THE COMMUNITY COLLEGE OF PHILADELPHIA: EDUCATING TEACHERS FOR A CHANGING WORLD

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Program Overview

The Community College of Philadelphia is currently in the fourth year of the Collaborative for Excellence in Teacher Preparation (CETP) project supported by the National Science Foundation. The Community College of Philadelphia is a two-year, urban, comprehensive community college that provides accessible, low-cost education for an extremely diverse population of city residents. The CETP partnership with Temple University and the Philadelphia School System has created a model for K-12 teachers' education which integrates new inquiry-intensive and technology-based pedagogy with mathematics and science core content courses. In keeping with the spirit of this grant, the College has created and implemented science and math courses primarily for pre-service teachers that provides exemplary models of teaching that reflect current research. These new courses emphasize a learning paradigm rather than a teaching paradigm. As such, the focus is on the learner and the learning environment. Expectations for student success are high. Students engage in individual and collaborative inquiry in an environment that expects and demands critical thinking. Although initially designed for pre-service instructors, we have found that all students benefit from these courses.

In order to promote student learning and preparation for careers in teaching, three courses at the Community College of Philadelphia were specifically targeted for change. Faculty involvement has been high from the beginning and continues to be a key factor in the success of these courses. As a result of these changes, other courses offered have also created or revised. In all, seven new or revised courses have been created and fully institutionalized. In addition, specific articulation agreements have been fostered with numerous four-year institutions in the area as these courses have proved to be extremely beneficial to the preparation of both pre-service teachers and to other majors. The courses that have been developed and implemented include: General Biology I (Biology 106), General Biology II

(Biology 107), Inquiry into Chemistry (Chemistry 105 and Chemistry 106), Mathematical Models I (Math 155) and Science, Technology and Society (STS 101 and STS 102). Institutionalization of these courses has occurred, and the courses have become the most highly recommended courses for education majors at the college.

Course Descriptions

General Biology I is a non-science majors course that was proposed, created, and implemented by a committee of interested faculty. This new course listing and subsequent advising of students has led to increased enrollment in the course. Currently, there are thirtytwo sections with twenty-six students each. Three of the sections are specifically designated for education majors. The new course outline and syllabi contain seven discovery questions with student outcomes or standards accompanying each. These have been based on the science and biology standards contained in the AAAS Benchmarks [1] and the National Science Standards [2]. In addition, the course has been based on the recommendations of the National Association of Biology Teachers. The major themes of the course center on cell biology, genetics, evolution, and ecology. This inquiry based course includes laboratory experiences and activities that emphasize science process skills. This semester (Fall, 1997), nine of the classes offered are taught in the Biology Computer Studio. Two of these are especially designated for education majors. The Biology Computer Studio is a multi-media classroom equipped with twenty-six computers. Each computer has over fifty software simulations and experiments and has internet capabilities. The studio also is a wet lab equipped with water, gas, and lab work space. The studio approach to biology adheres to the premise that students learn when they are actively involved. The classroom allows for both computer and wet labs, access to the internet, small and large group interactions, and enhanced lecture/discussion through multi-media. Through a partnership with Prentice Hall, the College has been designated as a Beta site for the new "Life on Earth" biology internet guide that accompanies the course textbook. We have provided important editorial feedback to the creator and keeper of this much used web site. For the more traditional classrooms, instructors are using cooperative learning, minds-on problem solving activities, and enhanced lecture/discussion using technology. Several alternative methods of evaluation are currently being utilized by instructors of General Biology I. Assessment emphasizes the skills and processes as well as the content examined in the course. Problem solving, case study analysis, critical thinking skills, journals, written and oral reports, and portfolios are some of the

alternative forms of assessment utilized by various instructors. Due to the popularity of this course, General Biology II was created and designed as a follow up course. It emphasizes a problem solving and case based approach to comparative anatomy and physiology in a laboratory setting. Several sections are currently using the Biology computer studio.

