workshop for faculty in the Natural Sciences and
the College of Pharmacy which Dr. Whimbey has agreed to conduct on Friday,
March 16, from 3 to 5 p.m. in the Gold Room. The event is sponsored as
a part of the CAUSE Grant. Ms. Hunter is in charge of the refreshments
and exotic entertainment which are rumored to be an integral part of the
workshop. Call JWC to reserve a place. It will be necessary to limit
the workshop to 25 participants.

Participants:

Biology (XU)

Sr. Grace Mary Flickinger
Ms. Jacqueline Hunter
Dr. Deidre Labat

Pharmacy (XU)

Dr. Duane Aldous
Ms. Ann Barbre
Dr. Lanny Foss
Dr. Sankar

Chemistry (XU)

Dr. Mary Ann Ryan
Dr. John Sevenair
Sr. Mary Carl Malmstrom
Dr. JW Carmichael, Jr.

Computer Sc (XU) Dr. Hassell

Physics (XU)

Dr. Harold Vincent

Other:

Dr. E. Wesley McNair--Meharry Med.
Dr. John Ruffin--NCCU
Ms. Gail Jones--Delgado
Ms. Jackie Lothscheutz--Delgado
Ms. Linne Hambleton--UNC Medical
Ms. Kathy Travaglini--Parkland C.

Mathematics (XU)

Mr. Winston Brown
Sr. Eileen Benton
Dr. Esther Fontova
Mr. Bill Jones
Dr. Bill Irbeck
Ms. Barbara Irbeck

IL

3/18/79

JW Carmichael

THIS WEEK AT XAVIER

Special Report: Project SOAR

It's a bird, it's a plane, it's Project SOAR -- Xavier's special summer program for pre-freshman science majors, which is soaring to national prominence.

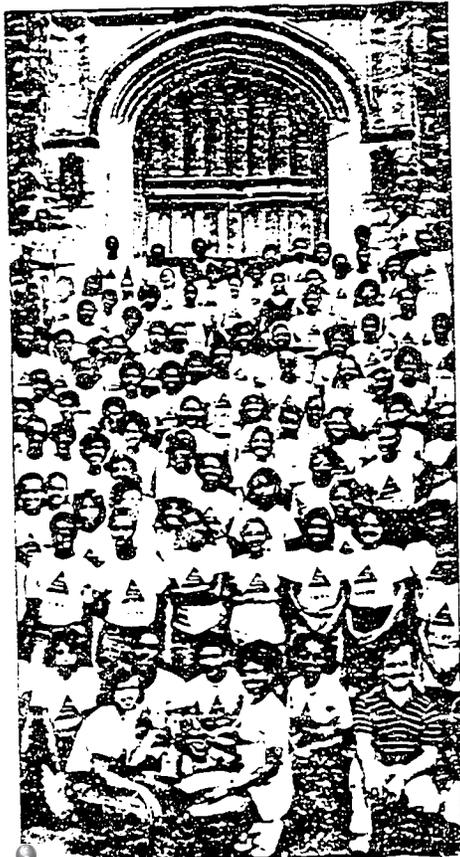
SOAR participants show an overall increase in general intellectual ability upon completing the program.

SOAR participants with poor reading ability make an average two-year advance in both reading comprehension and vocabulary.

SOAR participants with low scores on scholastic aptitude tests average the equivalent of a 114-point increase on the SAT.

SOAR participants are four times more likely to complete their freshman year as a science major than freshmen who did not complete SOAR.

The sciences at Xavier
In 1976 Xavier University of Louisiana had a full-time enrollment of 1612 with 26 percent of the students majoring in the natural sciences. That same year the Natural Science Division of Xavier, which has an 85 percent black enrollment, made a major new, cooperative effort to increase the University's potential for addressing the national problem of underrepresenta-



tion of blacks in the science-related fields.

Four years later it is obvious that the effort has been exceedingly successful. In the fall of 1980 Xavier's total enrollment stands at 2003, and more than 40% of these students are natural science majors. This increase in enrollment in the natural sciences has been accompanied by dramatic increases in placement of graduates in science-related fields. Over the past two years approximately 140 science students have been accepted into health professional schools or science graduate programs.

A major contributor to this success has been the very first cooperative endeavor undertaken -- the development of Project SOAR (Stress on Analytical Reasoning), a special six-week summer program for pre-freshman science majors by the Departments of Biology, Chemistry, Mathematics/Computer Science and Physics/Pre-Engineering, directed by JW Carmichael, Jacqueline Hunter, Lester Jones and Harold Vincent.

Project SOAR: an overview
Project SOAR is comprised of three components -- Piagetian-based laboratory experiments to improve general problem-solving skills, specific instruction to improve those analytical reasoning/reading skills needed on standardized exams and vocabulary building. Teachers in the program are a combination of regular science and mathematics faculty from Xavier, high school teachers and Xavier-educated medical and dental students.

Over the past four years 419 students have completed the SOAR program -- 57 in 1977, 109 in 1978, 113 in 1979 and 140 in 1980. Of this number, 390 were high school graduates who indicated a desire to enroll in a science the following fall, and 29 were 12th graders with similar interests. All of the latter participated in Summer 1980 in a special experimental portion of the program.

To provide the individual attention which is the corner stone of Xavier's success, each year the participants were divided into groups of approximately 25 students, and a medical or dental student was assigned as group leader/mentor/role model/parent image, etc. This group leader not only guided the SOAR students through the various components of the program, but also organized social activities and worked to motivate each student to maximum achievement.

Learning-by-doing promotes thinking
The first of three components of SOAR are 20 three-hour Piagetian-based laboratory exercises. Each is organized as a learning cycle containing explanation, invention and application phases. This organization is employed because studies indicate



WE'RE NUMBER ONE: Kelly King and Don Johnson, joined by fellow students during Summer 1980, assure the photographer that they're the tops in a SOAR competition. During the six-week program, Friday afternoons are given to group competition as motivational force.

that as many as 50 percent of college students in the U.S. cannot reason abstractly (at Piaget's formal level) in the manner needed for science or mathematics courses and that the learning cycle -- learning-by-doing -- actually promotes development of abstract learning. The original format was developed by Dr. Robert Karpus, dean, Graduate School of Education, University of California-Berkeley, based on his own experimental work with the theory of intellectual development postulated by Swiss epistemologist Jean Piaget.

Of the 20 such learning cycles used in SOAR, five teach are from biology, chemistry, mathematics and physics. They have been developed by Xavier's faculty as units which stress five major components of problem-solving. These are abilities to (a) identify and control variables, (b) use proportional reasoning, (c) consider exhaustively all combinations of factors, (d) use probabilistic relationships and (e) recognize correlations between variables.

The laboratories are conducted by a combination of Xavier science/math faculty and high school teachers. The prevailing atmosphere within each classroom is one of cooperative group effort to solve a problem, with the teacher circulating throughout the room, continually asking questions which require students to verify, further test and devise additional experiments or further extend his/her knowledge. Great care is taken to avoid lecturing and to answering questions in a manner that always requires additional thought.

Intelligence can be taught
The second component of SOAR specifically attempts to teach the type of step-by-step logical reasoning needed to perform well on standardized aptitude exams. The teaching method used is the "cognitive skills approach" espoused by former Xavier faculty member Dr. Arthur Whimbey, author of the book, "Intelligence Can Be Taught," and "Teaching Sequential



ITS A FIT: Arthel Neville gets some help in trying on the SOAR T-shirt from fellow SOAR student, Conchetta White. Neville, who has since enrolled in pre-pharmacy at Xavier, also works as a model. You'll agree that White is pretty enough to model.



TIME TO THINK ABOUT TOMORROW: Assistant Pre-Health Advisor Linda Montague discusses career plans with Andre Buck. Mobile high school graduate who has since enrolled at Xavier. Career counseling is made available to all students in the summer program.



I THINK WE'VE GOT IT: New Orleans area high school graduates Kim Dunn and Charles Valteau, enrolled in SOAR 1980 seem pleased with their lab work. The two are graduates of Xavier Prep and Brother Martin High School, respectively. (Photos by Huard)

Thought: The Cognitive-Skills Approach," *Phi Delta Kappan* (December 1977). The cognitive skills approach assumes that analytical reasoning is a skill of the same general sort as hitting a golf ball, swimming, etc., and that it can be taught in the same manner. This represents (a) demonstrating the skill in detail and then (b) requiring the student to practice while monitoring performance. This approach, while very common sense, has not been widely recognized previously, because thinking, unlike hitting a golf ball, takes place within one's head and cannot be easily monitored.

Further, the problem is compounded by our tendency to view "ability to work problems rapidly" as good problem-solving, when, in fact, good problem-solving is more accurately characterized by careful, slow analysis, with frequent checking for mistakes.

In SOAR students are first introduced to the approach as a group by Xavier-educated medical or dental leaders serving as group leaders. They are then carefully monitored while paired as *problem-solver* and *listener* in practicing its use. Ninety minutes are devoted to this approach Monday through Thursday throughout five working weeks of the six-week program. Half of the time is spent on quantitative problems, and half is spent on verbal ones.

"Problem-Solving and Comprehension: A Short Course in Analytical Reasoning" (Whimber and Lochhead, Franklin Institute Press, 1979) is used as the primary text for the first third of the program. A workbook, "Algebra - An Introductory Course" (Bramson, AMSCO Publications) is used in the quantitative portion, and selections from the ETS Graduate Record Examination Information Bulletin, the American Dental Association's Dental Admissions Test Preparation materials, etc. are used on the verbal section. All cognitive skills instruction is conducted by group leaders after training by and

with supervision from Xavier faculty skilled in the approach.

Vocabulary-building: it can't be avoided

Since vocabulary is a prerequisite to good reading comprehension, a vocabulary-building component is built into SOAR as the third unit. Vocabulary-building drills are conducted for 30 minutes Monday through Thursday by group leaders.

Motivation by group competition

Since students are seldom enthusiastic about building reading or vocabulary skills, carefully controlled competition between the different groups is used as motivation. The competition consists of an hour-long written test, covering the previous week's work in both analytical reasoning (euphemism for cognitive skills training) and vocabulary and a short quiz bowl. All students are required to take the written exam on Thursday afternoon. The exams are graded overnight, and the scores for the various groups are tallied. The results are not announced until Friday afternoon after four students from each group have represented their group in the quick-answer quiz bowl.

At the conclusion of the quiz bowl, scores from the written tests and the quick answers of the quiz bowl are added and -- with great fanfare -- a special SOAR trophy is awarded for the week to the group with the highest score. Points are purposely scaled so that the performance of the group as a whole on the written test is a major factor in determining the winning group, with the quiz bowl serving merely to stimulate interest and generate spirit among the remaining members of the group, who act as a cheering section for their representatives on the four-member quiz bowl panel.

Efforts are purposely made to use the group spirit to facilitate the paired problem-solver/listener arrangement used in the

cognitive therapy approach so that the students who score well willingly work with those who have done less well for the good of the group.

Project SOAR in more detail

Project SOAR has received national attention among educators as the result of having been featured, among a select number of interdisciplinary programs, in a series of reports on teaching in *Change* magazine in 1978 and by being included in an article on Piaget's legacy in American education in *The Chronicle of Higher Education*, Sept. 1980. Details of the program have also appeared in "Project SOAR (Stress on Analytical Reasoning): A Multidisciplinary Summer Program for Minority Science Students," *The American Biology Teacher*, March 1980, and "Teaching Critical Reading and Analytical Reasoning in Project SOAR," *Journal of Reading*, October 1980.

Related activities at Xavier University

The efforts initiated by the natural science departments with SOAR have spawned numerous academic year spin-offs. The obvious success of SOAR led to a follow-up multidisciplinary effort to modify entry-level courses in biology, chemistry, mathematics and physics to reduce attrition and increase level of performance. This effort has now been completed with similar success. Description of two parts of this endeavor may be found in "Cognitive Skills Oriented PSI in General Chemistry," *Journal of Developmental & Remedial Education*, Winter 1979, and "A Piagetian-Based General Chemistry Laboratory Program for Science Majors," *Journal of Chemical Education*, Sept. 1980.

Appendix IV--Schedule & Report of Dr. John Ruffin after consulting with Biology Department

Schedule of Activities
Dr. John Ruffin
Consultant to Biology Dept., CAUSE Grant

Thursday, February 23, 1978

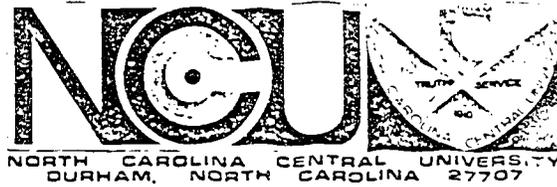
<u>Time</u>	<u>Activity</u>	<u>Place</u>
8:30 a.m.	Meet with Mrs. J. Hunter and S. G. M. Flickinger	Admin. Bldg. Room 320C
9:00 a.m.	Meet with Dr. Ashman	Admin. Bldg. Room 322
9:15 a.m.	Tour the Biology Dept.	
9:30 a.m.	Review Materials	Admin. Bldg. Biology Learning Center
11:00 a.m.	Seminar	Admin. Bldg. Room 212
12:00 p.m.	Lunch	
2:00 p.m. - 4:00 p.m.	Review Materials	Biology Learning Center

Appendix IV (continued)

Friday, February 24, 1978

<u>Time</u>	<u>Activity</u>	<u>Place</u>
9:00 a.m.	Meet with Sr. M. Veronica, University Dean and Sr. Miriam Francis, Dean of College of Arts and Science	Admin. Bldg.
10:00 a.m.	Meet with Dr. N.C. Francis, University President	Admin. Bldg.
11:00 a.m.	Meet with Dr. J. W. Carmichael	Chem. Bldg.
12:00 p.m.	Lunch	
1-3:00 p.m.	Written Report	Biology Learning Center

Appendix IV (Continued)



DEPARTMENT OF BIOLOGY

March 22, 1978

Sr. Grace Mary Flickinger, S.B.S.
Assistant Professor
Department of Biology
Xavier University of Louisiana
New Orleans, Louisiana 70125

Dear Sister Grace Mary:

My determination to do a thorough review of the revisions proposed for your introductory biology course accounts for the delay in my response. I have now read the report and after doing so I am convinced that there are few suggestions that I could make that would strengthen your proposal for this course in any substantial way. You and Mrs. Hunter obviously spent many long hours planning and I am sure that the conclusions I have reviewed are the results of your classroom experiences with the General Biology course. I must say that your experiences obviously parallel my own for I agree in toto with your plans. As a matter of fact, the Biology Department here at North Carolina Central is now using the two semester General Biology approach and finding it to be a much improved way of handling the introductory course as opposed to the one semester sequence. For sure, this system allows for a more in-depth approach and I feel the benefits will be obvious and will manifest themselves through student performance in upper level courses.

The topics to be covered are sound for an introductory level course. The organismal approach to be employed is logical and should make it easier for teachers to move more directly from one living system to another. Your approach will certainly launch a balance attack on both plant and animal systems and I am certainly in favor of this, particularly, since plant systems are usually covered in only a cursory manner in most general biology courses or in some cases completely omitted. I am pleased to say that it appears now that large numbers of biology departments are now aware of this deficiency and, as you are doing, are taking steps to solve this problem.

I noted that no time table was given for the concepts you plan to cover. This is a matter to which you may want to give quite a bit of attention. As I have indicated, the concepts are sound but failure could result by allowing one area of biology (or discipline) to receive more than its fair share of attention at the expense of the other areas. I am sure this is a common observation but one which all of us involved in general biology courses all too often overlook.

Again, I feel that you and Mrs. Hunter are definitely on the right track by initiating a two semester in-depth approach to the teaching of introductory biology and the concept proposed I am sure will lay a foundation for a better understanding of living systems. If I can be of further assistance to you as for as outlining more specific behavioral objectives, please feel free to call me at any time.

Thanks again for allowing me the opportunity of looking at Xavier's Science Program "close-up" and I do want you to know that I am thoroughly encouraged by all I saw.

Yours sincerely,



John Ruffin, Ph.D.

Appendix V--Schedule for Dr. John Ruffin & Report of Trip as Consultant to
Biology Department

Schedule for Visit

by

John Ruffin, Ph.D.

Associate Professor of Biology North Carolina Central University

to

Evaluate Biology Component of CAUSE

Thursday, March 15, 1979

9:00 - 10:00	Sr. G.M. Flickinger and Mrs. J. Hunter	Room 320 Admin. Bldg.
10:00 - 11:00	Biology Tutors	APLC
11:00 - 11:50	Seminar	212 - Admin. Bldg.
12:00 - 1:00	Lunch	
1:30 - 2:00	Dr. Carmichael	MSL
2:00 - 3:00	Dr. Ruby	306A - Admin. Bldg.
2:30 - 4:00	Free time to Review Materials	

Friday, March 16, 1979

9:00 - 10:00	Students	APLC
10:00 - 11:00	Mrs. J. Hunter and G.M. Flickinger	320 Admin. Bldg.
11:00 - 12:00	Free time	
12:00 - 1:00	Luncheon Meeting - Members of Freshman Studies Committee of Biology Department	
1:30 - 2:00	Wrap - up	320 Admin. Bldg.
2:00 - 4:00	Free time to write report	



DEPARTMENT OF BIOLOGY

March 27, 1979

Sr. Grace Mary Flickinger, S.B.S.
Chairman
Department of Biology
Xavier University of Louisiana
New Orleans, Louisiana 70125

Dear Dr. Flickinger:

My sincere thanks to you and Mrs. Jacqueline Hunter for the hospitality shown me during my recent visit to Xavier. Participating with the two of you in an evaluation of the Biology component of your Cause Program was indeed a pleasure.

It is always a pleasure for me when I am called upon to evaluate or critique a curriculum or program that is as well concentrated as yours. Xavier is indeed fortunate to have the kind of visible leadership shown by you, Mrs. Hunter and Dr. Carmichael.

I feel that the objectives of your program are presently being realized. This was evident to me in conversations that I had with many of your students while there. My visit to the APLC was most impressive. The APLC appears to be well equipped with audio visual materials which should assist the students in the Biology Block tremendously in understanding the material presented in class. The caliber of your tutors and the attention and supervision given them by the participating faculty to insure that they impart the very best to students is most complementary.

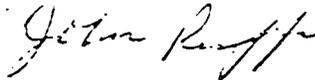
My visit with Dr. Carmichael was simply stimulating and rewarding. The energy and time that he devotes to the total program will insure its continued success.

The manner in which the Biology faculty works to insure continuity in Biology 124 Block is most advantageous. There was no doubt in my mind that they are receiving not only uniform but quality theoretical and practical experience from this course.

My only suggestion would be the incorporation of more native materials in the laboratory aspect of the course. It is my belief that by so doing you may provide a better handle on the fourth course objective listed in the course syllabus. This can be achieved very easily, as we discussed it during my visit. Again, as I indicated to you, please feel free to call on me for any suggestions in carrying out this phase of your program.

My opinion on Biology 124 is that this program is well orchestrated and participating faculty members are well in tune with each other. You are doing a fantastic job at Xavier in training students in basic principles of Biology and the results, I am sure, will be obvious in years to come.

Sincerely,



John Ruffin, Ph.D.
Professor of Biology

Appendix VI--Schedule of Visit
of his report as



by Dr. T. L. Brown and copy
consultant to Chemistry Department

Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125. TELEPHONE 504-486-7111

Schedule for Dr. T. L. Brown, Consultant for
the Chemistry Department under XU's CAUSE Grant

Monday, March 6

9:00- 9:15	Meet Ryan, Robinson, Carmichael	Chemistry Building
9:15- 9:45	Meet remainder of Chemistry Faculty	Chemistry Building
9:45-12:00	Review General Chemistry Materials	Despinasse Room
12:00- 2:00	Lunch	
2:00- 5:00	Review General Chemistry Materials	Despinasse Room
7:00- 9:30	Dinner with Ryan, Carmichael, & others	

Tuesday, March 7

9:00- 9:30	Meet with Deans	Dean's Office
9:30-10:30	Visit General Chemistry Drill	MSL
10:30-12:00	Complete Review of Materials	MSL
12:00- 1:00	Lunch	
1:00- 5:00	Written Report	Media Center

Dr. Brown is Professor of Inorganic Chemistry at the University of Illinois at Urbana-Champaign. He is the author of the textbook currently being used in General Chemistry.

Appendix VI (continued)

Evaluation of General Chemistry Course
at Xavier University of Louisiana

During a two-day visit in March, 1978, I was able to observe the operation of the general chemistry program at Xavier University. The following are offered by way of summaries of observations, judgments regarding effectiveness, and so forth, and suggestions for change where these seem appropriate.

1. Extent of Coverage

The amount of material treated in the full year-long program is adequate. The balance between Chem 101 and Chem 102, the first- and second-semester courses, respectively, seems a little light on the Chem 101 side. However, this is no doubt due in part to the need for a unit on the use of a calculator, and the need for some math review at the beginning of the course.

The coverage in the second semester is adequate. The absence of a module dealing explicitly with organic or biochemistry is understandable in light of the fact that most of the students are scheduled to take organic chemistry as a later course. Overall, the year-long sequence seems a bit light on descriptive chemistry. I would suggest that the optional module X include only chapters dealing with descriptive materials. This would mean deleting 9B, on Molecular Orbitals.

As a general comment, I would say that the total content is comparable to that in the general chemistry course offered in other colleges and universities. For example, the sequence and scheduling of chapters is not far different from that at Tulane University, where the same textbook is employed in the general chemistry course.

2. Learning Strategies

I was not able to observe a lecture. The structure and scheduling of the lectures seems appropriate in relation to other course elements.

The drill section I observed seemed to go quite well. I saw extensive discussion between students, and between students and Learning Assistants (LA) or senior faculty. The transfer of error-free information from learning assistants to students is controlled to an extent by providing the LA's with a completed workbook. Still, some range of judgment is required to properly grade tests. Without question the LA's can benefit from the responsibility. In general, the strategy of employing students to help teach students seems quite effective.

The Handbook is well-written. It contains a thorough, clear description of the course structure, grading system, and rules of course operation. Each module is represented by a detailed list of learning goals keyed to the text. The sample problems are keyed to the learning goals. This is an effective means for ensuring that students can evaluate their own ability to attain a particular learning goal. It would be desirable in addition to carry the student one stage beyond this, by exposure to problem material which is not specifically identified in relation to a particular learning goal, or in which more than one learning goal is embodied in a particular problem. However, it must be recognized that only a fraction of the students would be able to handle this higher level of material; it needs to be provided as enrichment rather than essential course content.

The tape programs seem to be moderately popular. It is difficult to assess their effectiveness. They probably are of help to students with reading difficulties. With the present course structure, the audio-tutorial materials simply reiterate the standard course materials. That is, no new materials are introduced in this mode. Efforts to help students overcome reading disabilities should help obviate the need for the tapes.

3. Faculty, Teaching Personnel

The faculty are able and enthusiastic. The considerable success of the program is clearly due to the extensive investment in time made by the faculty, particularly Dr. J. W. Carmichael.

Use of the more advanced undergraduates as resource persons seems to be a successful strategy. However, the competition for the Learning Assistants' time between their own course work and their teaching schedules does apparently create problems at times.

4. Facilities

The physical facilities available for the program are quite inadequate. The Modular Learning Center is presently in very small quarters in an old "temporary" building. However, the persons involved in the program have worked very successfully within the scope of the available facilities, and are operating a very successful program.

5. Lab Facilities and Course Work

The lab facilities for general chemistry located in the pharmacy building are quite satisfactory for lab work, aside from a shortage of hoods. I was unable to evaluate the lab program itself, but there is clearly a strong faculty commitment to developmental work in this area.

6. Student Attitudes

Discussions with several students currently enrolled in both Chem 101 and Chem 102 have given me a reasonably good basis on which to assess student attitudes. I was quite impressed with the high student morale and generally very positive attitude toward the chemistry course. The students feel that they can learn chemistry, that deficiencies in their backgrounds can be overcome. Many of them seem willing to work hard to do

well in the chem courses. These attitudes are engendered in large part by the evident enthusiasm and dedication of the faculty, and extensive faculty-student contact.

7. General Recommendations

The program as it now operates is clearly quite successful in producing a larger number of students better prepared to go on past general chemistry with their science education. Aside from the particular strategies employed, the success of the program suggests that extensive faculty-student contact in a learning environment which the student perceives as responsive and sympathetic can produce important improvements in learning rate. However, it requires an extensive commitment of time and energy on the part of able teachers.

It seems clear that keeping up with the schedule is a major factor in achieving success in the course. A student may fail to keep up simply because of an incapacity to meet the demands of all his/her courses. On the other hand, a student might fall behind because of poor time management, or with the mistaken supposition that catching up will not be difficult. It would be useful, I think, to look for additional, more formal ways to encourage and motivate students that show signs of falling behind. Perhaps some kind of "buddy" system, involving temporary assignment of an LA to a specific student, would help.



Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125, TELEPHONE 504/486-7411

Schedule for Dr. Arthur Whimbey, Consultant for
the Chemistry Department under XU's CAUSE Grant

Tuesday, March 13, 1979

1:00 - 2:00 p.m.	Dr. Ryan & Dr. Carmichael	Chemistry Building
2:00 - 5:00 p.m.	Visit General Chemistry Drill with Sr. Joanne Bauer	Chemistry Building

Wednesday, March 14

11:00 - 12:00 p.m.	CAUSE Committee & Chemistry Faculty	Chemistry Building
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Thursday, March 20

1:00 - 5:00 p.m.	Followup discussions with Dr. Ryan, Dr. Carmichael, & other faculty teaching General Chemistry	Chemistry Building
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Report Due: May 15, 1979

Dr. Whimbey is the author of Intelligence Can be Taught published by Innovative Sciences, Stamford, Connecticut, as well as a number of pertinent articles. He was chosen as a consultant for CAUSE because of the attached article describing ways of modifying PSI courses to make them more accessible to developmental students. The article was published in The Journal of Developmental and Remedial Education, Volume 2, Number 2.

Evaluation Of Chemistry 101-102 At Xavier University In New Orleans

Evaluator: Arthur Whimbey Spring 1979

Persons responsible for designing and conducting the course.

JW Carmichael, Dept. of Chemistry, Xavier Univ.

Mary Arne Ryan, Dept. of Chemistry, Xavier Univ.

Chemistry 101-102 at Xavier University is conducted in a modified PSI format. The modifications have been introduced to meet the needs of the educationally disadvantaged students who form a significant percent of the population (primarily minority) served by Xavier.

Through several years of teaching and educational research, Carmichael and Ryan have identified both the strengths of PSI for educationally disadvantaged students, but also special problems of such students which call for modifications of standard PSI. These observations have recently been confirmed by other educators in various academic disciplines (Cross, 1976; Whimbey, Boylan & Burke, 1979). The special problems include: 1. The procrastination problem; 2. Difficulties in reading and independent learning; 3. Math deficiencies; 4. Lack of laboratory experience; 5. Lack of problem-solving skills and formal reasoning.

Course Materials

1. Chemistry: The Central Science, Brown and Lemay.
2. General Chemistry Handbook, Carmichael and Ryan
3. Organic Chemistry Molecular Models
4. Audio Tapes to supplement the text and lectures, and to prepare students for the laboratory activities. Some produced by professor Carmichael, others purchased.
5. Calculators with logs, sines and scientific notation available for students to use.

Appendix VII (continued)

6. Standard chemistry laboratory equipment.
7. Computer??

Course Structure

1. Two 1-hour lectures per week.
 2. One 3-hour cognitive therapy-oriented drill per week
 3. One 3-hour Piagetian-oriented laboratory per week.
 4. One full-time General Chemistry Tutorial Director providing individual assistance as needed.
-

Course Format

The "Handbook" by Carmichael and Ryan, composed of lecture/text modules and laboratory modules, plays a central role in the course. Lecture/text modules contain clearly written objectives, assignments in the textbook, sample problems and other learning activities. In interviews, students reported they did take the time to read the objectives. They said the objectives and sample problem showed them exactly what they would learn in each module.

The laboratory modules, which alternate with the lecture/text modules, must be completed by students before they begin the corresponding lab experiments. These modules prepare students to conduct the experiments effectively and with understanding.

When asked about the textbook by Brown and Lemay, students reported that by and large they found it satisfactory. Many said they did at times need additional explanations and then turned to the audio tapes produced by professor Carmichael, which were available at Xavier's Alternate Paths Learning Center. All students expressed strong satisfaction with the tapes.

Although scheduled lectures are not a part of standard PSI, lectures have been retained in this course to offer students an additional source for learning as well as a guiding and pacing device; and while attendance is not required, records show 50% attendance at lectures.

The laboratory experiments have been designed in a Piagetian framework of providing concrete experiences for the abstract concepts discussed in the text and lecture. For this reason the laboratory modules are interspersed with the lecture/text modules in the Handbook, insuring that appropriate concrete experiences always precede the formal introduction of new concepts.

The 3-hour weekly drill sessions are used for administering quizzes and for cognitive therapy-oriented tutoring to teach both chemistry content and thinking skills.

Whereas the total registration for Chemistry 101-102 is generally 180-200 students per semester, drill sessions are limited to only 25 students and staffed with an instructor and one or two advanced students called "learning assistants." Students are encouraged to prepare for quizzes before coming to the drills and are allowed only 20 minutes for review and tutoring before starting a quiz. When the quiz is completed, the student takes it to an instructor or learning assistant for scoring. As is standard in PSI, the student has an opportunity to engage in additional study and then take another form of the quiz if his score is unsatisfactory. Because there are at most 25 in the sessions with an instructor and 1-2 learning assistants, an appreciable amount of time and personal attention can be given to students with learning difficulties.

Learning assistants have been trained to engage in "cognitive therapy" tutoring rather than "show-and-tell" tutoring. They do not just give answers or demonstrate the way a problem can be solved. They help students find answers for themselves. This may mean guiding

a student in carefully reading a section of the text. It frequently involves asking a probing question which suggests the way a problem can be solved or a conclusion reached from knowledge available to the student. Also, students are frequently asked to explain all their steps in reaching an answer, especially if the answer is wrong, but whenever the tutor suspects that a student's understanding of a topic is insecure. In demonstrating how a particular type of problem is solved, the tutor may instruct the student and provide explanations, but he allows the student to actually carry out the activities and computations. The tutor seldom carries out all the activities, leaving the student to just watch. After helping a student solve a problem, the tutor asks the student to solve one or more additional problems and to explain his steps as he proceeds. Throughout tutoring, the tutor constantly watches for instances where a student arrives at an answer without sufficient concern for accuracy, reasons or necessary cognitive steps. The tutors understand that their goal is to teach chemistry, but also to eliminate the student's need for tutoring.

A special grading system is used in the course which discourages procrastination, yet accommodates students who require more than a semester to complete the course. If a student has not completed all the requirements by the end of the semester but has made reasonable progress, he may receive a grade of DC (deferred credit) which allows him to continue with the remaining modules the next semester. However to discourage procrastination, students are told they must attend 75% of the labs and drills to be eligible for a DC. Also, each student's progress is posted promptly in the main office, and students who fall behind are sent reminders in the mail.

To alleviate the math difficulties educationally disadvantaged students may experience in chemistry, review modules on algebra,

graphing, significant figures, quadratic equations and logarithms are included in the Handbook just prior to topics requiring this math. Also, students are provided calculators to reduce computational labor and error.

Student Evaluation And Progress

Students are required to score 90% correct to pass each module quiz, a higher criterion than usually employed in PST, even with educationally advantaged students. (The quality and thoroughness of the quizzes can be seen from the samples in the Handbook.) The fact that this criterion is attained speaks to the effectiveness of the Handbook, audio tapes, Piagetian labs and drills in teaching the concepts and principles of chemistry.

Many educationally disadvantaged freshmen and sophomores have no idea how many hours good students spend studying and reviewing for final examinations. Many have never known the experience of being really prepared for a final exam. Recognizing that, the course allows students 3 attempts in preparing for and taking the final. This not only increases the course's major product--amount of chemistry learned by students who need a background in chemistry as part of their professional training--with little increase in the course's cost. It also seems to be part of a rewarding academic experience students find in the course, as evidenced by the increase in the number of students who change their major to chemistry after taking the course as it is now taught, compared to the number changing when the course was taught in the traditional manner. Furthermore, 83% of the students felt they learned more (and worked harder) in the present course than they would have in a traditional course. Indeed, scores on the ACS Cooperative

Examination For General Chemistry have jumped 17 percentile points since the changeover to modified PSI.

A number of departments at Xavier University are moving in the direction of cognitive process instruction, with greater emphasis on nurturing analytical reasoning. Chemistry is one of the leaders in this move, and studies at other universities (Peleg & Adler, 1977; Sadler, 1979) suggest that student performance in Chemistry 101-102 may improve still further as other freshmen and sophomore courses incorporate Piagetian and cognitive therapy methods to teach analytical reasoning and learning skills.

Appendix VII (continued)

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Sadler, W., Tapping The Potentials Of Interdisciplinary Studies In A Freshman Core Program. Bloomfield College, Bloomfield, N.J.

Whimbey, A., Boylan, H. & Burke, R. "Cognitive Skills-Oriented PSI For Developmental Students." Journal of Developmental & Remedial Education, 1979, 2, 7-10.

Appendix VIII--Schedule of Visit and Report from Dr. Solomon Garfunkel, Consultant
to Mathematics Department.

MAY 8 - 9, 1978

SCHEDULE FOR DR. SOLOMON GARFUNKEL,
CONSULTANT FOR THE MATHEMATICS PORTION
OF XAVIER'S NSF - CAUSE GRANT PROJECT

May 8, 1978	MONDAY
9:00 - 9:30	Pick up at Bourbon-Orleans and ride to Xavier
9:30 - 11:00	Meet with Mr. Jones and Mathematics Faculty Individuals
11:00 - 12:00	View of Campus
12:00 - 1:30	Lunch
1:30 - 2:00	Meet with Sr. Miriam Francis
2:00 - 2:30	Meet with Sr. Rosemarie
2:30 - 3:00	Meet with Dr. Carmichael
May 9, 1978	TUESDAY
9:00 - 9:30	same as Monday
9:30 - 10:30	Mathematics Group Faculty Meeting
10:30 - 12:00	Mr. Jones and Dr. Irlbeck
12:00 - 1:30	Lunch
1:30 - 5:00	Free time for Dr. Garfunkel to write sketch of report

Dr. Solomon Garfunkel
Department of Mathematics
University of Connecticut
Storrs, CT 06268

UNIVERSITY OF SAVIER

During my stay, I spent two days with the faculty and staff at Xavier University studying their basic mathematics offering. I was during that time able to speak with the mathematics department as a whole as well as with members of the computer science department, chemistry department and administration. While my specific charge was to evaluate the work done on mathematics 103 (pre-calculus), I feel that this can best be done in the context of the other basic courses.

Math 103

Overall, I feel that a yeoman's job has been done in the preparation of the materials for this course. The study guides are clearly written as well as the sample test material. Care has been given to provide a large number of contact hours for students to receive help from faculty and testing center personnel. The materials have been prepared with an eye toward self-pacing, although they are presently taught in a lecture format.

My only criticism is that the coverage may be too extensive in a three credit course for the designed audience. The most natural solution and one I strongly recommend is to make this a four credit course. It is my understanding that as an administrative matter this may take some time to effect. I would therefore like to make the following interim suggestions:

1. Create two tracks in Math 100, one for those going into 103 and one for those not continuing.
2. For those students in the 103 track add to the Math 100 syllabus the

Appendix VIII (continued)

materials from modules I and II of Math 103 (specifically: module I objectives 1 thru 11 and module II objectives 1 thru 9).

3. Shorten the present module III in Math 103, eliminating objectives 11 thru 14.

4. In module V, teach synthetic division for real factors - objective s 1 and 2. The rest of the material in this module may be dropped or simply summarized.

5. It is essential that the trigonometry in modules VII and VIII be included. If necessary this material should be introduced earlier to insure that it is not left off at the end of the course.

Math 104

Math 104 is presently taught as a standard first semester calculus course. However, this course is in fact a terminal one for approximately 120 out of 150 students. I strongly suggest that this course be broadened to include the calculus of exponential, logarithmic, and trigonometric functions. This can be done by taking a less rigorous approach to limits, continuity, etc. Some excellent texts already exist which take precisely this approach.. Math 207 could easily pick up the added rigor for those students going on in the calculus sequence.

As I have indicated, I feel that the program is proceeding quite well. There are however a few comments and suggestions which I feel will help the overall growth of the program.

Appendix VIII (continued)

1. In courses which have been carefully prepared by objectives, it would be helpful if final exams were standardized relative to these objectives. While I do not recommend common finals, I do feel that questions geared to common objectives would be helpful to both students and faculty and will aid in the evaluation of new course materials.

2. After new modular materials have been developed, it would be useful to obtain student line reviews. Faculty peer reviews often miss problems with materials which students are better able to point out.

3. I feel that the weakest point of the present program is its relation to the mathematics laboratory. Lab materials are not at present geared to course material. While I agree with the staff that the written materials have priority, I feel that the math lab potential should be realized. The lab space and personnel seems quite adequate; what is needed are experiments which relate to the subject matter being taught. Math labs have become extremely popular throughout the country and there is a wealth of material on which to draw.

Again, let me state that the progress that I have observed is excellent. I was especially pleased by the spirit of cooperation that exists not only in the mathematics department but throughout the university. This is an essential element in the success of any experimental program. I fully expect this program to achieve its goals.



Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125, TELEPHONE 504/486-7411

Schedule for Consultation

with

Dr. Raymond Coughlin
Department of Mathematics
Temple University
Philadelphia, Pennsylvania

Thursday, April 19, 1979

9:00	Mr. L. W. Jones	Mercedes Hall
9:30	Dr. Norman C. Francis with Physics consultant Dr. Jack Lochhead	President's Office
10:00	Mr. Jones Dr. Esther Fontova Mr. William Bany	Mercedes Hall
11:00	Mr. Winston Brown	APLC
12:00	LUNCH	
1:00	Joint staff meeting Mathematics & Physics and Cause committee	Faculty Meeting Room
2:00	Mr. Jones and other Mathematics faculty	Mercedes Hall

Friday, April 20, 1979

9:00	Mr. Jones	
9:30	Sr. Miriam Francis Qui Sr. M. Veronica Drawe	Dean's Office
10:00	Mathematics Faculty	Mercedes Hall
11:30	LUNCH	
1:00	Consultant's Report	Mercedes
3:00	APLC Dedication	APLC

Appendix IX (continued)

Consultant Report
Evaluation of the Mathematics
Component of the CAUSE Project
at
Xavier University
of Louisiana

Prepared by: Raymond Coughlin
Department of Mathematics
Temple University
Philadelphia, Pa.

Appendix IX (continued)

During the two day visit to Xavier University of Louisiana on April 19th and 20th I interacted with the faculty of the departments of Mathematics, Biology, Physics and Chemistry. I was asked to concern myself mainly with the calculus sequence offered by the Mathematics Department. In addition, any comments or suggestions that I could make about other aspects of the Mathematics program, especially the pre-calculus segment, would be welcome.

Before I get into the meat of this report, I find it necessary to comment on the faculty at Xavier University. I was greeted by Bill Jones on Thursday morning and my first meeting was with Dr. Norman C. Francis, President of Xavier University. Soon after I met with other members of the Mathematics faculty and then a round table discussion with most of the faculty from the four departments. I found a genuinely warm and friendly atmosphere. I found a resourceful, dedicated and mission-oriented group of teachers. The faculty works well together, they define goals, implement strategies, and use a highly developed sense of cohesiveness to insure their students get an outstanding education. I was very impressed with the President and his faculty.

Many of the recommendations that I will make will require a great deal of effort to implement. I feel confident that the faculty can do an outstanding job because they have already demonstrated their dedication to teaching and perseverance. I urge the administration of Xavier University to support their faculty in these endeavors with inducements such as released time. The long range benefits will be bountiful.

The Mathematics Department has decided to implement a novel approach to the teaching of calculus. Of approximately 125 students taking the first semester, only about 25 are physical science majors who are required to take the second and third semesters. The remaining 100 students are required to take only the

one semester course. Xavier has decided to use a survey of calculus text designed for a one-semester course, in the first semester. They will then use a classical calculus text, designed for a three-semester course, in the remaining two semesters.

I feel this approach is not only pedagogically sound, but, because of Xavier's clientele, it offers the bulk of their students a great advantage over the traditional two tract system where the students would be separated at the outset. Let me refer to those taking a one semester course as the non-science majors, even though I recognize that some of them major in the natural sciences. These students gain little by taking a one semester course if the text used is a classical one. On the other hand, the survey of calculus texts are specifically designed to meet their needs. Thus the non-science majors benefit from this approach. The only possible disadvantage, then, would be for the science majors in the first semester in which, it may be argued, they get a less rigorous treatment of calculus. While this may ring somewhat true, it is far outweighed by the fact that the science major will get an overall view of calculus in the first semester. There is plenty of time in the next two semesters to initiate the student to the more rigorous aspects of the subject. I strongly feel that the survey of calculus in the first semester will help even the prospective mathematics major understand what calculus is all about, what types of problems it solves and where it fits in the total fabric of science. Rather than covering just the derivative in depth in the first semester, Xavier's students will encounter both the derivative and the integral as well as some of their applications. In the next two semesters when these topics are revisited, with their meaning and usefulness firmly entrenched, there is time enough to train the students' minds in the rigorous methodology of mathematics.