Because many pre-service teachers elect to enroll in Biology, emphasis has been placed on the changing pedagogy in this area. The goal is to provide an excellent model of science instruction. However, Mathematical Models I has also been developed specifically for preservice teachers. It is offered as an alternative to traditional math courses and was developed collaboratively with faculty from Temple University and the Community College of Philadelphia. The emphasis is on problem solving using an inquiry based approach to education with extensive use of graphing calculators. Mathematical topics are at a freshman level and may cover topics selected from algebra, probability, plane geometry, counting, financial analysis, and trigonometry.

Another course created and implemented with the support of the CETP is Inquiry Into Chemistry. It, too, is offered as a lab based science course for pre-service teachers and nonscience majors. The course emphasizes a discovery approach in which students learn to interpret laboratory observations in the manner of a real world scientist. The experiments are less prescribed and more open to interpretation with the goal of appreciating chemistry more as a rational field of inquiry than as a fixed set of rules.

A new inter-disciplinary course, Science, Technology, and Society, was developed by a committee of members of the Biology, Chemistry and Engineering departments of the Community College of Philadelphia. The course was proposed and subsequently approved January, 1995 as STS 101. The course utilizes theme based investigations that are conducted using the technology in the studio lab as well as field trips and guest speakers. The course was offered over the summer to high school students involved in the Tech Prep program. The course was also offered during the Fall 1997 semester and is currently being offered for the spring semester of 1998. This course has been specifically designed for both non-majors as well as for students involved in the Culture, Science, and Technology program.

There have been several changes in the teacher preparation requirements for elementary

teachers at the Community College of Philadelphia. Two courses in Education form the core of Education offerings at Community College of Philadelphia. These include Education 201: Introduction to Education and Education 225: Educational Psychology. These courses, developed many years ago, promote and model pedagogy consistent with CETP philosophy. This pedagogy supports an inquiry based philosophy which is reflected in both reading materials and in class activities. The CETP project has stimulated further activities which encourage development of critical thinking abilities in students through cooperative learning methods. Active learning is encouraged in these courses.

The analysis of case studies is an important technique for use in education courses. Many situations occur in classrooms that can provide pre-service teachers with insight into classroom management, teaching and learning opportunities for special education children, and faculty-student relationships. By exposing students to these important issues and having them work through them, they are able to understand different problem-solving approaches. In this way students begin to understand how scientists go about solving problems in their work. The model of a scientist collecting data is likened to teaching where observations and other data help to make decisions regarding practice.

Students' readings in both Introduction to Education and Educational Psychology reflect CETP philosophy and practice. When students learn about Piaget, Vygotsky, Montessori, and Dewey, they not only read the words of these educational philosophers, but also they engage in hands-on activities to understand and appreciate their work. In addition, some reading materials from the CETP psychology course at Temple University are being incorporated into the Educational Psychology course. Material relating to mastery motivation and gender issues in math and science education have been added to the syllabus. It is our belief that the modeling of hands-on activities suggested by some of these readings is a strategy which will become part of Community College of Philadelphia students' repertoires of behavior to be practiced when these students enter the classroom in professional roles.

Though not officially part of the CETP project, Education 202 was developed and was offered by the College for the first time in Spring 1997. Education 202: Introduction to the Foundation of Education Field Experience, gives students of education the opportunity to do direct observations in a school setting. This field experience using participant-observational strategies encourages students to become critical educational researchers. Students will formulate hypotheses about the teaching-learning process as classroom dynamics and interactions are observed and analyzed. By noting interactions between pupils and teachers in terms of who initiates talk, who participates in discussion, and what kind of classroom climate is fostered, students will get information about the expectations each brings to the process, what happens in the classroom, and how the teacher and learner change under certain circumstances. This activity can generate relevant questions about specific features of a classroom experience. Classroom observations followed by weekly group class discussions will help the students begin to understand the complexity of classroom dynamics. In classroom settings, students not only observe classes in action, but also they work with students in small groups, helping them with reading, math, and other projects. In weekly seminars at Community College, students discuss different aspects of classroom life such as instructional strategies, activities and motivation, evaluation strategies, and staff and parents as part of the school culture.