Another side of the issue centers on the type of student that Xavier educates. Often the student comes to the calculus course less prepared than his counterpart at some other universities. This is in part due to Xavier's laudatory mission of

instructing and training many inner-city young people. I feel that the survey of calculus course in the first semester of the calculus sequence will be a beneficial buffer for these less prepared students.

The key issue of this report centers on the instructional techniques used by the Mathematics Department in teaching calculus using this novel approach. I would recommend that the faculty list their short term and long term goals of the calculus sequence. By short term I mean the goals that the students can reasonably attain by the end of the sequence (both one semester and three semester goals). This exercise has been virtually completed by the faculty in their writing of the calculus handbook. I saw a rough draft of this document. I would suggest that some applications be added to the handbook as well as a more thorough description of the types of final exams that might be administered.

The long term goals are also important. I mean long term in the sense of abilities retained after a number of years. I think these differ from short term goals in that one would not expect a senior who took a one semester calculus course in the freshman year to pass the final exam three years later. What abilities do you want the student to exhibit, say, three years after the course? Once these long term goals are defined one graphically sees the difference between a survey of calculus and a classical calculus course. In short, the faculty must have concrete answers for the question "Why should a student take a one-semester survey of calculus course?". The goals for the classical course are immediate, it is the survey course goals which must be worked on.

One theme that one might center one's attention on in order to differentiate between the two types of long range goals would be: the science major must master the techniques of calculus and retain them for further course work but the non-science major would be required to understand why, how and where others utilize these techniques.

Xavier's faculty is certainly well equipped to assemble a good list of short and long range goals, but to shed further light on what I am suggesting, let me present a brief, initial description.

	Survey course (one semester)	Classical (three semesters)
short term	graph $y = x^3 - x$, $y = \frac{x}{1-x^2}$ $y = e^{2x}$...	$y = x^3 - x$, $y = (x^3 - x)^{1/2}$ $y = e^{1-x^2}$, ...
long term	be able to read a journal article using 1st and 2nd order differential equations be able to read a text in a math related field, such as econometrics which utilizes extremal techniques for functions of several variables	solve 1st and 2nd order differential equations solve extremal problems for functions of several variables.

By their very nature, the long term goals will be vaguer in content, less concrete in presentation. The purpose for going through this exercise is to acquaint the instructors with the difference between the classical calculus course and the survey course. Once that difference is established, teaching techniques and strategies can be discussed and agreed upon. I think this is necessary because this will be a new course for most of Xavier's professors. In order to coordinate the many sections that will be taught, each instructor must have a clear idea of the goals of the course. This will insure uniformity of pedagogical approaches.

Once the goals are established, the faculty is in a good position to discuss teaching strategies. For example, the following questions must have concrete answers: How much class time will be devoted to applications, proofs, homework problems, and each section in the syllabus? How much outside reading will be assigned and/or recommended? Will a term paper on one or more of the applications be assigned? Will the science majors be urged to do extra credit? Will exams be

Appendix I: (continued)

uniform? Will the students' ability to read and comprehend articles and books in related disciplines be monitored by giving them some articles in the beginning of the semester and getting their reactions compared to their ability at the end of the semester?

I can't emphasize too much that the faculty must have a common approach to the teaching of the survey course. It is a different course than the first semester of a classical course and it must be so taught.

A related problem would be the choice of textbooks. A number of excellent survey course texts are available and the faculty have narrowed the choice to a few good ones. Meshing the first semester with the next two is a harder problem. I have considered a number of texts for the second and third semesters and, while a number of them would be adequate I am convinced that Swokowski and Riddle are superior, with the nod to Swokowski. If Swokowski is used, I suggest the following syllabus:

Second semester (Math 207): Chapters 9,10,14,15,16,18.

Third semester (Math 208): Chapters 7,11,12,13,17,19.

Chapter 19 could be covered in the second semester. Also in the second semester I'd recommend that some further work on limits from Chapters 2 and 4 (Section 4-5 explicitly) be incorporated. This would provide the science major with a good introduction to the more rigorous development of calculus. This syllabus provides the student with a more than adequate background for advanced work in mathematics.

The pre-calculus courses at Xavier appear to be of high quality. I am especially impressed with the handbook. The material is sectioned into modules and learning goals are listed. A student passing out of this course is adequately prepared for calculus. I'd highly recommend that this same format be followed when developing the handbook for calculus. It did appear that this is the case. I would suggest that solutions and hints to selected exercises be included in the handbook. Also, further readings or selected applications would be a welcome

Appendix IX (continued)

welcome addition. Sample tests with and without solutions should be included.

I found the Alternate Pathway Learning Center to be a boon for the students. I have two recommendations for the Center. The use of the tapes and cassettes should be demonstrated in the regular classroom so the student is more comfortable with them when in the Center. This would have the added benefit of familiarizing the faculty with them. The CAI equipment on hand could be better utilized. This would require a great deal of time and effort from one or more faculty members, but the reward would be great. There is a good deal of material available in this area.

One of the most impressive parts of my visit to Xavier was seeing the beautiful rapport the faculty has with the students. A visitor can't help noticing the friendly greetings, the jibes and kidding as well as the serious interactions that constantly takes place. Given Xavier's mission, I believe this warm atmosphere is an outstanding pedagogical aid. I'd suggest that the faculty pursue avenues that might foster this close relationship outside the classroom. For example, at Temple University we formed a problem solving group with faculty and students that meets once a week. We have a good, easy, recreational time solving interesting problems. You'll find we solve many of the Monthly problems and the students get a kick seeing our group's name in print each month. I believe Xavier could start the same type of group. You could meet once a week solving problems of your own choosing; from the Monthly, the Math Teacher, or from any number of good books. Not only Mathematics majors will be interested, but Physics, Chemistry and Biology people will get involved. You might even consider some friendly competition among the four departments. (I myself would even pay to see Bill Jones and J.W. square off on a math contest! Sparks would fly!) We have even carried this idea to the area high schools. I'm sure with Xavier's dedication and resources, especially the Alternate Pathway Learning Center, such an endeavor would be successful.

Appendix IX (continued)

I left Xavier with a very positive attitude toward the institution. From the President to the faculty I found boundless energy and commitment. I hope I have been of some service and have provided some help.

Appendix X--Schedule & Report of Dr. Pickett, Consultant to Physics Department
Schedule of Activities
Dr. Charles Pickett
Consultant to Physics Dept., CAUSE Grant

Tuesday, April 11, 1978

<u>Time</u>	<u>Activity</u>	<u>Place</u>
8:30 a.m.	Meet with Dr. Vincent	Admin. Bldg. Room 210A
8:45 a.m.	Tour of Physics	Admin. Bldg. Room 217
9:00 a.m.	Meet with Dr. Loup	Admin. Bldg. Room 210A
9:30 a.m.	Meet with Sr. M. Veronica and Sr. M. Francis, Deans	Dean's Office
10:30 a.m.	Meet with Mr. Bivens	Admin. Bldg. Room 217
11:00 a.m.	Dept. Meeting	Admin. Bldg. Room 217
12:00 Noon	Physics 201 Class	Admin. Bldg. Room 304
1:00 p.m.	Lunch	
2:00 p.m.	Meet with Dr. Suitart	Admin. Bldg. Room 217A
2:30 p.m.	Review Materials	Admin. Bldg. Room 217

Appendix X (continued)

Wednesday, April 10, 1978

<u>Time</u>	<u>Activity</u>	<u>Place</u>
9:00 a.m.	Review Materials	Admin. Bldg. Room 217
11:00 a.m.	Written Report	Admin. Bldg. Room 217
12:00 Noon	Physics 202 Class	Admin. Bldg. Room 304
1:00 p.m.	Lunch	
2:00 p.m.	Meet with Dr. M. C. Francis, University President	Admin. Bldg. President's Office
2:30 p.m.	Written Report	Admin. Bldg. Room 217

Mississippi Valley State University

DEPARTMENT OF CHEMISTRY AND PHYSICS



ATTN: BENJ. MISSISSIPPI 38941

April 17, 1978

Dr. Harold A. Vincent
Associate Professor
Physics/Pre-Engineering Department
Xavier University of Louisiana
New Orleans, Louisiana 70125

Dear Dr. Vincent:

Thank you for the invitation to be a consultant for the physics phase of your NSF Cause project at Xavier University. The visit to your campus was both enjoyable and informative. I especially enjoyed Dr. Parrot's presentation, "The Physics of Musical Scales." I am especially impressed with the pre-med program at Xavier and feel that I have attained some ideas that will help us to strengthen our pre-med program at Mississippi Valley State University.

I can appreciate the long hours that you have given in the preparation of the physics phase of the NSF CAUSE project especially as relates to the course objectives. Ironically, I am in the process of writing performance objectives for the introductory physics course here at "the Valley" and I feel that using your list as a reference will make my work somewhat less time consuming.

The format for my evaluation is as follows:

(1) Activities:

Tells you specifically the things that I did to collect the data for my evaluation.

(2) Persons consulted:

A listing by name and positions of persons whom I interviewed in the formulation of my evaluation.

(3) Evaluation and suggestions:

A separate evaluation of each part of the physics phase of the CAUSE project with suggestions when appropriate.

(A) Overall evaluation:

An overall evaluation as relates to the success or failure of the program based upon the individual evaluations of the separate parts.

ACTIVITIES

1. Read the overall CAUSE Proposal.
2. Thoroughly read the material for the physics phase of the CAUSE Proposal.
3. Visited two different in-session physics laboratories.
4. Visited four different in-session physics lectures and remained for the whole hour in two of them.
5. Attended Physics Departmental Meeting.
6. Interviewed all faculty members and administrators involved in the physics phase of the NSF CAUSE project.

(2) Persons consulted:

1. Dr. Juliette Ioup
Associate Professor
Dept. of Physics/PRE-ENG.
2. Dr. Augustin C. Guitart
Professor
Dept. of Physics/Pre-Eng.
3. Mr. Bill Bivens
Instructor
Dept. of Physics/Pre-Eng.
4. Dr. Harold A. Vincent
Associate Professor
Dept. of Physics/Pre-Eng.
5. Sr. M. Veronica, S.B.S.
University Dean
6. Sr. Miriam Francis, S.B.S.
Dean of the College of
Arts and Sciences
7. Dr. J. W. Carmichael
Director of the Xavier
CAUSE Project
8. Dr. Norman C. Francis
President

Appendix Y (continued)

(3) Evaluation and suggestions:

Administration

I am very pleased to inform you that all of the administrators that I interviewed were cognizant relative to the specifics of the CAUSE project. This trend was epitomized in my conversation with Dr. Norman Francis, your President. I was especially impressed not only with his general knowledge of the CAUSE project but with the specific knowledge of the general objectives of the physics phase of the project. Needless to say no program can be very successful without the support of the institutions administrators and I can say without reservation that you have the support of the administrators at Xavier University.

Faculty

It was both surprising and refreshing to see an institution the size of Xavier University with three full-time and one part-time physicists on the faculty. In talking with these faculty members, I found that each one was aware of the specific objectives of and in total support of the physics phase of the CAUSE proposal. In examining the credentials of your physics faculty members, I found that you have 75% Ph.D.'s. I was fortunate enough to spend some time in an actual classroom setting with all of your physics faculty members except one and again I was impressed. It is the opinion of the evaluator that your physics faculty is both willing and capable of implementing the physics phase of your CAUSE project.

Course Content

It is clear to this evaluator that you have given special attention to the fact that you are unlikely to cover all topics covered in the textbook within a two semester period. I do feel that you have made good choices in reordering the sequence of topics covered in your present textbook. I do suggest that you formulate a flexible time frame to coincide with your topic sequence.

Test Bank

I found several typographical errors on some of the test and I made note of these. I noticed two questions that I thought might have been misleading for students and I indicated that they should be reworded. Other than these minor flaws I feel that the test bank is quite suitable as an instrument to both test for your stated objectives and serve as a tool of self evaluation for students. Unfortunately, I am in a dilemma relative to how an answer sheet should be handled. In my conversation with you, we discussed several possibilities all of which had disadvantages. I think that this will have to be a judgement call by you and hope for the best. . . good luck.

Course Objectives

EXCELLENT

Appendix X (continued)

Sample Problem

The problems that you have formulated are in keeping with your goals, and are representative of an introductory level physics course. I would like to see the correct choice in writing your problems and questions and to see some of your solutions in detail. This of course allows you to change your problems, but you still have a useful set of sample problems for your students.

Laboratory

The experiments that you have chosen are adequate for your number of students. In my conversation with you, I noted that the format for the experiments were somewhat inconsistent. You informed me that the inconsistency in format resulted from each physics faculty member being responsible for the formulation of some of the experiments. You also showed me the general laboratory instruction sheet that should alleviate any confusion on the part of the student. I do feel that this instruction sheet is more than adequate and I feel that you made the right choice in letting each faculty member have input in the formulation of the laboratory activities. I do however suggest that you name those experiments that were not named and rework the formats for consistency.

Overall evaluation

It is obvious that you have spent many hours in the preparation of the materials and activities for the physics phase of your NSF GAUSE project. If you are as successful in the implementation of the program as you have been in the preparation of the program the hours that you have spent will not have been in vain. To successfully implement your program, you must have the continued support of both your administration and faculty, and as I indicated above they are certainly knowledgeable of your program and appear to be in full support of your efforts.

Sincerely,



Charles A. Pickett, Ph.D.
Chairman
Department of Chemistry and Physics

CAP/frb



Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125 TELEPHONE 504-386-7411

College of Arts and Sciences

CONSULTANT SCHEDULE

for

DR. JACK LOCHHEAD

THURSDAY, APRIL 19, 1979

8:30 a.m.	H. A. Vincent	Rm. 220 A
9:30 a.m.	Dr. N. C. Francis	President's Office
10:00 a.m.	Sr. M. Veronica Drawe and Sr. Miriam Francis Quinn	Dean's Office
11:00 a.m.	Physics Seminar	Rm. 217
12 Noon	Lunch	
1:00 p.m.	KENAN and CAUSE Committees and Math Consultant	Rm. 201 of Pharmacy Building
2:00 p.m.	Dr. JW Carmichael	MSL
3:00 p.m.	Phy./Pre-Eng. Department	Rm. 217



Xavier University of Louisiana

NEW ORLEANS LOUISIANA 70125. TELEPHONE 504.486.7411

College of Arts and Sciences

CONSULTANT SCHEDULE

for

DR. JACK LOCHHEAD

FRIDAY, APRIL 20, 1979

8:30 a.m.	Physics-CAUSE Materials Evaluation	Rm. 220 A
10:30 a.m.	Physics-APLC Component: facilities and materials	APLC
11:30 a.m.	Lunch	
1:00 p.m.	Consultant's Report	Rm. 217
3:00 p.m.	APLC Dedication	APLC

by Jack Lochhead

Appendix XI (continued)

May 1, 1979

On April 19 and 20 I visited Xavier University and met with three members of the Physics Department as well as most of the CAUSE staff. Professor Harold Vincent is responsible for the Physics component of the CAUSE project; this report focuses on the work that he has done. My observations are based on discussion with Professor Vincent and on the workbook he has written to accompany Physics 201-202; scheduling problems prevented me from visiting 202 classes. I did, however, attend an undergraduate seminar. I was impressed with the serious attitudes of the students and with the rapport they had with the Physics faculty.

All components of the CAUSE project have carefully reviewed the syllabus in the core courses with the goal of maximizing the interrelatedness of these courses and reducing the number of non-essential topics. The 201-202 workbook reflects this emphasis on basics essential to later course work. Nonetheless there are probably a few unnecessary items in the course and I would recommend continued ~~pr~~^u~~ing~~ⁿ so that more time is available for the toughest topics. Two areas where it may be possible to reduce the coverage are the Mechanical Properties of Matter and rotational motion. I am skeptical of the ability of most first year students to absorb much in those areas- careful coordination with the chemistry course may allow for additional ~~pr~~^u~~ing~~ⁿ in Kinetic Theory and Thermodynamics.

The course exams include both short answer or multiple choice questions and longer questions requiring complex calculations. I was particularly impressed by the quality of the short qualitative questions. Many of these require a sophisticated understanding of physics and stress areas where students frequently have serious difficulty. I encourage the continuing emphasis on such questions because they help both faculty and students recognize how much physics is really being learned in contrast to the rote learning of rules.

Appendix XI (continued)

Questions of this type¹ should also be included among the sample problems which currently contain only calculational problems.

The 201-202 laboratories are good traditional exercises. They have a distinct advantage over many more modern laboratories in that they use simple equipment which the students can readily understand. One laboratory- the simple pendulum- uses the learning cycle format emphasized in Xavier's SOAR program. I would like to see more of the laboratories redesigned to fit this format. However, the change should be done gradually; it usually takes several attempts to tune a learning cycle lab to fit the level of student.

The workbook contains a few typographical errors and section headings are sometimes left out. It would be useful to have the booklet reviewed by a competent secretary or student who could make small format corrections.

The goal of the CAUSE program is ambitious and important. The physics component has made significant progress but maintaining that development will require continuing interaction with faculty in other departments, especially those in math and chemistry. Interdepartmental coordination of this kind is very rare and Xavier is fortunate to have accomplished it.

¹Professor Robert Bauman, Dept. of Physics, University of Alabama, Birmingham refers to such problems as "asking very difficult questions about very easy material". It would probably be very profitable for the Xavier physics program to establish contact with Prof. Bauman's group.

Appendix XII--A Prescription for the Common Final Examination for Mathematics 103

COMMON FINAL EXAM FOR (PRECALCULUS) MATHEMATICS 103

A prescription for a final exam was arrived at in conference with all five instructors of precalculus during the Fall 1978. This prescription consisted of listing by module objective of the content to be tested on the final exam. The prescription included by each objective the point value of each of the problems to be included. The total point value amounted to 105 points. It was then decided that a subcommittee (Dr. Esther Fonteva and Dr. B. William Irbeck) would be responsible for the actual writing of two forms of a test following the prescription.

Consequently, these forms (see attachment) were administered to all 6 classes with approximately one half of each class taking form A and the other half taking form B. The results for each form were compared as a check for equivalency. These showed that the forms were approximately equivalent. Further data per instructor was also collected. This data is summarized on the next page. It should be noted that the distribution of scores according to the usual grade intervals 90-100, 80-90, 70-80 etc. showed that the scores were not normally distributed.

PRESCRIPTION FOR PRECALCULUS EXAM

Objective	Point Value	Objective	Point Value
III.4	-- 3 pts.	IV.8	-- 4 pts.
III.5	-- 3 pts.	IV.10	-- 3 pts.
III.6	-- 3 pts.	IV.11	-- 1 pts.
III.10	-- 3 pts.	IV.13	-- 3 pts.
III.12	-- 4 pts.	V.2	-- 2 pts.
III.5	-- 4 pts.	V.8	-- 2 pts.
III.11	-- 1 pts.	V.9	-- 6 pts.
III.13	-- 1 pts.	V.10	-- 3 pts.
III.14	-- 3 pts.	VI.6	-- 4 pts.
III.15	-- 1 pt.	VI.7	-- 3 pts.
III.5	-- 3 pts.	VI.10	-- 2 pts.
III.9	-- 4 pts.	VII.7	-- 1 pts.
III.11	-- 1 pt.	VIII.3	-- 5 pts.
III.12	-- 3 pts.	VIII.9	-- 3 pts.
III.14	-- 3 pts.		
		Total	105 pts



Appendix XIII-- PRECALCULUS COMMON FINAL EXAM

DATA FROM DECEMBER 1978

INSTRUCTOR	FORM A		FORM B		COMBINED		
	N	\bar{X}	N	\bar{X}	N	\bar{X}	S
BROWN	17	58.1	11	58.1	28	58.3	17.0
FONTOVA	21	60.3	23	64.5	47	62.3	21.9
IRLBECK	14	61.5	14	56.1	28	57.3	21.8
JONES	19	53.3	16	55.1	35	54.3	18.1
KLEINHAUS	14	52.9	12	58.3	26	55.4	19.2
COMBINED	88	60.1	78	60.1	164	60.1	21.1

CORRELATION BETWEEN EXAM SCORE AND COURSE GRADE = .95

DISTRIBUTION OF SCORES ON FINAL EXAM

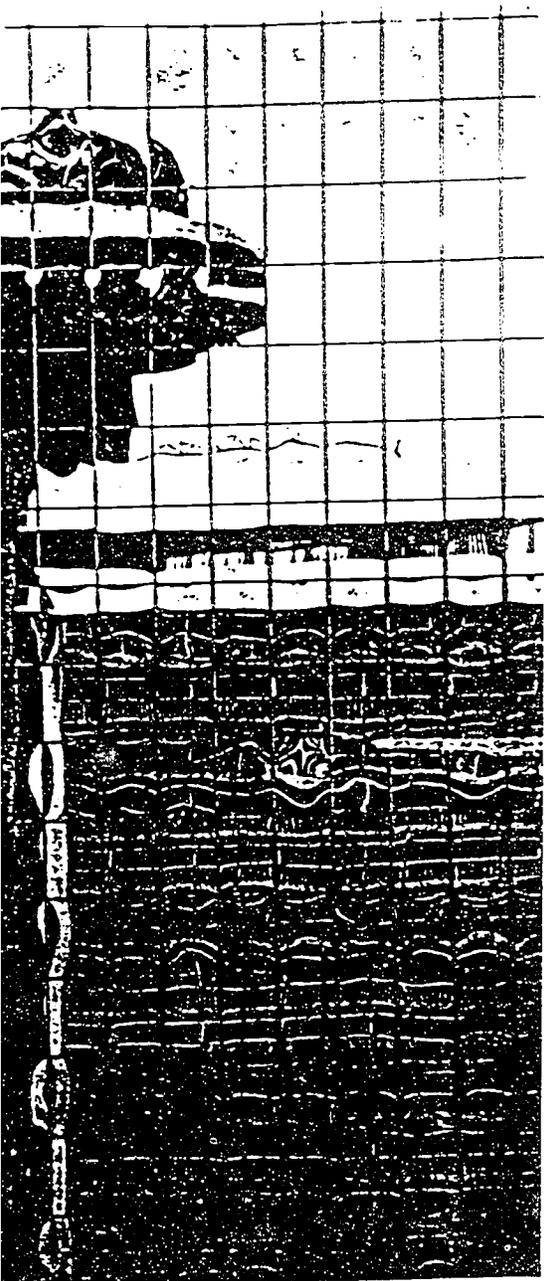
	100-90	89-80	79-70	69-60	59-50	49-40	39-30	2-0
FORM A	5%	14.9%	16.5%	17%	14.8%	17%	16.9%	1.9%
FORM B	16.3%	16.4%	6.9%	11.8%	17.1%	17.1%	16.5%	7.9%
COMBINED	5%	16.1%	6.5%	11.9%	16.9%	17%	16.1%	7%

DISTRIBUTION OF COURSE GRADES FOR THOSE STUDENTS WHO TOOK FINAL EXAM

INSTRUCTOR	A	B	C	D	F
BROWN	17.6%	21.4%	21.4%	25.7%	13.5%
FONTOVA	17.6%	17.6%	27.5%	21.4%	15.8%
IRLBECK	17.6%	17.6%	17.6%	17.6%	17.6%
JONES	17.6%	17.6%	17.6%	33.7%	5.7%
KLEINHAUS	17.6%	17.6%	17.6%	24.2%	11.7%
COMBINED	18.0%	17.7%	20.7%	23.8%	13.4%



FINA
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ATLAN
Marc



Friday, March 23

1 PM-2 PM

49. LOCI Project Symposium—Review of Selected NSF LOCI Projects.
*Atlanta Hilton Hotel
 Thomas Jefferson Room*

Presenter: Martha T. Hatcher, Professor of Biology, Gainesville Junior College, Georgia.

50. LOCI Project Symposium—Review of Selected NSF LOCI Projects.
*Atlanta Hilton Hotel
 Council Room*

Presenter: Dorothy Brock, Associate Professor of Biology, Northern Georgia College, Dehlonga.

2:10 PM-3:10 PM

51. LOCI Project Symposium—Review of Selected NSF LOCI Projects.
*Atlanta Hilton Hotel
 Thomas Jefferson Room*

Presenter: Rebecca A. Halyard, Associate Professor, Biology, Clayton Junior College, Atlanta, Georgia.

52. LOCI Project Symposium—Review of Selected NSF LOCI Projects.
*Atlanta Hilton Hotel
 Council Room*

Presenter: Dorothy Brock, Associate Professor of Biology, Northern Georgia College, Dehlonga.

1 PM-2 PM

53. CAUSE Project Symposium—Review of Selected NSF CAUSE Projects.
*Atlanta Hilton Hotel
 John Adams Room*

Presenter: Harry Prince Allen, Associate Professor of Mathematics, Ohio State University, Columbus.

Highlights of the Science Learning Center at the University of Texas at Arlington.

Presenter: Ann Benham, Associate Director, Science Learning Center, University of Texas, Arlington.

Multi-Pathway Learning.

Presenter: Jacqueline T. Hunter, Instructor, College of Arts and Sciences, Xavier University, New Orleans, Louisiana.

Improvement of Science Instruction and Development of Evaluation Procedures.

Presenter: Philip John Arnholt, Assistant Professor, Concordia College, Milwaukee, Wisconsin.

Complementary Concept Modules for Mathematics, Chemistry, Biology and Physics.

Presenter: Eldon L. Miller, Chairman, Department of Mathematics, University of Mississippi, University.

PROGRAM
Annual Convention
 ATLANTA, GEORGIA
 23-26, 1979

Appendix XV--Portion of Program from CAUSE Dissemination Workshop indicating presentation by Dr. Carmichael concerning XU's CAUSE Grant

COMPREHENSIVE ASSISTANCE TO SCIENCE EDUCATION (CAUSE)

INFORMATION EXCHANGE SEMINAR

(CIES)

- PROGRAM -

(All sessions and meals will be in the Jane S. McKimmon Center)

Monday, August 6, 1979

11:00 am - 12 Noon	CIES Registration
12 Noon - 1:00 pm	Lunch
1:00 pm - 1:10 pm	Welcome and Seminar Administrative Procedures - Denis Jackson, Project Director N.C. State University
1:10 pm - 1:15 pm	Introduction of NSF staff - Richard W. West, Program Director CAUSE
1:15 pm - 1:20 pm	Schedule of Events - Lawrence H. Oliver, Program Manager CAUSE
1:20 pm - 1:40 pm	Historical Overview of CAUSE and Purpose of Seminar - Richard W. West
1:40 pm - 1:55 pm	Science Education at NSF - Marjorie Gardner, Division Director Science Education Resources Improvement (SERI)
1:55 pm - 2:00 pm	Seminar Evaluation - Judith B. Erickson, SERI
2:00 pm - 3:00 pm	

Session 2-1

Chairperson: Lawrence H. Oliver

Presenter: Avery J. Dennis, Sandhills Community College

"Improvement of Instructional Delivery via Establishment of an Individualized Instructional Laboratory" (Area 3)

Appendix XV (continued)

Session 4-1 Chairperson: Richard W. West
Presenter: J.W. Carmichael, Jr., Xavier University
at New Orleans

"Development of an Alternate Pathway Learning Center" (Area 4)

3:00 pm - 3:30 pm Coffee/Soft Drinks

3:30 pm - 4:30 pm

Session 2-2 Chairperson: Richard W. West
Presenter: Curtis Miles, Piedmont Technical College

"Development of an Interdiscipline Electronics/Math Problem Solving
Curriculum" (Area 3)

4-year and Ph.D. Institutions - Proposal Reading File (Area 5)

4:30 pm - 5:30 pm

2-year Institutions - Proposal Reading File (Area 5)

Session 4-2 Chairperson: Marjorie Gardner
Presenter: James L. Koevenig, Florida Technical
University

"Use of Video Cassettes and Minicarts to teach Remedial Skills and Concepts
in the Biological Sciences" (Area 4)

6:30 pm - 7:30 pm Dinner (Area 2C)

XX

Tuesday, August 7, 1979

7:30 am - 8:30 am Breakfast (Area 2C)

8:30 am - 9:30 am

Session 2-3 Chairperson: Richard W. West
Presenter: William Palow, Miami-Dade Community College

"A Computer-Managed Multimedia Math Learning Center" (Area 3)

Session 4-3 Chairperson: Lawrence H. Oliver
Presenter: Gerald W. Esch, Wake Forest University

"Restructuring and Revitalization of Undergraduate Education in Biology"
(Area 4)





XAVIER UNIVERSITY OF LOUISIANA Inter-Office Memo

To JW Carmichael, Professor of Chemistry
 From Leslie R. Morris, Director of the Library
 Date December 18, 1980
 Subject APLC Attendance

LRM

Month	1979/80	1980/1	1978/79*
July	3549	3124	
August	3055	2405	
September	14997	15979	
October	19221	15979	
November	16198	19700	
December	<u>11293</u>	11947	
January	5905		1292
February	13453		10210
March	15647		13704
April	12929		11691
May	10282		5570
June	<u>5224</u>		4380
TOTAL	131753	TOTAL 53155	46853

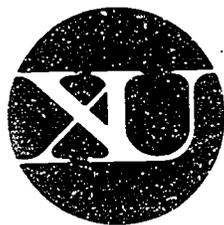
SUB TOTAL

*Added by JWC from previous memo.

Tentative Program

Appendix XVII--Program for SREB-sponsored SREB Workshop in New Orleans
SCIENCE INSTRUCTION SEMINAR

<u>Sunday</u>	6	p.m.	<u>Reception and Registration</u>	
	7:30	p.m.	<u>Overview of entire program</u>	James M. Godard, SREB
	8	p.m.	Presentation: <u>Development and Operation of Science Learning Centers</u>	Dr. Howard Carter Tuskegee Institute
			Commentators: Dr. Johnny Gills Jackson State University	
			Sister Grace Mary Flickinger Xavier University	
			Discussion	
<u>Monday</u>	9	a.m.	<u>Summer Programs</u>	Dr. J. W. Carmichael Xavier University
			<u>Outreach to High Schools</u>	_____
			Discussion and Coffee Break	
			<u>Computer-Assisted Instruction</u>	Dr. William G. Hodge Benedict College
			Discussion	
	1:30	p.m.	<u>Demonstrations (Xavier Campus)</u>	
			Learning Centers, Tutorial Services	Sister Grace Mary
			Computer-Assisted Instruction	Dr. Brown / Sr. Eileen + G. + H. + J. + K.
			Laboratory Teaching Procedures	Sr. Josephine
			High School Programs	
<u>Tuesday</u>	8:30	a.m.	<u>The Literature of Science</u>	Ancilla Coleman Jackson State University
			<u>Science Instrumentation</u>	Robert A. Inyore N.C. Central University
	Noon		Adjournment	



Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125, TELEPHONE 504/486-7411

Schedule for

Dr. Bobby N. Irby

Chairman, Department of Science Education

U. of Southern Mississippi

to evaluate

CAUSE Grant SER77-06227

Monday, April 21

9:00- 9:30	JW Carmichael	University Guest House
9:30-10:00	Sr. Veronica Drawe, University Dean	Admin. 207
10:00-11:00	JW Carmichael	Guest House
11:00-12:00	CAUSE Committee	Guest House
	Jacqueline Hunter, Biology Sr. Grace Mary, Biology Bill Jones, Mathematics Harold Vincent, Physics Sr. Joanne Bauer, Chemistry JW Carmichael, Chemistry Bill Irlbeck, Math (cannot attend)	
12:00- 1:00	Lunch	Faculty Dining Room
1:00- 2:00	Chemistry: Sr. Joanne, Barbara Wells, & JWC	Guest House
2:00- 3:00	Physics: Harold Vincent	Admin. 320A
3:00- 4:00	Math: Bill Jones & Bill Irlbeck	Mercedes

Tuesday, April 22

9:00-10:00	Biology: Sr. Grace Mary & Jacqueline Hunter	Admin. 320
10:00-11:00	Visit APLO & talk with students	APLO
11:00-12:00	JW Carmichael	MSL
12:00- 1:00	Revisit as needed & write report	



Appendix XVIII (continued)

University of Southern Mississippi

Southern Station, Box 5087
Hattiesburg, Mississippi 39401

May 7, 1980

Department of Science Education

Dr. J. W. Carmichael
Director, CAUSE Project
Xavier University of La.
New Orleans, LA 70125

Dear Dr. Carmichael,

Please find attached the evaluation report on Xavier University's Cause Project.

If you have any questions about this report, please do not hesitate to call on me.

Sincerely,

Bobby N. Irby
Chairman

BNI:ke

Appendix XVIII (continued)

Report of Site Visit
To Xavier University
Of Louisiana CAUSE Project

Prepared By: Bobby W. Irby, Chairman
Department of Science Education
University of Southern Mississippi
Hattiesburg, MS 39401

I. Advance Preparation

A. Advance Preparation

Prior to my visit to Xavier University of Louisiana, Dr. J. W. Carmichael, Jr., Project Director, sent me copies of the original CAUSE proposal and subsequent reports on the Mathematics and Science Project. The project was for the development of a multi-departmental improvement program for the entry-level courses in science and mathematics for science majors. The documents were studied to provide sufficient background about the work proposed, to maximize the usefulness of a 2-day on-site visit.

Dr. Carmichael arranged an itinerary as follows:

Monday, April 21

9:00 - 9:30	J. W. Carmichael	University Guest House
9:30 - 10:00	Sr. Veronica Drawe University Dean	Administration 207
10:00 - 11:00	J. W. Carmichael	Guest House
11:00 - 12:00	CAUSE Committee Jacqueline Hunter, Biology Sr. Grace Mary, Biology Bill Jones, Mathematics Harold Vincent, Physics Sr. Joanne Bauer, Chemistry J. W. Carmichael, Chemistry Bill Irlbeck, Math	Guest House
12:00 - 1:00	Lunch	Faculty Dining Room
1:00 - 2:00	Chemistry: Sr. Joanne Baeur Barbara Wells, J. W. Carmichael Sr. Carla, Chairman	Guest House

Monday, April 21 (Continued)

2:00 - 3:00	Physics: Harold Vincent	Admin. 220A
3:00 - 4:00	Math: Bill Jones & Bill Irlbeck	Mercedes

Tuesday, April 22

9:00 - 10:00	Biology: Sr. Grace Mary & Jacqueline Hunter	Admin. 320
10:00 - 11:00	Visit APLC & talk with students	APLC
11:00 - 12:00	J. W. Carmichael	MSL
12:00 - 1:00	Revisit as Needed & write report	

B. People Interviewed

The following people were interviewed during my site visit:

CAUSE Committee: Dr. J. W. Carmichael, Director
Sr. Joanne Bauer
Ms. Jacqueline Hunter
Sr. Grace Mary Flickinger
Mr. Bill Jones
Dr. Harold Vincent

Mathematics: Mr. Bill Jones
Dr. Bill Irlbeck
Sr. Rosemarie Kleinhaus,
Chairperson

Chemistry: J. W. Carmichael
Sr. Joanne Bauer
Sr. Mary Carla Mahmstrom,
Chairperson

Physics: Dr. Harold Vincent,
Chairperson

Administrators: Sr. Veronica Drawe,
University Dean

Students: Unidentified

Appendix XVIII (continued)

II. On-Site Interpretation

A. Project Institutionalization

Accomplishment of total institutionalization of the project is among the very significant accomplishments of the project leadership. The eight courses for the science and mathematics entry-level preparation of science majors which were developed as one of the major objectives of the CAUSE project, have become an official part of the Xavier University's Science and Mathematics Curriculum.

Additional evidence of institutionalization of the project include (A) the strong support by the administration, (B) the current and projected role of the Alternate Pathway Learning Center (APLC), (C) classroom and laboratory facilities and probably the most important, (D) the faculty interest and commitment to the program. These courses, (as all courses at Xavier University), are taught exclusively by regular faculty members, including laboratory. Teaching assistants are not utilized as instructors. Taken together, these represent a very important commitment of physical and human resources to the Xavier University's academic program.

Additionally, during the CAUSE project, Chemistry developed and implemented a second semester Piagetian-based laboratory in general chemistry for its entry-level majors and established the mechanism for evaluating their majors' progress throughout their degree programs.

B. Facilities

Facilities are somewhat old and in need of renovation. Also, they are possibly in need of expansion, but at the present, these are put to maximum use and are considered adequate (possibly with the exception of chemistry). Basic equipment for the teaching of entry-level courses addressed by the CAUSE project seems to be sufficient. However, no detailed evaluation of the facilities and equipment needs was undertaken. Conclusions were based on input from faculty.

II. On-Site Interpretation (Continued)

Teaching Assistants, (undergraduate or graduate) are not available to assist the faculty with the day-to-day chores. Faculty members lecture, prepare all laboratory set-ups, grade papers, develop evaluation instruments, etc. This contact manifests itself in superior instruction. Student benefits seem to be worth the extensive effort of the faculty. However, it would seem cost effective to utilize senior science majors to assist with laboratory preparations and free the faculty for other constructive activities. Surely the faculty has been involved in many extracurricular activities that effectively promote Xavier University and CAUSE.

C. Course Structure

The entry-level courses of all four departments (two courses per department) consist of a commercial textbook, laboratory manual, and student workbook. The latter two items were developed as part of the CAUSE Project. Additionally, each department has begun to administer common final examinations in all sections of a given course. Chemistry chose to use the American Chemical Society's Cooperative Examination as the final in the second semester. Mathematics and Physics were developing second semester final examinations of similar specifications.

Handbook. The handbook varies slightly among departments but basically it contains content objectives, sample problems, tests, sample calculations and solutions to problems, audiovisual materials, and references to alternate pathways for learning. The handbooks seem to be well received by the students. The brightly colored covers have served as a symbol of the CAUSE program on campus, influencing the development of handbooks by other departments.

Notable changes were made by Biology and Mathematics in their entry-level courses. Biology developed two semesters of general biology to replace a one semester each of general biology and zoology. Mathematics modified pre-calculus

Appendix XVIII (continued)

II. On-Site Interpretation (Continued)

(college algebra and trigonometry) to increase emphasis on practical skills, and developed a survey of calculus to replace Calculus I, designed to serve as either a terminal course or the first semester of a traditional three-semester sequence. The results of the changes are good. The faculty and students expressed support for the new programs in biology and mathematics.

Chemistry's innovative entry-level chemistry program and its SCAR program (pre-entry level summer program for high school seniors) seem to have served as one CAUSE model for other departments to follow in the development of their entry-level courses.

D. Learning Center

The Alternate Pathway Learning Center (APLC) occupies 4,000 square feet of space on a ground floor wing of the University Library. Students can receive tutoring, view displays and demonstrations, use audiovisual materials and models, and employ calculators and computer assisted instruction. The APLC floor area is divided equally among the four content areas. Tutors are scheduled throughout the day. The APLC is open to the students on the same schedule as the library.

Students do not sign in or out and no attempt is made to check on the use of the center by individual students. However, count is recorded by turn-stile, which indicated 14,970 counts for Sept. 1979 and 10,000 plus for each month thereafter through March 1980. Some students utilize the facility more than others, but a remarkable indicator of its popularity is that considering an enrollment of 587 students, the average student use of the APLC was 17 times per month.

E. Project Staff

The CAUSE Project at Xavier was a direct outgrowth of extensive pre-planning and needs assessment at the University on the part of the faculty within the Departments of Biology, Chemistry, Physics, and Mathematics. The CAUSE

II. On-Site Interpretation (Continued)

project was implemented by a committee, which was expanded from the original representation of five to twelve in an effort to ensure that development was truly departmental. This effort seems to have been very successful. It is noteworthy that the chairpersons of each of the departments involved in CAUSE were active participants in its development. These included Sr. Gracy Mary Flickinger (Biology Chairperson), Sr. Mary Carla Mahmsurom, (Chemistry Chairperson); Dr. Harold Vincent, (Physics Chairperson); and Sr. Rosemarie Kleinhaus (Mathematics Chairperson). Their enthusiastic support was a definite contributor to the success of the project and added assurance that the program would continue as the entry-level science and mathematics courses for science majors.

F. Administrators

Sr. Veronica Drawe, University Dean and chemist by training (Ph.D.), felt that the most important area of improvement resulting from CAUSE was (1) increased cooperation and willingness among the science faculty to discuss new and innovative ideas for the improvement of educational opportunities of the entry-level science majors at Xavier University, and (2) increased student performance on standardized tests, coupled with increased student interest in the sciences as indicated by increased enrollment in the sciences.

Further, Sr. Veronica felt that the CAUSE program will continue as Xavier University's Science Program for science majors. However, as she indicated, Xavier University's faculty is cognizant of the need to continue to evaluate all phases of the educational program and make any additional changes needed for future improvements. Thus, the CAUSE program will continue to be modified as needed in the future, and probably will be expanded to include other content areas as well as additional levels of study in the sciences.

Appendix XVIII (continued)

II. On-Site Interpretation (Continued)

The administrative leadership and support of the faculty is very strong and admirable.

III. Evaluation and Conclusion

A. Faculty

Faculty should be encouraged to maintain the high degree of cooperation which characterized the project. This has resulted in strong articulation of one course sequencer in the four content areas. Moreover, it has been a major cause of the realization of a uniform and common philosophy throughout the eight courses.