In addition to these Education courses at Community College of Philadelphia, students in the Education Curriculum follow a program which includes liberal arts courses such as math and science courses. Math 155, Biology 106, Biology 107 and Chemistry 105/106, courses developed in conjunction with the CETP grant, have been included in the Education curriculum and students are encouraged to take them. The pedagogy offered in these courses is supported by Education faculty at Community College who hope to recruit more students for these excellent courses.

Student Recruitment and Retention

During the Spring 1997 semester the Philadelphia CETP offered a seminar for education students at the Community College. This well-attended seminar severed two purposes. The first objective was to provide students with a forum to discuss the following issues: multicultural settings, principles of cooperative learning, methods in science and math instruction, use of technology, and, career planning. Secondly, students were given information on each of the CETP courses and, they were able to get information on the education program at Temple University. Many students transfer to Temple University and through the grant we have assured students a smooth articulation with Temple University. Students will continue to see the CETP philosophy in both content and methods courses at Temple University; the

seminar provided us with a platform to promote this arrangement. We are planning to offer this seminar each year.

Another exciting dimension of the CETP grant has been the dissemination of yearly scholarships for promising pre-service teachers at the Community College. In 1996 we awarded seven scholarships, while in 1997 there were thirteen, and eleven in 1998. These applicants must demonstrate their commitment to their field through experience, grade point average and written expression.

To further promote the CETP courses, we found it imperative that academic advisors and counselors be properly informed. The principle investigator of the grant along with several faculty members have had meetings and classroom demonstrations with counselors to insure that they are well informed so that they can help students make the right choices. Our foresight in this matter has led to increased enrollment and retention in the CETP developed courses.

Students preferentially enroll and stay in courses they know will transfer to other colleges. The department heads along with the education coordinator have worked very hard to insure articulation agreements with Temple University as well as numerous other area colleges and universities concerning the CETP developed courses. Many Community College education majors take their content courses at the Community College and their methods courses at Temple University. Collaboration with Temple University has increased retention and participation of a diverse population of pre-service teachers. The majority of these students go on to teach in the Philadelphia Public School System.

Staff Development

Staff development has been key to the creation and continued success of the CETP developed courses. Working with Temple University faculty has led to the development of parallel courses at Temple and the Community College as well as to articulation agreements between the institutions.

Staff development at the Community College has included enhanced committee involvement and extended time opportunities. Initially, the challenge was to involve faculty in the development process. Extended time opportunities enticed faculty to participate in the creation and implementation of new and revised courses. Members of this group during the 1995-96 academic year were involved in course revisions and development of course syllabi, laboratory experiences, class activities, and assessment. During the 1996-97 academic year, extended time was granted to those individuals interested in developing classroom strategies that utilized technology and software purchased. In addition, there were weekly meetings conducted for instructors of new courses; participation in this was voluntary and well attended.

Staff development has also included several initiatives. The first was to increase the working members of the committee for General Biology I. The second was to offer extended time as a way to increase participation in this group for the academic year 1996-97. Third, faculty were offered extended time to learn technology. Specifically, faculty were required to prepare a lesson/activity that utilized multi-media. Over fifteen different faculty members successfully participated in these projects. Fourth, on-going support to learn technology and new pedagogical practices is provided in small groups and one on one through the Biology Computer Studio. This service is made available by providing extended time for a faculty position to specifically function in staff development. Through these processes faculty are using technology and are coming together frequently to discuss successful strategies and activities. As a result, instructors of other biology courses are beginning to change the way they teach. Many of the activities and labs created through these projects are now available to other instructors as a result of a shared faculty computer room. To foster the institutionalization of continued improvement in teaching, the department has allotted for extended time for one staff person to serve as a coordinator in this area.

Outcomes

The success of the students in these classes has been well documented by both qualitative and quantitative measures. Student retention is higher than in more traditional classes, and students in CETP courses have outscored their peers in traditional courses on pre and post test assessments. Most importantly, their attitudes towards science and math, and science and math courses, has become more positive.