B. Research

The faculty should be encouraged to become involved in research concerning the impact on students of the science majors program and/or of specific courses, laboratory activities, alternate pathway of learning, etc. Research of this type will develop continued faculty interest in the program and will result in continued faculty professional growth.

Analysis should be made of the status of incoming students' capabilities in basic process and reasoning skills. A correlation between these skills and the effectiveness of the Piagetian-based laboratory activities could be established.

C. Project Objectives

In general, the most important achievements of CAUSE were (1) Standardization of entry-level mathematics and science courses for science majors and (2) the development of a commonality of purpose among the science and mathematics faculty. These achievements resulted in the attainment of the specific objectives to (1) improve performance in and (2) reduce attrition from the entry-level science majors courses in biology, chemistry, physics, and mathematics.

III. Evaluation and Conclusion (Continued)

1. Biology

Students increased an average of 27 percentile points on points on the CAUSE General Biology exam. Students completing year sequence (123 and 124) increase from 49% to 54% from 1977-78 (pre-course) to 1978-79 (course). Students completing BIO 123 spring semester increased from 28% in 1978 to 57% in 1979. This is most significant because spring sections have higher percentages of students with known academic deficiencies and correspondingly lower probability for success. The attempt to increase performance and reduce attrition in the biology sequence appears to have made excellent progress.

2. Chemistry

Students increased an average of 20 percentile points on the ACS exam in general chemistry. Students completing Chemistry 101 increased from 60% before CAUSE (1976-77) to 68% for the first year of CAUSE (1977-78) and to 79% in 1978-79. Students completing Chemistry 102 increased from 77% before CAUSE to 87% in 1978-79. Students completing the two semester sequence increased from 45% in 1976-77 (before CAUSE) to 66% in 1978-79. The attempt to increase performance and reduce attrition in the chemistry sequence has made tremendous progress.

3. Mathematics

Students completing Math 103 increased from 36% (pre-CAUSE) to 45% in 1978 (CAUSE). Students completing Math 104 increased from 61% to 83% after CAUSE. The attempt to reduce attrition is evident. Data for student performance was not available.

4. Physics

Students completing Physics 201 increased from 59% (pre-CAUSE) to 69% (CAUSE). Students completing Physics 202 increased from 60% (pre-CAUSE) to 73% (CAUSE). Students completing the two semester sequence in Physics (201 and 202)

III. Evaluation and Conclusion (Continued)

increased from 53% to 73%. Physics has reduced attrition considerably.

D. Conclusion and Recommendations

The project set out to address four specific objectives pertaining to science and mathematics majors.

1. To reduce attrition from and increase achievement by students in entry-level courses in science and mathematics.
2. To determine the effectiveness of the mechanism chosen to accomplish #1.
3. To provide an Alternate Pathway Learning Center.
4. To document and disseminate information.

Progress toward meeting these objectives has been excellent, and where objectives are not yet fully addressed, significant mechanisms have been established that will result in advancement toward meeting them. In short the CAUSE project has been successful.

THE PROCEEDINGS OF THE ELEVENTH ANNUAL
CONFERENCE OF THE INTERNATIONAL CONGRESS
FOR INDIVIDUALIZED INSTRUCTION

THE GEORGIA CENTER FOR
CONTINUING EDUCATION

THE UNIVERSITY OF GEORGIA
ATHENS, GEORGIA

NOVEMBER 7-9, 1979

VOLUME I

ISSN 0195-6590

LC

Professor Bloom is Charles W. Swift Distinguished Professor of Education, the University of California, LA. Bloom is a founding member of the International Association for the Evaluation of Educational Achievement (IEA) and a past president of the American Educational Research Association (AERA).

9:10 - 9:30 am Discussion with Benjamin Bloom

Friday, November 3, 1978

Business Meeting, Lower Level Auditorium

8:30 - 9:00 am 1977 Business Meeting, Part 2, Lunch breakfast
Reports of Officers
Election of Officers
Research Paper Award
Poster Paper Award
Preview of 1980 Meeting, Dearborn, Michigan
Announcement of 1981 Meeting site

9:30 - 10:00 am Coffee break, Lounge

Session IIIA, Room 4

10:00 - 10:20 am Zimmerman, John L.
Kansas State University
ECOLOGICAL IMPACT ASSESSMENT VIA GUIDED DISCOVERY

10:20 - 10:40 am Tompoy, Robert
The University of Georgia
CROSS-CULTURAL ASSESSMENT

10:40 - 11:00 am Sanswell, Ronald W.
TST-Waco (Texas)
A SYSTEMS APPROACH AND LEARNING ACTIVITY PROGRAM

11:00 - 11:20 am Ryan, Gerald C.
Southwestern Michigan College
THE DIRECTOR: A TECHNOLOGICAL AND RITE EFFECTIVE INSTRUCTION

11:20 - 11:40 am Flickinger, Sr. Grace Mary
Loyola University of Louisiana
ALTERNATE PATHWAYS FOR LEARNING IN A MULTIDIRECTIONAL LEARNING CENTER

11:40 - 12:00 pm Benrens, John H.
University of Illinois
REGIONAL CONSIDERATION FOR AUTO-TUTORIAL LIBRARY CARE

...the well-prepared and the educationally-disadvantaged have a reasonable chance of achieving success, the science department at Louisiana State University has established a multidisciplinary center in order to offer a variety of alternate pathways for learning. This alternate pathway learning center (ALPC) is directed by the department chair and a member that each utilizes the capabilities which are best suited for his own special needs as a teacher or learner. The alternate pathways available in the facility include individualized learning; computer-assisted instruction; individualized self-paced commercial and locally-produced materials; individualized testing; and individualized assistance in acquiring selected test-taking and study skills. This approach, "standards with sympathy," has been extremely effective in both reducing attrition from and increasing performance in the entry-level science courses.

BARBARA BRADSHAW W.
East Texas State University, Commerce, Texas 75825
THE EFFECTIVENESS OF A CAI PROGRAM ON STUDY SKILLS

In order to provide study skills instruction on an individual basis to all students who want the information, a computer-assisted instructions (CAI) program was developed. This study investigated the effectiveness of the CAI "study" program on students' study behaviors and attitudes. Subjects were undergraduates enrolled in psychology classes who were randomly assigned to the experimental (had access to the CAI program) and control (had no access to the CAI program) groups. There were 51 subjects in the experimental group and 67 subjects in the control group. All subjects responded to the Survey of Study Habits and Attitudes (SSHA) three times during the semester. Measures on the SSHA were used to determine differences and changes in study habits and attitudes. Trend analyses on the seven SSHA measures showed no significant differences between the groups, significant differences among the trials and interactions. Scores on trials increased during the semester. Reverse patterns of perceptions were found on study habits with upward shifts for the experimental (CAI) group and downward shifts for the control group. Students in the experimental group reported favorably about the CAI "study" program and to the method of presentation. It was concluded that the CAI "study" program effectively presented the information on study skills and how to develop these skills.





Xavier University of Louisiana
NEW ORLEANS, LOUISIANA 70118 TELEPHONE 804-486-7411

TO : Dr. Carmichael, Director of Xavier's NSF - CAUSE Grant
FROM : G. T. Hunter, Biology Representative for CAUSE
DATE : November 28, 1979
RE : Continuation of the Biology portion of the CAUSE program

When Xavier's NSF - CAUSE proposal of 1978 was written the Biology department made a commitment to implement the CAUSE program even though personnel could change and funding would be withdrawn. The Biology portion of the grant was aimed at providing a coordinated, standardized approach to the teaching of General Biology for Science Majors and General Biology Laboratory for Science Majors. In order to maintain this coordinated approach the Biology department offers the following plan.

I. Integrate new faculty

- A. New faculty should meet initially with faculty already teaching General Biology, in order to allow new faculty to:
 1. Obtain background information on the development of the course.
 2. Become familiar with course--Workbook, text, quizzes, laboratory manual
 3. Biweekly meetings throughout the semester of General Biology faculty to talk over what is happening in the various sections of the course in an effort to iron out all problems as soon as possible

II. Updating the course with input from students and faculty:

- A. Questionnaire at mid-semester to get some conceptions that students have about the course, whether or not they are using the supports that are built into the course (workbook, tapes, tutoring services, etc.). The results are tallied, reviewed by the General Biology faculty, feedback and clarification, if needed, are given to the students by faculty. If it seems necessary, changes may be made.
- B. Biweekly meetings of the General Biology faculty allows new faculty to have input into the course by observation and discussion of things that work or don't appear to work. This provides a valuable and continuous source of input into the course and serves to allow new faculty to feel as though the course is his/her own because of the

contribution that is made.

2. Annual meetings with the faculty of the Biology Department to review the General Biology materials, re-evaluate it, make deletions and additions that seem appropriate.
3. Collect statistics at mid-semester and the end of the semester and compare them with those from previous years as a rough gauge of present performance.

III. Maintenance of the APLO

1. The Biology department will be represented by one faculty member and one student tutor on the APLO Committee.
2. Training session for all Biology tutors.

IV. Coordinator to Supervise the General Biology Course.

A coordinator will be appointed by the chairman. His/her duties are outlined on the following page.

DUTIES AND RESPONSIBILITIES OF GENERAL BIOLOGY COORDINATOR

The coordinator is expected to:

1. Prepare a day-by-day outline for the semester detailing the material to be covered each class meeting and provide a copy to each instructor.
2. Meet with the other teachers individually or in groups on a regular basis to coordinate the teaching and provide a forum for discussion of the content of course, textbook, alternate pathways, etc.
3. Prepare in conjunction with the other teachers of the course a common final examination for the course.
4. Collect copies of each instructor's hour exams as well as a copy of midterm grades and final grades.
5. As soon as possible after mid-term, compute a grade distribution for each section as well as for the combined group. This grade distribution should show the percentage of students making at least a C and those making below a C. Also a student-attitude questionnaire should be distributed to all sections and the results tabulated.
6. At the end of the semester, collect a copy of class roll from each section's instructor containing name, final exam score, (plus standardized CLEP test score, if a standardized test is given), and final course letter grade for each student. Each instructor is to submit class average on the final exam (plus standardized test, if any is given) and grade distribution for his or her section.
7. Calculate over all average on final exam (plus average on any standardized test given) and overall grade distribution. This data is to be recorded on the coordinator report form (see appendix) and placed in the departmental files. This information to be recorded on the department's master sheet in the departmental file.
8. Order binders for workbooks and laboratory manuals (should be done by spring for the following year).
9. Make corrections in the laboratory manual and the workbook.
10. Get workbooks and laboratory manual to the printers and to the bookstore (send to printers by the end of the spring semester).
11. Put the answers to the workbook questions in the APLC.
12. Update the list of alternate pathways as new materials come in.

Appendix XX (continued)

Appendices to be attached to this form:

1. Copy of course schedule given to each student.
2. Copy of common final examination. (See Jackie Hunter)
3. Results of mid-term student attitude questionnaire.
4. Grade distribution report.
5. Master copy.

Appendix XX (continued)

Course: Basic Principles of Biology
 Biology 12⁴

Classes: 3 hours/wk

Credit: 3 s.h.

Texts: Biological Science (second edition) by Keeton
Workbook for Basic Principles of Biology

COURSE OBJECTIVES:

This course is designed so that the student

1. will be introduced to the basic concepts which unify all biological sciences.
2. will be given experience in organizing and studying problems utilizing the scientific method.
3. will develop a respect for and appreciation of life in its various forms.
4. will become aware of the diversity found among living things. Specific behavioral objectives for each module are listed in the student workbook.

ATTENDANCE

Students are urged to be present and punctual for all classes. In the event of absence, for any reason, the student is solely responsible for the information missed.

Additional Help

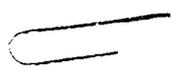
Tutoring is available in the Biology section of the Alternate Pathway Learning Center (in the Library). In addition, the APLC is well equipped with A-V materials designed to assist you to understand the material presented in class. Students are urged to take advantage of the services offered in the APLC. The Biology hours are as follows:

Mon. - Thurs	8:00 a.m. - 3:00 p.m.
Fri.	8:00 a.m. - 3:00 p.m.
Sat.	9:30 a.m. - Noon

In addition, your instructor is available and willing to help you with the material.

Assignments

Students are to answer all the questions in their Workbook. The answers can be checked in the APLC.



COURSE OUTLINE

Module	DATE	
	M - W - F	T - Th.
13.01 Mitosis	Jan. 21 - 23	Jan. 22 - 24
13.01 Meiosis	Jan. 25 - 28	Jan. 29
14.01 Mendelian Genetics	Jan. 30 - Feb. 1	Jan. 31
14.02 Classical Beyond Mendel	Feb. 4 - Feb. 6	Feb. 5
14.03 Molecular Genetics	Feb. 8 - 11 - 13	Feb. 7 - 12
Test I	Feb. 15	Feb. 14
15 Plant Development	Feb. 18 - 22	Feb. 21
15.01 Animal Development	Feb. 21 - 27	Feb. 21 - 26
16 Evolution	Feb. 29 - Mar. 3	Feb. 28
17.01 Ecosystems	Mar. 5 - 7 - 10	Mar. 4 - 6
Test II	Mar. 12	Mar. 11
17.02 Populations	Mar. 14 - 17	Mar. 13
17.03 Intersp. Interactions	Mar. 19	Mar. 18
17.04 Biotic Comm.	Mar. 21 - 24 - 26	Mar. 20 - 25
18 Classification	Mar. 28	Mar. 27
19 Viruses and Monera	Mar. 31 - Apr. 2	Apr. 1
20.01 Thallophyte	Apr. 9	Apr. 8
Test III	Apr. 11	Apr. 10
20.02 Embryophyta	Apr. 9 - 16	Apr. 15
21.01 Protozoa and Porifera	Apr. 18 - 21	Apr. 17
21.02 Coelenterates and Platyhelminthes	Apr. 23 - 25	Apr. 22 - 24
21.03 Aschelminthes etc.	Apr. 28 - 30	Apr. 24 - 29
21.04 Echinodermata and Chordata	May 2 - 5	May 1 - 6

Appendix XX

October 31, 1979

During the past two years, the Biology Department has spent considerable time and effort in planning the course in which you are now enrolled. In doing this, we have sought student input as a means to evaluate the various components of the course. You please assist us in this process by indicating the degree to which you agree or disagree with the following statements on the various parts of the course. The statements are as follows:

- 5--strongly agree with the statement
- 4--agree with the statement
- 3--am neutral toward the statement (I do not really agree nor disagree)
- 2--strongly disagree with the statement
- 1--strongly agree with the statement

Objectives in the Handbook:

1. I read the objectives for the course.	30%	46%	12%	5%	2%
2. The objectives help me understand what I should study.	40%	38%	15%	5%	1%
3. The objectives help me pass the quizzes and tests.	24%	35%	27%	10%	3%
4. The objectives group too many ideas together. It would be better if they were split up into more objectives covering single ideas.	9%	23%	26%	26%	15%
5. The objectives are a complete waste of paper - they should be eliminated.	1%	5%	9%	15%	70%

OTHER COMMENTS ON OBJECTIVES:

Some Comments on the Handbook:

6. I found the book a bit difficult to read.	4%	4%	3%	2%	1%
7. The book is a good reference for the course.	2%	36%	24%	4%	8%
8. The book is a good reference for the course.	3%	3%	3%	2%	2%
9. The book is a good reference for the course.	3%	3%	3%	2%	1%
10. The book is a good reference for the course.	14%	16%	31%	31%	8%
11. The book is a good reference for the course.	0%	6%	21%	36%	36%
12. The book is a good reference for the course.	1%	4%	7%	15%	73%
13. The book is a good reference for the course.	1%	4%	7%	15%	73%

Some Comments on the Handbook:

14. The book is a good reference for the course.	15%	25%	2%	1%	1%
15. The book is a good reference for the course.	3%	4%	3%	2%	1%
16. The book is a good reference for the course.	3%	3%	3%	3%	1%

Appendix XX (continued)

	8 th	21 st	24 th	26 th	27 th
8. The above three books are to be assigned to students in the following manner:	3	4	3	2	1
9. The above three books are to be assigned to students in the following manner:	4	22	36	17	15
10. The above three books are to be assigned to students in the following manner:	3	4	27	22	21
11. The above three books are to be assigned to students in the following manner:	2	19	26	8	14
12. The above three books are to be assigned to students in the following manner:	10	4	3	2	1
13. The above three books are to be assigned to students in the following manner:	41	36	16	3	3
14. The above three books are to be assigned to students in the following manner:	2	4	3	2	1
15. The above three books are to be assigned to students in the following manner:	33	25	33	4	5
16. The above three books are to be assigned to students in the following manner:	6	4	3	2	1

OTHER COMMENTS ABOUT THE ASSIGNMENT ARE AS FOLLOWS:

18. In a typical college course (three hours per week plus a final) tests are given. In this course, which is assigned to 3 hour-courses is better than. There are two chapters to be done in this course.
19. The tests will be given in multiple choice form for "problems".
20. The tests will be given in multiple choice form for "problems".

OTHER COMMENTS ARE AS FOLLOWS:

There are 1000 students in the class as 53 in

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L. Hunter

Ujepeduy IV

July, 1979

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Appendix V

SOURCE	NUMBER	TOTAL	MEAN	ST. DEV.	GRADE DISTRIBUTION				
					A	B	C	D	F
1954 1955 1956	4	162			29.9%				
1957	2	84			51.1%				
1958 1959 1960	4	182			13.8%	34.1%	54.3%	26.2%	25.1%
1961	2				50.9%				

Appendix XX (continued)

2%

Appendix XXI--Chemistry's Plans for Continuation of Activities after Grant

December 12, 1979

Continuation of the General Chemistry Program after CAUSE

The following represent some suggestions for maintaining a smooth and general chemistry sequence once the CAUSE grant expires. Special emphasis is placed on how new faculty may be easily integrated into the system, how the course may be updated utilizing both faculty and student input, the development of a timetable to insure smooth running of the course, and the maintenance of the Alternate Pathways Learning Center.

I. INTEGRATION OF NEW FACULTY:

1. Initial meetings with faculty already working in General Chemistry, in order to allow new faculty to:
 1. obtain background information on the development of the course and to gain insight as to why we have this type of course rather than a traditionally taught course here at Xavier.
 2. become familiar with course materials--handbook, text, lecture notes, lab manual.
 3. become acquainted with the course structure (lecture, lab, and drill) by running through the "mechanics" on paper. Appendix I.
2. Weekly meetings throughout the semester, of General Chemistry faculty to talk over what is happening in the various parts of the course--what works, what appears not to work, attempting to iron out difficulties and to answer questions as they arise.
3. Timetable for Chemistry 101-102. Appendix II.

II. UPDATING THE COURSE VIA INPUT FROM STUDENTS AND FACULTY:

1. Questionnaire at mid-semester to get a feel for what students are ~~then~~ thinking and feeling about the course, whether or not they are using the supports that are built into the course (handbook, tapes, tutoring services, etc.). The results are tallied, reviewed by General Chemistry faculty, and feedback and/or clarification are given to students by faculty when needed. Appendix III.

- B. Statistics at mid-semester and end of semester. Appendix IV
- C. Weekly meetings of General Chemistry provide a valuable and continuous source of input into the course particularly from new faculty who hopefully begin to feel as though the course is his/her own because of this investment that is made.
- D. Since the material to be covered in the general Chemistry course is determined by the Chemistry Department as a whole, there is a need for periodic input from the Chemistry faculty into the course. As a means to this end, one Chemistry staff meeting in the spring semester of each year might be devoted to reviewing the material in the course, evaluating the objectives and making any additions and deletions that seem appropriate. N.B. Any additions to the course material must be accompanied by the deletion of an equivalent amount of material.

III. Maintenance of the APLC:

- A. The Chemistry department will be represented by one faculty member and one student tutor on the APLC Committee.
- B. Training session for tutors who will be working in the APLC (along with those who work in the drills as learning assistants).

1. Get set of four keys for drill from JWC's Office.
2. Open the door at the far end of the MSL (the one closest to the Quant. Lab).
3. Unlock the file cabinet with tests and the cabinet with the answer books .
4. Count the grade books to see that all four are there.
(If not see me immediately.)
5. Let anyone who wishes take the test start. Remember that people from other drills need a slip to come in.
6. By 15 minutes after the beginning of the drill, everyone has to start taking a test.
7. As soon as everyone starts taking the test, you should:
 - a) write the CHALLENGE QUESTION for the drill on the board and encourage them to work it,
 - b) take roll (AND KEEP IT JUST LIKE YOU DO GRADES),
 - c) complete, sign, and put in campus mail absence slips for Sr. Miriam Francis, (YOU MUST DO THIS, IF YOU AREN'T WILLING TO TAKE THE RESPONSIBILITY WITH THIS JOB, THEN QUIT NOW.)
 - d) Put two bonus problems on the board.
8. The students have 45 minutes to take the test so that by the end of the first hour you should collect everyone's test.
9. As soon as students finish the exam (even if the 45 minutes isn't up), start grading. You should grade all tests as rapidly as possible and be finished by 15 minutes after the end of the first hour. Students should pair up and work bonus question while you grade.
10. Students who get 90% (9 of 10 questions) are free to leave as soon as you record their grade. Remember the +1 point (if applicable). They can take the test with them. Also record bonus point.
11. All other students remain in drill (or are reported as absent). Spend the next 45 minutes (the last 45 of the 2nd hour) going over what they missed. It is better if you get them working in groups. Using the chalk board, etc.
12. At the beginning of the 3rd hour, all who haven't passed a test take another version. Again, they have 45 minutes--with no Challenge question possible.
13. You should spend the last 15 minutes grading the tests, signing slips to attend other drills IF THE STUDENT CAME AND STAYED THE WHOLE TIME IN DRILL.

Appendix XXI (continued)

14. At the end of the period, you should
 - a. make sure you have a record of everyone's progress.
 - b. turn in a list of those behind to Jacinta.
 - c. count and make sure the grade books are all in the cabinet.
 - d. lock the file cabinet and the grade book-cabinet.
 - e. return keys to JWC, have a GOOD STIFF DRINK. GOOD LUCK!
 - f. lock the other door of the MSL.

TIMETABLE FOR CHEMISTRY 101-102

<u>ACTIVITY</u>	<u>DATE (approximate)</u>
Handbook Revisions	Feb. 1
Lab Manual Revisions	Feb. 1
Review/Revision of module tests	Feb. 1
Chemistry Staff meeting to review General Chemistry course material	March 1
Course plans	Beginning of each semester
Questionnaires	Mid-semester
Statistics	Mid and end of semester
Exams Lecture Lab	Dec. 1/ April 15 Dec. 1/ April 15
Ordering of supplies Binders Textbooks	March 1 April 1
Duplication--Printing Office Handbook Lab Manual Final Exams	March 15 March 15 Dec. 8/ April 21
Duplication Module tests Forms	May 31

Appendix XXI (continued)

QUESTIONNAIRE ABOUT GENERAL CHEMISTRY

During the past two years, the Chemistry Department has spent considerable time and effort developing the course in which you are now enrolled. We are now seeking student input as we attempt to evaluate the various components of it. We would like please assist us in this effort by indicating the degree to which you agree with each of the following statements about the various components of the course. The evaluation scale is:

- 5--strongly agree with statement
- 4--agree with the statement
- 3--am neutral toward the statement (i.e. neither agree nor disagree)
- 2--slightly disagree with the statement
- 1--strongly disagree with the statement

Objectives of the Handbook:

	5	4	3	2	1
1. I read the objectives for the modules.....	43	41	16	3	7
2. The objectives help me understand what I should study.....	54	35	6	3	3
3. The objectives help me pass the quizzes and reviews.....	41	43	16	6	4
4. The objectives group too many idea together. It would be better if they were split up into more objectives covering fewer ideas.....	14	6	29	27	22
5. The objectives are a complete waste--eliminate them.....	4	3	11	7	84

OTHER COMMENTS ON OBJECTIVES:

Sample Problems on the Handbook:

6. I work the sample problems in the modules.....	61	34	9	1	0
7. The sample problems are similar to the ones on the module.....	45	34	19	7	1
8. The sample problems help me pass the module tests.....	51	25	7	7	4
9. There are too many sample problems. There should be fewer....	6	7	16	21	51
10. There are not enough sample problems. Add more.....	14	6	34	16	19
11. The sample problems are a complete waste--eliminate them.....	3	3	0	9	80
12. There is no need to leave space to work on the problems.....	6	6	6	7	79

OTHER COMMENTS ON SAMPLE PROBLEMS:

Sample Review Tests in the Handbook

13. I go through the sample reviews in the handbook before Reviews	69	21	4	7	0
14. The sample reviews are similar to the real Reviews.....	46	33	11	9	3
15. The sample Reviews are good. They should be retained.....	63	21	7	4	0

OTHER COMMENTS ON SAMPLE REVIEWS:

Alternate Pathways to Learning:

16. I go to the APLC often to study Chemistry.....	34	34	21	7	4
17. The APLC is a benefit to Chemistry students at AU.....	50	20	11	8	0

18.	I use the taped lectures often.....	15	10	10	10	39
19.	The taped lectures help me learn the material in the modules..	25	25	20	?	39
20.	I use the Chemistry tutoring services in the APLO often.....	10	10	39	5	39
21.	The Chemistry tutoring in the APLO is good. The Chemistry tutors helpful and available when they are scheduled to be.....	25	25	1	?	5
22.	I use my General Chemistry Handbook often.....	75	15	3	3	31
23.	The Chemistry Handbook helps me. I am getting a better grade than I would get if it weren't available.....	60	25	5	?	0

OTHER COMMENTS ABOUT THE ALTERNATE PATHWAYS TO HELP YOU LEARN:

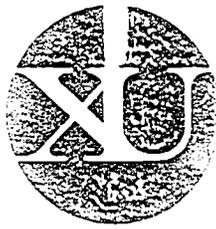
Chemistry's individualized system of Teaching:

In addition to the Handbook, tapes, tutoring, etc., the General Chemistry course is "individualized" with lots of small tests, instant grading, optional points, etc. The following considers a number of these.

24.	I have more contact with instructors in General Chemistry than in other courses. (Remember that it is "team taught" with Carmichael, Wells, and Williams involved in various roles.).....	40	20	15	0	10
25.	I like the system because I can re-take tests on which I do poorly.	75	20	5	0	3
26.	Module tests are easier than those in regular courses because each covers less material.....	30	25	20	5	10
27.	I like being able to use calculators on the tests.....	65	15	10	0	0
28.	I like knowing exactly what will be on each test. It makes it easier to study.....	60	15	20	3	0
29.	I like "instant grading" of module tests.....	80	15	5	0	0
30.	The course is structured such that I got to know other students rapidly and hence was able to benefit from mutual experiences such as borrowing notes, discussing problems, passing answers on tests, etc.	50	10	15	3	10
31.	I learn more in Chemistry taught this way than I would have in a course taught in the traditional manner.....	5	25	?	0	0
32.	I spend more time studying Chemistry than I think I would have if the course had been taught traditionally.....	40	20	20	10	6
33.	I study for this course to learn the material rather than just for a test.....	40	30	20	0	25

Appendix VIII (continued)

- 14. There is less pressure on me while taking an exam in General One than there is in taking a traditional "hour exam" because I know I can re-take it..... 49
- 15. I like the fact that I can make up missed classes by enrolling in "middle"..... 70
- 16. I like the fact that I know exactly how many credits I need for a "4" in advance so that I can work toward that grade all the time..... 80



Louisiana State University of Louisiana

3101 ORLEANS, B. LOUISIANA 70002 TELEPHONE 504-388-1000

To: Dr. J. W. Carmichael, Director of the NSF-UISE Project

From: Dr. W. Jones, Jr., Mathematics Representative of the UISE

Date: November 30, 1979

Re: Continuation of the mathematical portion of the UISE Project

When Dr. Jones' NSF-UISE proposal of 1979 was written the mathematics department, as well as the other science departments, agreed to continue the proposed program after NSF funding ended. The mathematics portion of the grant was aimed at providing a coordinated, standardized approach to the teaching of Precalculus and Introductory Calculus. In order to maintain this coordinated approach, the department has chosen to have the chairman appoint each semester a course leader for each of Precalculus and Introductory Calculus who will supervise these courses.

Furthermore, in order to coordinate the other subsection courses in the department, a section leader will be appointed for them also. This decision points out the responsiveness of our department to new ideas and our will to go on not only to maintain the NSF-UISE program but to apply its good ideas to other courses as well. The duties of the course leaders are detailed in the following appendix.

All aspects of the continuation of the UISE program were discussed in our staff meeting of November 29, 1979. The decisions were reported in our staff minutes, an excerpt of which is included in an appendix to this memo.

WJL:jj

Committee of Instructional Methods
Department of Mathematics, University of Illinois

Recommendations

1. Staff member present:

1. The department's resources for conducting the activities to be held by APLO are available:

Maintenance of course materials

Course leaders will be designated each semester for all multi-section courses, in addition to Precalculus and Introductory Calculus. These course leaders will serve as coordinators of the various sections. Their duties are given in detail on an accompanying memo. The course leaders for Spring 1980 will be: Math Review - Dr. Fantova; Math 1010 - Mr. Turner; Math 1020 - Sr. Eileen; Math 1030 - Dr. Imbeck; Math 1040 - Mr. Bill Jones.

Integration of new faculty into the department

2. New faculty will be integrated into the system via weekly departmental meetings and by the course leaders of the courses they are teaching. Course leaders are expected, therefore, to actively seek the opinions of the new faculty concerning the courses, as well as informing these new faculty of the history of the development of the courses.

Maintenance of data collection and processing course evaluation

3. The course leaders are responsible for collecting the data and disseminating the results of the evaluation to the departmental faculty. These duties are detailed on an accompanying memo.

Maintenance of course syllabi

4. Mr. Jones will have the responsibility for seeing that the course syllabi for Math Review, Precalculus and Introductory Calculus will be printed and made available for the students to purchase. This procedure is to be detailed on an accompanying memo so that, if necessary, someone else could carry this out.

Maintenance of APLO activities

5. The chairman will appoint an APLO Director who will insure that the activities of the Mathematics area are effectively and efficiently carried on. This includes selecting the tutors, overseeing the tutoring, updating the list of alternate pathways as new materials come in, representing the department on the APLO committee, and other duties as the chairman sees fit to assign.

DUTIES AND RESPONSIBILITIES OF COURSE LEADERS
IN THE DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

Each course leader is expected to:

1. Prepare a day-by-day outline for the semester detailing the material to be covered each class meeting and provide a copy to each instructor.
2. Meet with the other teachers individually or in groups on a regular basis to coordinate the teaching and provide a forum for discussion of the content of course, textbook, alternate pathways, etc.
3. Prepare in conjunction with the other teachers of the course a common final examination for the course.
4. Collect copies of each instructor's hour exams as well as a copy of midterm grades and final grades.
5. As soon as possible after mid-term, compute a grade distribution for each section as well as for the combined group. This grade distribution should show the percentage of students making at least a C and those making below a C. Also a student-attitude question should be distributed to all sections and the results tabulated.
6. At the end of the semester, collect a copy of class roll from each section's instructor containing name, final exam score, (plus standardized test score, if a standardized test is given), and final course letter grade for each student. Each instructor is to submit class average on the final exam (plus standardized test, if any is given) and grade distribution for his or her section.
7. Calculate over all average on final exam (plus average on any standardized test given) and overall grade distribution. This data is to be recorded on the course leader report form (see appendix) and placed in the departmental files. This information to be recorded on the department's master sheet in the departmental file.

Appendix (XII) Copy of used

NAME OF AGENCY

ADDRESS OF AGENCY

CITY AND STATE

NAME OF INSTRUCTOR

ADDRESS OF INSTRUCTOR

CITY AND STATE

NAME OF COURSE

MIDTERM

NUMBER OF STUDENTS

NUMBER OF TESTS

GRADE

CC

APPENDICES TO BE ATTACHED TO THIS FORM:

- 1. ²⁰ copies of each form of KU common exam
- 4. instructor's reports from each section
- 5. results of midterm student-attitude questionnaire
- 1 2 Copy of day-by-day outline given to instructor

2 copies of each instructor's report

COMMENTS (include any other pertinent information about the course and/or any other data collected or parameters computed.)

INSTRUCTOR'S SIGNATURE

QUESTIONNAIRE ABOUT PRE-CALCULUS

FALL SEMESTER 1979

During the past two years, the Mathematics Department has spent considerable time and effort developing the course in which you are now enrolled. We are now seeking student feedback in an effort to further improve it. Would you please assist us by indicating the degree to which you agree with each of the following statements about the various components of the course by circling the number corresponding to your attitude about the statement. The evaluation scale is:

- 5 -- strongly agree with the statement
 4 -- agree with the statement somewhat
 3 -- am neutral toward the statement
 2 -- slightly disagree with the statement
 1 -- strongly disagree with the statement

<u>Objectives in the Handbook:</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>
1. I read the objectives often.	22%	38%	20%	14%	7%
2. The objectives help me understand what I should study.	34%	28%	18%	14%	6%
3. The objectives help me pass the quizzes and reviews.	23%	26%	23%	27%	9%
4. The objectives group too many ideas together. It would help if they were split up into smaller ideas.	11%	13%	31%	23%	21%
5. The objectives are a complete waste of paper. I vote they be eliminated from the handbook next year.	5%	3%	7%	9%	77%

Comments:

Sample Problems in the Handbook:

6. I work the sample problems.	54%	30%	10%	3%	1%
7. The sample problems are similar to the ones in the test.	43%	30%	11%	9%	2%
8. The sample problems helped me pass the test.	44%	23%	16%	7%	4%
9. There are too many sample problems. It would be easier to focus on what is important if there were fewer.	5%	7%	11%	28%	44%
10. There are not enough sample problems. I find it difficult to work test questions because the sample problems didn't provide enough practice.	11%	7%	20%	32%	29%
11. The sample problems are complete waste of paper.	4%	1%	3%	9%	82%
12. The sample problems are helpful, but I vote to get rid of the space to work them in the handbook.	6%	6%	11%	11%	67%

Comments:

Sample Tests in the Handbook:

- | | | | | |
|--|----|----|----|----|
| 13. I go through the sample tests in the handbook before the real test. | 71 | 17 | 1 | 1 |
| 14. The problems on the sample test are similar to those on the real tests my instructor gives in class. | 42 | 32 | 11 | 11 |
| 15. The sample tests are a good part of the course. I vote to keep them. | 11 | 33 | 4 | 18 |

Comments:

Alternate Pathways to Learning:

- | | | | | | |
|---|-----|-----|-----|-----|-----|
| 16. I go to the APLC often to study mathematics. | 14 | 117 | 187 | 21 | 34 |
| 17. I use the taped lectures often. | 8 | 10 | 18 | 4 | 17 |
| 18. The APLC is a benefit to science students at Xavier. | 48 | 23 | 13 | 27 | 6 |
| 19. The taped lectures help me learn the material in the modules. | 123 | 107 | 40 | 11 | 213 |
| 20. I use the tutoring services in the APLC often. | 217 | 177 | 207 | 147 | 377 |
| 21. The mathematics tutoring in the APLC is good. The mathematics tutors are helpful and available when they are scheduled to be. | 147 | 167 | 46 | 8 | 114 |
| 22. I bought the Handbook for this course. | 367 | 67 | 27 | | 67 |
| The Handbook helps me. I am certain I have a better grade than I would have if it weren't available. | 43 | 227 | 19 | 9 | 6 |

Comments:

Miscellaneous:

- | | | | | | |
|--|----|-----|----|---|---|
| 24. Having a Handbook with taped lectures is worth the price I paid for the Handbook. | 34 | 217 | 37 | 6 | 3 |
| 25. My instructor makes sure that we use the Handbook by reminding us of the sample problems, sample tests, etc. and by using the Handbook to guide the lectures in class. | 69 | 21 | 3 | 3 | 1 |

Appendix XXII (continued)

26.	In a typical college course, only 3 or 4 tests (plus a final) are given. In this course, there will be 6 tests (plus a final). Having a greater number of tests is better.	65	19	9	8
27.	I like being able to use calculators in the tests.	41	17	33	7
28.	I like knowing exactly what will be on each test. It makes it easier to study.	64	15	11	10
29.	I got to know other students in the course and was able to benefit from mutual experiences (borrowing notes, discussing problems, etc.).	22	28	31	19
	I learn more in Mathematics this way than I would have in a traditional Mathematics course.	38	27	20	15
31.	I spend more time studying Mathematics taught this way than I would have if it were taught traditionally (without a Handbook, tapes, etc.)	30	24	26	12
32.	I study for this course to learn the material rather than just pass a test because I know the final is going to be a killer.	44	24	18	14
33.	I do not need the Handbook for this course because I know the material already.	17	6	16	58
34.	I do not need the handbook for this course because it does not follow what my instructor does in class.	31	1	8	60

Comments:



Xavier University of Louisiana

NEW ORLEANS, LOUISIANA 70125. TELEPHONE (504)486-7411

College of Arts and Sciences

TO: Dr. JW Carmichael, Director of NSF-CAUSE Project,
Xavier University of Louisiana

FROM: Harold A. Vincent, Physics/Pre-Engineering Department
and CAUSE Committee Representative

DATE: January 23, 1980

SUBJECT: Continuation of the Physics Portion of the CAUSE Project

When the Xavier University CAUSE proposal of 1978 was written, the Physics/Pre-Engineering Department agreed to continue the proposed program beyond the period funded by the NSF. At the time that the project was funded, a single faculty member taught the lecture classes directly affected by the project, and one same person and one other were responsible for the laboratory classes affected. With the increase in the numbers of students enrolling in these courses and, hence, the increase in the number of class sections and faculty teaching them, it is necessary to establish a written departmental policy on the continuation of the physics component of the CAUSE project.

Maintenance of Coordinated Approach

- 1) The Department Chairman will designate, in the spring semester, course leaders who will be responsible for coordinating course activities and schedules during the following school year. One course leader will be named for the lecture sections of Physics 2010-20 and one for their laboratory complements, Physics 2010-20LB.

Each course leader is expected to:

- a) prepare syllabi for the courses
- b) arrange a schedule (when) and plan (what is included) for quizzes, tests, examinations, homework assignments and (laboratory) exercises.

- c) meet with the teachers of the various sections individually or in groups on a regular basis to coordinate the teaching and provide a forum for discussion of contemporary problems of the courses.
- d) prepare, in conjunction with the teachers of the other sections, a common final examination.
- e) collect copies of the teachers' quizzes and tests and midterm and final grades.
- f) As soon as possible after midterm, compute a grade distribution for each section as well as for the combined group. The distribution should show the percent of students making a C or better and that of the students making below a C. Also, a student attitude questionnaire (already prepared) should be completed by students in all sections and the results tabulated and distributed to the teachers.

Integration of
New Faculty into
Departmental
Systems

- 1) In pre-hiring discussions, the Department Chairman will describe to the prospective faculty member the physics component of the CAUSE project.
- 2) In initial meetings with the newly hired faculty, the department's CAUSE coordinator will provide background information on the development of the general physics course, and the accomplishments to date.
- 3) The new faculty member will be given a Physics Manual so that he/she will become familiar with its content materials. An explanation of how the materials are used in the course will be provided.
- 4) Special attention will be devoted to ensuring that the new faculty member understands the objectives and mechanics of the Piagetian-based laboratory exercises.
- 5) The new faculty member will be given a tour of the Alternate Pathways Learning Center, with a discussion of tutoring, computer terminals, filmstrips and tape cassettes, and the grading machine.
- 6) Weekly meetings will be held by teachers of the general physics course in order for each to be made aware of what is happening in the various parts of the course -- what is working, what appears not to be working, attempting to correct the difficulties and answering questions as they arise.

Main Place of
Data Collection
and Course Evaluation

The course leaders are responsible for collecting data and disseminating the results of the on-going evaluation conducted around the midterm of the semester. The Department Chairman will be responsible for the end-of-course evaluation.

Appendix XXIII (continued)

Maintenance
and Revisions of
Physics Manual

- 1) Professor Vincent will be responsible for revisions of the Physics Manual. Additions, deletions and alterations should be agreed upon by department faculty and submitted to Prof. Vincent for inclusion in the manual.
- 2) The Department Chairman will be responsible for ordering and having available (in the bookstore) on the first class day of the fall semester the appropriate number of manuals.

Maintenance of
APLC Activities

The Department Chairman will appoint an APLC coordinator, who will ensure that the activities of the Physics area are effectively and efficiently conducted. These include selecting tutors, arranging the tutoring schedule, monitoring of tutoring activities, keeping current the list of APLC learning materials, representing the department on the APLC Committee, selecting a student representative on the APLC Committee, and other duties deemed necessary by the chairman.

COURSE LEADER'S REPORT

COURSE: PHYS. _____ SEMESTER _____ COURSE LEADER _____

MEAN ON XU EXAM _____ MEAN ON STANDARDIZED EXAM _____

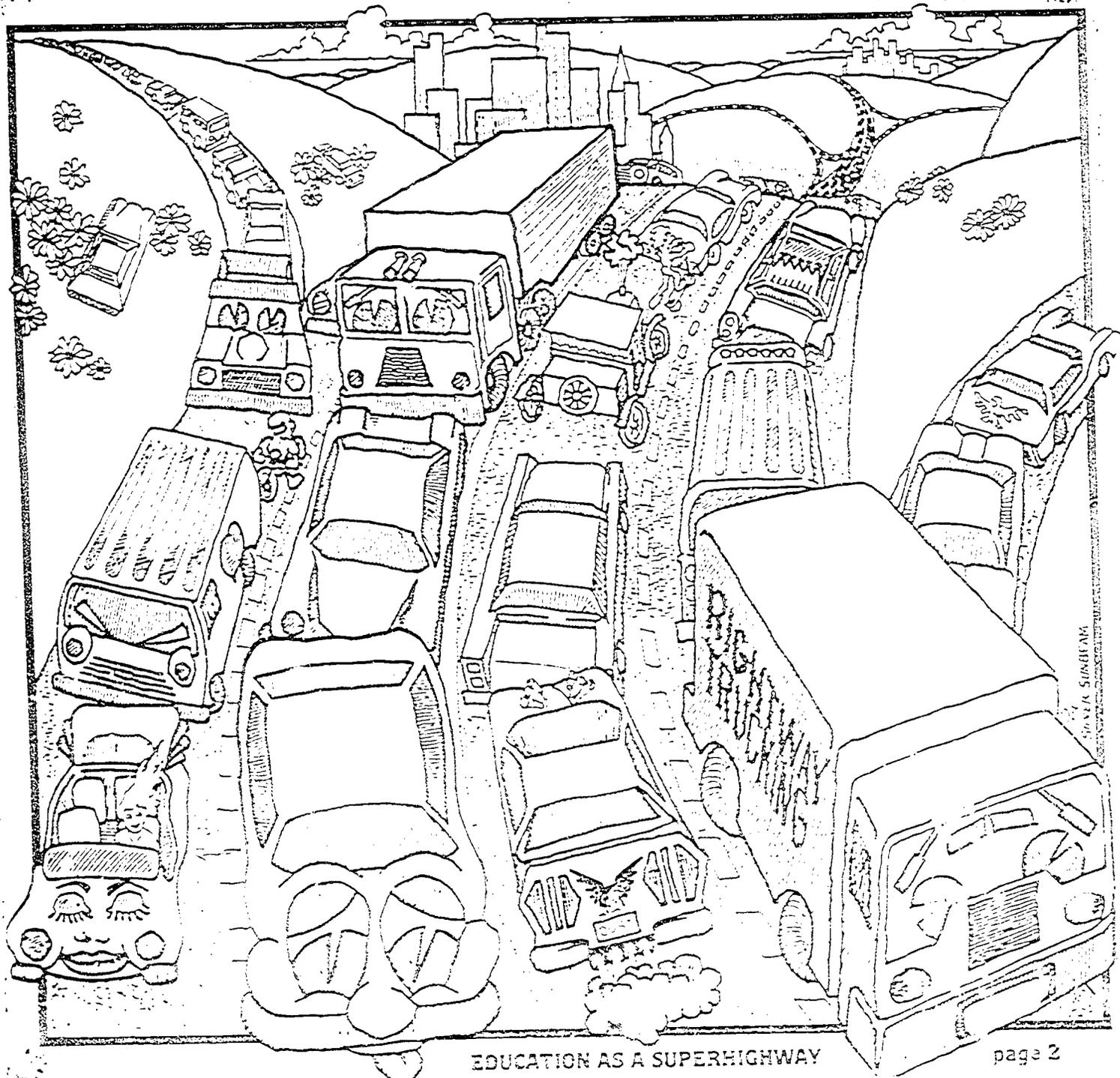
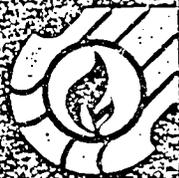
STUDENTS TAKING XU EXAM _____ STUDENTS TAKING STANDARDIZED EXAM _____

NUMBER _____ PERCENT _____ NUMBER _____ PERCENT _____

GRADE	GRADE DISTRIBUTION			
	MIDTERM		FINAL	
	NUMBER	PERCENT	NUMBER	PERCENT
A				
B				
C				
D				
F				
W				
I				

Journal of Developmental & Remedial Education

Winter 1979
Volume 3, Number 2



EDUCATION AS A SUPERHIGHWAY

Appendix XXIV (continued)

chemistry course. In addition, students are often required to do extra work outside of class, such as reading, writing, and laboratory work.

5. Minimizing Procrastination

PSI allows students to bring their own ideas. However, procrastination is often continued by students who do not indicate that they are doing so. The program in determining the PSI of the educational institution is not perfect. There are many things that can be done already, all of which are being done. The effort has been made to make the PSI a more effective educational tool. The program is being revised to make it more effective.

First, students should be encouraged to do more work outside of class.

Second, students should be encouraged to do more work outside of class. The program is being revised to make it more effective. The program is being revised to make it more effective.

Third, students should be encouraged to do more work outside of class. The program is being revised to make it more effective. The program is being revised to make it more effective.

6. Reduce the amount of time spent in class

The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

7. Increase the amount of time spent in class

The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

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The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

8. Special Tutoring Directed Toward Building Self-Confidence. Students in the program are encouraged to do more work outside of class. The program is being revised to make it more effective. The program is being revised to make it more effective.

9. Final Exams Demand High Level of Performance but are Repeatable. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

10. Final Exams Demand High Level of Performance but are Repeatable

The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

11. Special Tutoring Directed Toward Building Self-Confidence

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Xavier employs a special grading system which allows students to do more work outside of class. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

12. Extensive Out-of-Class Tutoring Offered

The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

13. Piagetian-based Laboratory Sequence

The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

14. Student Evaluation and Performance

The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective. The program is being revised to make it more effective.

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at Navit, the "insider" faculty at Navit's SVA. We discuss a series of interesting Navit:

2. The percentage of students completing the two-semester sequence has increased from 30% to 60% (the median) within the latest phase of development to more than 65% at present.
3. Students in general chemistry have consistently rated the course highly in a University-wide course evaluation program. In addition, a department-administered questionnaire indicated that 55% of the students used general chemistry even though they felt they worked harder in the present course than they would have in a traditional one. The compensating factor was apparently the fact that they felt they also learned more than they would have in a traditional course.

Conclusion

Navit's general institutional philosophy of "standards with sympathy" has been translated into a general chemistry sequence which maintains high requirements for completion while supporting a number of teaching techniques designed to assist the student to reach the expected level of performance. These techniques, derived from an empirical tradition, have made the course more accessible to the traditionally disadvantaged and, as a result, have, with an increase in performance in general chemistry from the sequence. The other science departments at Navit are also expanding their efforts to find new teaching techniques with special emphasis on learning analytical reasoning. Studies of other institutions, Peleg and Adler, 1977; Sadler, 1979, suggest that student performance in chemistry may improve if the present two-semester courses are replaced by a single semester course. Peleg and Adler's methods to teach general chemistry were aimed at teaching skills.

With the help of the authors, we have prepared a list of references for the interested reader.

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Mary Ann Ryan
Donald Robinson
and JW Carmichael, Jr.¹

Navier University, The University
New Orleans, LA 70126

A Piagetian-Based General Chemistry Laboratory Program for Science Majors

Over the past few years, considerable attention has been given to the development of instructional materials and its implications for the science teacher. Of particular interest is the possibility that the theory provides a basis for formulating instructional strategies which would encourage the development of conceptual understanding. Piaget's formal operational level of cognitive development makes the sciences more accessible to the majority of students engaged. An excellent resource paper also reviews the literature concerning these and related concepts employed in this *JCE* program (1).

As a part of an effort to explore new methods of instruction, the major emphasis on increasing attention from entry level science courses in 1977, the science departments at Navier began a multi-track instruction in New Orleans. The first of these programs was developed and field tested. The second program for us (this effort led to the development of another departmental courses, two each from Biology, Chemistry, and Physics, Mathematics, and Physics, respectively) is a "learning cycle" (2). Subsequent field testing of these courses for two years in a pre-freshman level of general science courses. Through SOAR (Stress On Active Learning) has indicated that their use produces statistically significant improvement in SOAR participants. The appropriate learning activities believed to be most effective in this program, but not yet possible to measure, that this improvement is accompanied by a corresponding increase in student performance on entry level science courses.

When entering that a six-week summer program normally for the first six weeks of the normal academic year, over it and the other science majors were allowed to attend in 1979, the first semester at Navier also began formulating laboratory experiences similar to those in SOAR for use in its program of multi-track instruction in science majors. The first stage of this effort, spurred on by the apparent success of SOAR, has now been completed. A full, two-semester sequence of experiments in the learning cycle format has been developed and has been in use in the general chemistry laboratory for the past several semesters, beginning in 1978. This paper will discuss various aspects of the new program for the general chemistry laboratory, learning methods of application, and the implications of the traditional instruction framework. The following paragraphs are of the program, which is somewhat different from the traditional laboratory program.

An Overview of the General Chemistry Laboratory Program

The traditional laboratory program in general chemistry is designed to provide the student with a series of experiments which are designed to illustrate the concepts of general chemistry. The student is given a list of experiments to perform, and the instructor provides the necessary equipment and materials. The student is expected to perform the experiments and to record the results. The student is also expected to write a report on the results of the experiments. The traditional laboratory program is designed to provide the student with a series of experiments which are designed to illustrate the concepts of general chemistry. The student is given a list of experiments to perform, and the instructor provides the necessary equipment and materials. The student is expected to perform the experiments and to record the results. The student is also expected to write a report on the results of the experiments.

The new program is designed to provide the student with a series of experiments which are designed to illustrate the concepts of general chemistry. The student is given a list of experiments to perform, and the instructor provides the necessary equipment and materials. The student is expected to perform the experiments and to record the results. The student is also expected to write a report on the results of the experiments.

stressed skills and verification of chemical principles with detailed explanation and instruction at every step. This approach appeared to be very good for teaching laboratory skills and was effective, for many students, in teaching, reinforcing, a variety of chemical principles and calculations of value. However, because traditional experiments primarily required verification of ideas which had already been spelled out in detail at the outset of the experiment, they provided little opportunity for the educationally disadvantaged student to gain experience in "doing science" or to develop the ability needed to analyze data for solve problems of a general nature. Therefore, because the success of SOAR indicates that experiments in the "learning cycle" format potentially enable educationally-disadvantaged students to overcome deficiencies, the chemistry department chose to initiate its current laboratory program—a full, two-semester sequence of "learning cycles."

Generally, laboratory experiments in the learning cycle format place more emphasis on learning by doing than is the case for traditional verification experiments. Each learning cycle consists of three phases: *exploration*, *invention*, and *application* (discovery). The phases, and what occurs in each during a laboratory period at Navier, are described briefly below.

In the first of these phases, exploration, the student is allowed to interact with concrete materials to acquire information about a given chemical or physical system with a minimum of guidance. The student is given only a brief introduction to needed laboratory skills, a review of safety precautions, and such general guidelines as are necessary to establish sufficient limits to ensure that the experiment can be completed during a 3-hr laboratory period. *NO* theoretical introduction is given and the student is *not* given any prior information about what relationships to seek. Whenever practical, individual students (or groups of them) are allowed to determine pertinent variables for the system. The instructor seldom attempts to eliminate extraneous factors (and often *purposely* introduces them), and students are allowed to make non-dangerous mistakes without interference. The student would normally complete this activity by the midpoint in the laboratory period. If this is not enough time to collect the amount of data needed for the desired analysis, an individual's data would be pooled (that from "another laboratory section" (careful) collected by the instructor) or with that from classmates.

In the second phase, invention, the student is asked to analyze the data gathered during exploration. As appropriate, analysis might include seeking relationships between variables, making generalizations from these relationships, constructing graphic presentations, and developing an empirical equation which describes the relationship mathematically. As in the previous phase, the instructor does not tell the student merely to verify a known answer but rather asks questions which guide the student to develop a logical analysis of the data. In addition, the instructor does not encourage the student to do a generally unimportant result (such as the relationship between height and volume of a cylinder in an experiment designed to emphasize density) but instead encourages them to investigate to see what other relationship might exist. Students are actively encouraged to work together in pairs or groups in the invention phase. In addition, the instructor should encourage the student to work with the

Acknowledgment

ACKNOWLEDGMENT is gratefully made to the National Science Foundation, Office of Biological Services, and UM/SE (UM/SE) for their generous support of the project. The support of the National Science Foundation is gratefully acknowledged.

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Project SOAR

(Stress On Analytical Reasoning)

J. W. Carmichael, Johnette Hassell, Jacqueline Hunter, Lester Jones,
Mary Ann Ryan, and Harold Vincent

IN RECENT YEARS, there has been considerable interest in Piaget's theory of intellectual development and its implications for teaching science in high school and college (Renner and Lawson 1973; Lawson 1975; Beitel 1975; Piaget 1973). This article describes a Piagetian-based summer program, Project SOAR (Stress On Analytical Reasoning), for natural, health and mathematical science majors. The program was jointly developed and is conducted by the Departments of Biology, Chemistry, Computer Science, Mathematics and Physics at Xavier University of Louisiana. Its overall goals is to increase performance in and reduce attrition from science and mathematics courses and consequently to increase the number of qualified graduates in these areas. The program is a direct outgrowth of the University's primary institutional goal to provide educational opportunities to black Americans. Xavier University of Louisiana is a small, predominantly black institution located in the approximate geographic center of the city of New Orleans. In 1978-79, 85% of the total enrollment of approximately 1,600 was black, and more than 40% of the students were a natural, mathematical, or health science majors.

Piaget's Theory and Its Implications

According to Piaget's theory, individuals progress through definite stages of intellectual development and are limited in what they are capable of comprehending while in each stage. Only upon reaching the highest level of development, the formal operational stage, does an individual acquire the ability to reason with concepts, relationships, abstract properties and generally to use thinking processes in situations where one does not deal with tangible objects. The importance of this theory to those interested in mathematics and science education

becomes evident when one considers that as much as 50% of the college freshmen in the United States can only function at the concrete operational level (McKinnon and Renner 1971; Kolodiy 1975) and that much of the content of mathematics and science requires, by its very nature, formal reasoning (Herron 1975; Baum 1976). Piaget's theory, then, makes it possible to better understand what is meant by the common complaint (of faculty) that many students lack problem-solving skills.

Further, according to Piaget, learning occurs, not upon the individual's being told of the detailed implications of an idea, but rather as the individual actively analyzes a problem situation, considers tentative solutions, evaluates their effectiveness, and then tries new approaches when the first ones are not successful. It thus appears that science and mathematics instruction would better serve students who lack problem-solving skills if organized so as to confront students with concrete problems and meaningful inquiries *before* moving to abstract ideas. Furthermore, since Piaget also suggests that individuals capable of formal thought revert to concrete operational reasoning when encountering new material, it would appear that even the formal thinkers (supposedly those successfully completing the courses) would also benefit from such an approach. One study has verified this conclusion (Sheehan 1970).

A particularly promising format suggested for use in teaching to promote intellectual development is the three-part "learning cycle" consisting of exploration, invention, and application (Karplus 1974). In the exploration phase, the student is allowed to interact with physical materials with a minimum of guidance so that new information can be acquired that does not fit the existing mental framework. The student is not told exactly what to look for, but rather is asked to investigate a particular problem in an open manner. In the invention phase, the student attempts to analyze the data gathered in the previous phase. The instructor encourages the student to organize the data, to form hypotheses, and to look for inconsistencies, thus providing an opportunity for the student to build, destroy, and rebuild reasoning patterns. In the application phase, further experimentation and analysis

This article was written by the members of the Project SOAR staff, Xavier University of Louisiana 70125. Staff members include: J. W. Carmichael, professor, Chemistry Department; Johnette Hassell, associate professor, Computer Science; Jacqueline Hunter, assistant professor, Biology Department; Lester Jones, assistant professor, Mathematics Department; Mary Ann Ryan, assistant professor, Chemistry Department; and Harold Vincent, associate professor, Biology Department.

<u>Discipline</u>	<u>Short Description of Learning Cycles</u>
Biology Chemistry Computer Science Mathematics Physics	Environmental factors which determine open-circuit voltage in a cell Variables which determine the rate of the iodine clock reaction Factors which determine survival in a computer simulation Control of numerator and denominator for comparison of fractions Study of two systems which exhibit periodic motion
Biology Chemistry Computer Science Mathematics Physics	Proportional representation of geological eras Relationship between amount of reactant & product if Mg is burned Relationship between the length of shadow and the height of object Construction of paper triangles to yield trigonometric ratios Study of force required to move objects of varying masses
Biology Chemistry Computer Science Mathematics Physics	Effect of simulated Martian environment on pillbugs Identification of chemicals with missing labels Learning to flowchart through permutation of steps Study of numbers of geometric figures obtainable on a pentagon Combinations of switches which will ring a bell
Biology Chemistry Computer Science Mathematics Physics	Knives, forks, and spoons to simulate chromosomes in meiosis Sampling as a means of estimating the number of beads in a jar "Craps" played on an interactive computer terminal Loaded dice yield probability as a prediction number Octahedral and cuboctahedral dice simulate radioactive decay
Biology Chemistry Computer Science Mathematics Physics	Effect of hormones on physical characteristics of Euglenae Concentration versus length of time to react Simulation of battles investigating variables pertinent for victory Graphing of scattergrams and determining strength of linear fit Relationships between variables in simple DC circuits

are used to encourage, refine, and enlarge the understanding of a concept that helps to stabilize the newly modified mental framework. The entire process might be termed a "concrete approach" because it introduces concepts at a concrete level before considering abstract relationships.

This article describes one part of a major project to determine the coordinated, multidisciplinary, concrete approach which will attract attention from entry-level science and mathematics courses. Chappetta (1976) has recently completed a review of related studies. Of particular interest are two previous pilot studies organized totally as a Project SOAR-based course over a summer program (McKinnon, 1976) and a one-semester academic year project (Trotter, Koss, and Hest, 1978). These projects differ markedly from Project SOAR, however, in that neither directly emphasized specific components of problem solving.

Description of Project SOAR

The Project SOAR model consists of a sequence of learning cycles to research in depth an aspect of mathematics, natural or social sciences, which promotes solving among the students the problems related to that aspect. The term "learning cycle" is further defined

SOAR is the first phase of a projected program that will introduce Piagetian components into entry-level mathematics and science courses for majors in the involved disciplines. When completed, the total program will encompass approximately one half of the course load of science and mathematics majors during the first two years at the University. Contemplated development is intended to supplement, not replace, existing tutorial and developmental programs. The present investigation assesses the interim progress of the program.

The core of Project SOAR consists of twenty-five, three-hour laboratory experiments (five from each of the participating disciplines) that stress five of the major components of problem solving: control of variables, proportional reasoning, probabilistic reasoning, combinatorial reasoning, and recognizing correlations. Each experiment presents a real problem from one of the disciplines and requires the use of the desired component of problem solving to obtain a reasonable solution. The components of each experiment complement the content of the corresponding entry-level course. The author of each experiment organized it into the learning cycle format and modified it until the rest of the authors of this paper agreed that it was suitable with respect to maintainability

...to encourage problem solving, and to increase student interest.

During the three week program, the participants in Project SOAR were randomly divided into five groups. Each group completed two experiments per week. By the end of the program, the groups had completed five experiments. Each student attended to develop the given activity structure for that week, but in a different setting. Faculty members were assigned to the various experimental sessions so as to maintain a student faculty ratio of approximately 7:1. Prior to the program all faculty members completed a training program in Piagetian based science teaching using readily available materials (Harris 1977). Because of the low student to faculty ratio, the three hour time period for each laboratory session was possible to give each student as much individual attention as was desired each day. Laboratory activities were carefully designed to encourage the student to predict, test, and examine them, form hypotheses, defend them, discuss them with peers, seek inconsistencies, make corrections, etc. Care was also taken to ensure that the students understood that the object of each experiment was to obtain an answer, a logically consistent one, the data collected, not an accepted, "correct" one. Thus, most student inquiries directed to instructors were more than direct answers. The instructor generally responded with encouraging comments or open-ended questions placed on the papers. No traditional grades were assigned. A short description of each of the problem solving activities is given in table 1.

The objectives of SOAR students engaged in activities designed to improve vocabulary, note-taking ability, and ability to visualize in three dimensions. To increase motivation, the program was coordinated with the academic programs in terms of social functions, tours of local spots of interest, and presentations by various scientists and mathematicians.

There were 57 students in Project SOAR in 1977 and 1978. All had graduated from high school immediately before enrolling in the program and were expecting to enter college in the fall. We solicited the participants by using a variety of media, brochures mailed to high schools, and a television series on science and mathematics programs. Selection was by the "warm body" method. We accepted into the program both years those who completed the short SOAR application and submitted an application to Xavier for the fall, indicating an interest in mathematics or science. Each year more than 1000 applications were circulated at the University as well as in the area. The program is further described in the book *Project SOAR: Learning to Learn* (1977).

Lawson's Instrument

Lawson's instrument of formal reasoning developed by

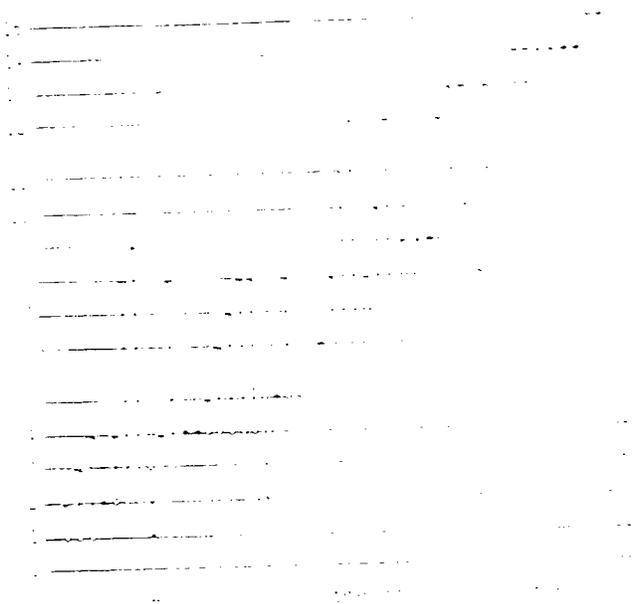


FIGURE 1. Project SOAR participants and Lawson's instrument of formal reasoning (1977).

Lawson (1978) is included as a pre- and post-test for SOAR participants in both 1977 and 1978. Lawson designed this instrument for group administration and to strike a balance between time-consuming individual interviews and easily misinterpreted pen-and-paper tests. Moreover, Lawson validated the test for eighth, ninth, and tenth grade students ranging from thirteen to eighteen years old. It consists of fifteen items each of which begins with the instructor demonstrating a physical situation about which the student may ask questions freely. The instructor then poses a question about some aspect of the demonstration and each student responds individually by choosing the correct multiple choice answer and explaining in detail how the answer was obtained in an individual test booklet. Answers are correct only if both portions are acceptable. Lawson's validation procedures indicate that scores of five or fewer correct items represent concrete reasoning, six to eleven correspond to a transitional level (between concrete and formal), and twelve or more correct is expected for an individual at the formal operational level. The instrument requires approximately ninety minutes to administer.

In 1977 all SOAR participants took Lawson's test via demonstrations in one group setting. In 1978 they watched the demonstrations via video in four separate groups of equal size. A SOAR instructor was present with each group to explain the video demonstration further and supervise administration of the instrument.

Because the same instrument served for both pre- and post-tests, instructors were careful to ensure that test items were discussed only during the administration of the exam and that activities in SOAR did not duplicate test items. Moreover, unlike interviews in which the student receives feedback, Lawson's construction of the test provides no opportunity to learn from the test experience. In spite of these precautions and the time lapse of six weeks between administrations of the pre- and post-

project, and the results of the study are presented in this report.

The project was designed to determine if the use of a structured approach to instruction would result in a higher level of achievement for students with learning disabilities.

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Project Director

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At the University of Louisiana, the Department of Biological Sciences (New Orleans) has developed a pre-college summer program in the department's core areas: general reading, mathematics, physics, mathematics, and biology. The department's summer course in mathematics, including algebra and trigonometry, was developed in 1973-74. Funding for the project was provided by the William B. Keenan, Jr. Foundation Trust and by Title III Grant #G00-76-01673.

Arthur W. Himpel
 W. Carmichael, Jr.
 Lester W. Jones
 Jacqueline T. Hunter
 Harold A. Vincent

A number of educators have noted the close relationship between critical reading and analytical reasoning. As early as 1877, Thorndike filed a paper "Reading as Reasoning: A Study of Mistakes in Paragraph Reading." More recently, Holmes (1967) analyzed 1000 test items and had a battery of reading tests and concluded that reading is a "verbal-processing skill" and symbolic reasoning. In 1971, Fryer (1971) pointed out that from the verbal reading test, the Kansas State Reading Test (1975) through current instruments like the College Board Achievement Test, questions appearing in tests of reading comprehension bear a strong similarity to questions on standard verbal intelligence tests. This article describes a successful precollege summer program, Project SOAR (Stress On Analytical Reasoning), which uses "problem-solving process instruction" as a method of reading comprehension and analytical skills that emphasizes the connection between the two. Students who completed just 7 1/2 weeks of SOAR showed gains equivalent to one year's gain in verbal standards.

Project SOAR was developed by the School of Biological Sciences, University of Louisiana.

Project SOAR was a pre-college program with an additional laboratory and post-testing trial at the University of Louisiana and a predominantly Black institution in New Orleans. The program was conducted as a joint project of the departments of biology, chemistry, mathematics and computer science, and physics. It is specifically designed to improve the problem-solving and academic skills of pre-freshmen entering the University with an interest in the natural, earth, or mathematical sciences. The program carries no academic credit but is available as a post-orientation to all science students accepted at the university. In 1970, approximately one-half of the entering science freshmen, 110 students, completed the program. To facilitate the instructional process, participants were divided randomly into five groups of approximately equal size.

Project SOAR has two components: (1) Pagehan-based laboratory exercises from 9 a.m. to noon and (2) cognitive process instruction for problem-solving, comprehension of classes, and vocabulary building from 1 to 3 p.m. The Pagehan-based laboratory experiments were developed and conducted by faculty from the departments of biology, physics, mathematics and computer science and physics. Each was three hours in length and organized in a "learning cycle" format (Kempus, 1974) with introduction, invention, and application phases. The experiments in the various academic areas were designed to stress analytical problem-solving. The following components of the

Journal of Research in Science Teaching

Following the District's decision to add to their curriculum, the following year in the fall one and a half weeks students continued to work in pairs. In the fall students were to use cognitive process instruction as the answered reading comprehension and sentence completion exercises from the following sources: *Breaking the Reading Barrier* (Gibson, 1959), *Dental Admission Test Preparation* (National American Dental Association, 1977), *One Day Record Examination Information Bulletin* (1978-79 Educational Testing Service, 1978), *Taking the SAT: College Entrance Examination Board* (1978), and *Six-Tax Paragraphs* (Rusk, 1974).

The supplement was a warning in reading and problem-solving subjects spanning Monday through Thursday of the entire fall semester and possibly from Monday through the College Board's entrance exam (1978-79).

Group competition

On Friday afternoon classes were there was a District-wide competition of the three groups' combined scores against other. The District had three components: a multiple-choice program testing comprehension and vocabulary materials and a written exercise. The written exercise consisted of a short composition, a reading comprehension exercise, and a sentence completion exercise. The written exercise was a multiple-choice program testing comprehension and vocabulary materials and a written exercise. The written exercise consisted of a short composition, a reading comprehension exercise, and a sentence completion exercise.

Immediately following the fall semester, the District made both the former determinant of the winning group and individuals who performed well on the written exams were given enough of the following class period in a special bi-weekly newsletter.

These competitions generated strong enthusiasm and group cohesiveness. Students were regularly seen studying vocabulary or problem-solving during the lunch hour or other spare moments. In addition, students having difficulty with either written component actively sought tutoring so as not to pull down their team's score, and those who had done well in a particular area willingly acted as tutors for their teammates.

Further, special tutoring sessions established in the afternoon were attended, even though attendance was not required. While individual competition may be ill-advised in the educational settings, the team competition in SCAR was obvious.

of tremendous benefit in getting the students to study subjects which were less and critical reading which were high, otherwise have found it.

Program evaluation

The program was extremely successful. The students reported a great deal of fun and a great deal of learning. In addition, SCAR students made significant gains over the five weeks on a instrument designed to measure Piaget's levels of intellectual development (Lewison, 1978), a standardized reading exam, The Nelson-Denny Reading Test, and a reading

and comprehension test. In addition, the SCAR program was summarized in the *Change article* (Lewison, 1978). The latter was also described in the following.

Pre and posttest comparisons for scores on both the comprehension and vocabulary portions of The Nelson-Denny Reading Test (Form D for the pretest, Form O for the posttest)

Pre and posttest comparisons for scores on both the comprehension and vocabulary portions of The Nelson-Denny Reading Test (Form D for the pretest, Form O for the posttest) are given in the table. This table group could not be used because many of the better students scored so high that their scores had no validity. The data in the table indicate that the average increase in level of performance on the comprehension portion of the Nelson-Denny ranged from 1.4 grade levels for those participants who had scores less than or equal to the 12th grade level on the pretest to a high of 3.0 grade levels for those who scored less than or equal to the 10th grade level at the beginning of the program.

Further increases in the comprehension portion of the exam were statistically significant beyond the 90th percentile. These dramatic gains in reading comprehension in a five-week program devoted to teaching analytical reading support the position taken by Theodore Parr and others, of the importance of reading as a means for developing analytical reasoning skills and for providing a reading program appropriate.



Education

Educators discuss teaching the handicapped

Chemical education meeting emphasizes methods for communicating chemistry to physically handicapped, women, and minorities

David A. Smith,
C&EN, Chicago

When an audience of 100 chemists gathered at the American Chemical Society's annual meeting in San Francisco, Calif., to discuss the Sixth Biennial Conference on Chemical Education for the Handicapped, the "handicapped" included not only physically handicapped persons, but also women and minorities. The meeting was held at the Sheraton Hotel in San Francisco, Calif., on Oct. 27-28.

The meeting was organized by the American Chemical Society's Division of Chemical Education, which is a part of the American Chemical Society's Division of Chemical Education. The meeting was held at the Sheraton Hotel in San Francisco, Calif., on Oct. 27-28. The meeting was organized by the American Chemical Society's Division of Chemical Education, which is a part of the American Chemical Society's Division of Chemical Education. The meeting was held at the Sheraton Hotel in San Francisco, Calif., on Oct. 27-28.

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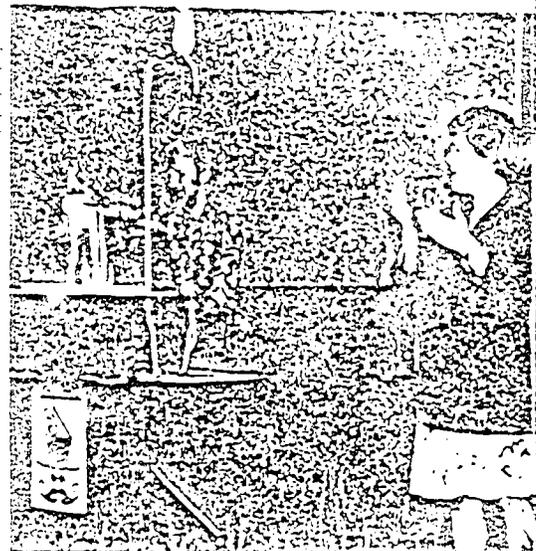
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"Chemical magic" show was "signed" by skilled interpreter from NTID staff

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A person working with a large piece of fabric or paper, possibly a book cover or a large document, in a workshop or studio setting.

ENTRY-LEVEL MATHEMATICS COURSES FOR MINORITY STUDENTS

A Short Communication

presented to the

Fourth International Congress on Mathematical Education

by

Dr. W. J. DuRapa, Jr.
Dept. of Mathematics & Computer Science
Xavier University of Louisiana
New Orleans, LA 70125 USA

OVERVIEW OF XAVIER UNIVERSITY

Xavier University is the only predominantly black Catholic university in the Western Hemisphere, although 85% of its faculty and administration is composed of laymen and one-third of the students are non-Catholic. The University has an enrollment of over 1800 students, who come from 30 states and 10 foreign countries. However, two-thirds of the students live in the greater New Orleans area.

Xavier's primary mission is to provide educational opportunities to black Americans, with emphasis on residents of the Gulf South. Xavier's institutional philosophy might be summarized as *standards with sympathy*, i.e., a commitment to accept many students with discernible academic weaknesses, coupled with an equally strong commitment to demand a high standard of performance for graduation. It is possible to do both simultaneously only because the University provides sensitive support services, especially at the freshman level.

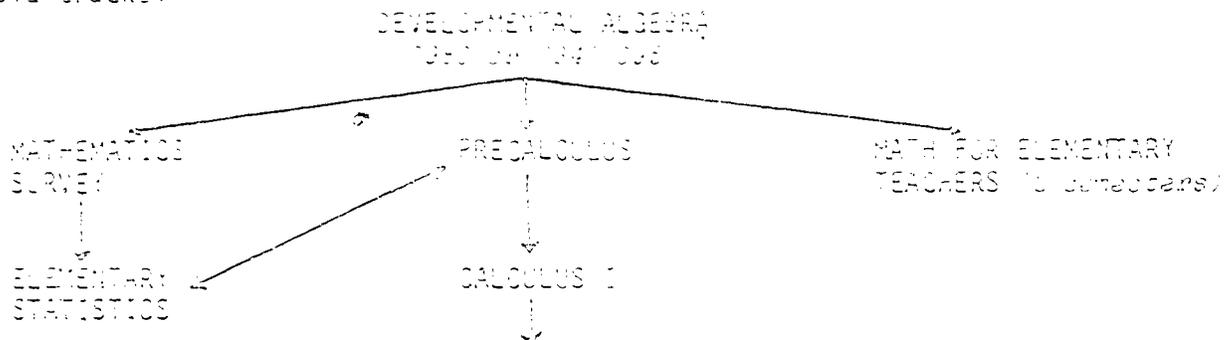
ORIGIN OF THE CAUSE GRANT

In 1977, Xavier became the first predominantly-black institution to receive funds from the National Science Foundation's highly competitive CAUSE (Comprehensive Assistance to Undergraduate Science Education) Program. The primary objective of Xavier's project (CAUSE Grant SER77-05227) was to initiate a multi-departmental effort by the Departments of Biology, Chemistry, Mathematics/Computer Science, and Physics to reduce attrition from and to increase performance in entry-level science and mathematics courses as a means of increasing the number of students who ultimately graduate in the sciences. The four departments developed and implemented a set of basic strategies to achieve this objective.

CAUSE'S ENTRY-LEVEL MATHEMATICS PROGRAM

All students entering Xavier are required to take a locally-produced entry-level Placement Examination which determines whether the student must complete a developmental, non-degree credit mathematics sequence (either the

one-semester MATH 1000 or the two-semester MATH 1040-1050 for those needing stronger remediation before enrolling in regular college courses. The tree diagram displays possible tracks:



The CAUSE Grant focuses on improvement of the two college-credit mathematics courses taken by most science majors after passing either the Placement Exam or the developmental algebra sequence, i.e., Precalculus and Calculus I. Precalculus is a combination of elements from algebra and trigonometry. The Calculus I course is both a terminal course for most science majors and the first semester of a three-semester sequence for a much smaller number of students. Development of these courses under CAUSE has been accompanied with corresponding development (financed through other sources) of both the developmental courses and the remaining two courses in the Calculus sequence. The CAUSE Grant provided for the development in Precalculus and Calculus I of

- (1) an effective and efficient tutoring system which is housed in the AP LC (Alternate Pathway Learning Center) in Xavier's library;
- (2) handbooks containing
 - (a) learning objectives for each module,
 - (b) sample problems to match each objective with space to work them in the handbook,
 - (c) sample tests for each module with detailed solution keys,
 - (d) supplements when material is lacking in the text,
 - (e) six modules in each of the two courses;
- (3) audio tapes to accompany each of the twelve modules. These tapes were placed in the AP LC along with additional, commercially-produced audio-visual aids.

EVALUATION OF THE MATHEMATICS SEGMENT OF XAVIER'S CAUSE PROGRAM

It is unlikely that a science or mathematics major who makes lower than a "C" in a science or mathematics course will be able to successfully pursue a career in one of these areas. For that reason, the percentage of students who complete entry-level courses with a "C" or better is a suitable measure of success in the courses. The following table contains some statistics from the Precalculus and Calculus I sequence at Xavier for the past three years.

	SEMESTER	NO. ENROLLED	NO. WITH "C" OR BETTER
PRECALCULUS	Fall '77 *	155	56 (36%)
	Fall '78	215	97 (45%)
	Fall '79	201	103 (51%)
CALCULUS I	Spring '78 *	107	50 (47%)
	Spring '79	117	73 (62%)
	Spring '80	131	66 (50%)

* Before implementation of CAUSE-developed materials

These and other statistics suggest a reduction in attrition from an increase in performance in entry-level mathematics courses. This result is the major objective of Xavier's CAUSE project.

Appendix XXX--
 PERSONS REQUESTING INFO ON CAUSE

NAME	POSITION	INSTITUTION	REQ'D INFO	PURCH'D MAT	VISITED U
David O. Dickerson	Vice President for Academic	Seattle Pacific University Seattle, WA	X		
Timothy A. O'Shea	Associate Professor of Chemistry	Texas Wesleyan College Fort Worth, TX	X		
Shelton E. Stewart	Professor of Biology	Lander College Greenwood, SC	X		
Kay M. Eisen	Associate Professor of Chemistry	Mount Mary College Milwaukee, WI	X		
Robert Silberman	Department of Physics and Astronomy	University of Nebraska Lincoln, NB	X		
Wesley Lingren	Professor of Chemistry	Seattle Pacific University Seattle, WA	X		
Donald Zebolsky	Chairman, Dept. of Chemistry	Creighton University Omaha, NB	X		
Betty Dotson	Project Director of Right-to-Read	Indianapolis Public Schools Indianapolis, IN	X		
H. David Snyder	Department of Physics	Gallaudet College Kendall Green, DC	X		
Clara Watnick	Chairperson, Physical Sciences Dept.	Hostos Community College Bronx, NY	X		
Dennis Staley	Instructor, Academic Resource Center	Southern Illinois University Edwardsville, IL	X		
Scott Hovensten	Instructor of Chemistry	US Air Force Academy Colorado	X		
Morton Friedman	Professor and Head Instructional Research and Evaluation	University of California Los Angeles, CA	X		
Richard Hutchinson	Director, Institute for Cognitive Studies	Manhattan Community College New York, NY	X		
Jerome Lebkob	Chairman, Dept. of Chemistry	Iona College, New Rochelle, NY	X		
William Wasserman	Instructor, Chemistry	Seattle Central Community College, Seattle, WA	X		
Ann Barbul	Acting Director, Center for Health Careers Services	Morgan State University Baltimore, MD	X		
Stephen Main	Associate Professor of Biology	Wartburg College Waverly, IA	X		
Anthony Digenakis		Delaware Technical and Community College Newark, Delaware	X		

(continued)

Appendix XXX (continued)

PERSONS REQUESTING INFO ON CAUSE

NAME	POSITION	INSTITUTION	REQ'D INFO	PURCH'D MAT	VISITED XU
Mike Staubugh	Chemistry Instructor	Weber State College Ogden, Utah	X		
Robert Burge	Chemistry Instructor	Suffolk Comm. College Seiden, NY	X		
Lee Kleiss	Chemistry Instructor	Fayetteville State U. Fayetteville, NC	X	X	
M.D. Bishop	Chemistry Instructor	Clemson University Clemson, SC	X		
Van Crawford	Chemistry Instructor	Mercer University Macon, GA	X		
Linda Fowler	Chemistry Instructor	Cincinnati, OH	X		
Lucy Pryde	Chemistry Instructor	SW College Chula Vista, CA	X		
Bruce Munney	Chemistry Instructor	U. of Wisconsin-RF River Falls, WI	X		
T. Lang	Chemistry Instructor	Nazareth College Rochester, NY	X		
Jane Copens	Chemistry Instructor	Hamline University St. Paul, MN	X		
Sr. Mary Bryan	Chemistry Instructor	Rosemont College Rosemont, PA	X		
Barbara Lorenzo	Chemistry Instructor	John Abbott College St. Anne de Bellevue, Canada	X		
Jeanne Lagowski	Chemistry Instructor	University of Texas Austin, TX	X		
William Stratton	Chemistry Instructor	Earlham College Richmond, IN	X	X	
Kathleen Davis	Chemistry Instructor	Delaware State College Dover, Delaware	X	X	
Allen Hanson	Chemistry Instructor	St. Olaf College Northfield, MN	X		
Roger Festa	Chemistry Instructor	Norwalk Board of Ed. East Norwalk, CT	X		
Rita Kubony	Chemistry Instructor	Walden, MA	X		
Joan Sabourin	Chemistry Instructor	Delta College Michigan	X		
Betty Derrick	Chemistry Instructor	Valdosta State College Valdosta, GA	X		
Marlene Koitz	Chemistry Instructor	U. of Illinois-CC Chicago, IL	X		
Charles Kenyon	Cooperative Learning Center	SE Mass. Univ. N. Dartmouth, MA	X		
Wilmer Stratton	Chemistry Depart	Earlham College. Richmond, IN	X	X	

(continued)

Appendix XXX (continued)

PERSON REQUESTING INFORMATION ON CAUSE

Name	POSITION	INSTITUTION	REQ'D INFO	PURCH'D MAT	VISITED XU
Chairman	Chemistry Department	Oakland University Rochester, MI	X	X	