The General Biology I committee developed a pre and post test to measure differences in

courses taught traditionally versus those that were focusing on the learner and the learning environment (CETP courses). This test was piloted in the Spring of 1996. Several modifications were made and the pre-test was given to all sections Fall, 1996. The post-test was given during final exams in December, 1996. Overall, the results suggest that those students in the traditionally taught classes do not do as well as those in classes that are less traditional. Students in the CETP sections averaged 68% on the post test while students in the traditional classes averaged 52%. The pre-test average for both groups was 52%. The test consisted of sixty items that covered the entire course. Emphasis was placed equally on content and process skills. Item analysis revealed that students in CETP courses outscored their peers on content questions but, they significantly outscored their peers on the problem solving and analysis questions. Sample questions and results are shown on Figure 1. The testing instrument was used for one other semester and similar results were obtained. Further changes and refinements are being made and it is hoped that a new pre/post test will be administered in the 1998-99 academic year.

Students attitudes towards the courses are routinely monitored each semester through the internal evaluator for the CETP. Table 1 shows students attitudes in Biology courses. Seven of these sections are CETP and considered the new model while two of the sections were the same course but taught more traditionally. Overall, the students in the CETP sections clearly find their course more useful, interesting, and, likable. Table 2 shows the same survey given to two sections of math courses. One course is the revised CETP class while the other course offers the same material but the pedagogy is more traditional. Again, the CETP section was seen more favorable by students. This data represents only one semester but, it is typical of data collected from 1996 to the present.

Student focus groups conducted yearly by the internal investigators have revealed a similar pattern as the surveys. In addition, students generally achieved higher grades in CETP courses.

Milestones and Dissemination

Overall, the successful model that we have created contains the following accomplishments. We have:

• redesigned the content and pedagogy of selected core courses: at the Community College

of Philadelphia we have redesigned or created six courses. These include: Biology 106, 107, STS 101, Chemistry 105, 106, and Math 155. In addition, other biology courses have been influenced by the CETP. These include Biology 109, 110 and 241. Instructors have adopted new practices in both the learning environment and in evaluation. Parallel courses have been designed at Temple for both Math 155 and Biology 106. Articulation agreements have been made with Temple and other area four year institutions. Emphasis for new and revised science courses has been on the processes of science and math rather than covering vast amounts of content. There are a variety of instructional strategies utilized and students have many opportunities to discuss and explain in a cooperative, problem solving environment.

- developed a new, team-taught cross-disciplinary science course: STS 101 has been created and offered as a cross disciplinary course. A committee of instructors from across the disciplines created the course. The course ran in SS I, Fall 1997 and is currently being run (spring 1998). A follow up course (STS 102) is currently being created by a committee of four faculty. It is anticipated that this course will be offered for the Fall 1998 semester.
- given a series of staff development workshops and seminars: at the Community College we have offered staff development every semester that the grant has been funded. Currently, staff are offered extended time to create new materials. There are also specific times that faculty can come to the studio on a drop in basis to learn specific uses of hardware and software. CCP has also offered seminars for area secondary schools and has offered seminars for other educators and for pre-service teachers.
- expanded programs to attract and retain minority students: CCP works closely with the E=mc² and AMP programs.
- have fostered institutional ties with the following grants/programs within the college: Culture, Science, Technology grant; Alliance for Minority Participation grant.
- formed linkages with faculty from the Community College of Philadelphia and other area community colleges. Using the pedagogical reforms embraced by the CETP, instructors

are developing, implementing and evaluating a new laboratory manual in biology.

- collaborated with Prentice Hall on improving their web sites and their textbooks.
- worked with Prentice Hall in publishing lab manuals for the various courses offered.
- have and are working with Logal software as a beta site for the new internet version of Logal Biology - a week long seminar will be offered this summer for area participants to learn to use the software.
- hosted on February 5 and 6, 1997 a hands on Inquiry-based Biology workshop that was attended by many local college and university administrators and professors.
- hosted (April 12, 1997) a seminar for CCP education students that focused on teaching practices, technology, cooperative learning, teaching in diverse environments, courses for education majors at CCP, and transfer issues.
- created a Biology department web site with links to all of the courses taught, the instructors, and course outlines/syllabi. There are special hyperlinks for the CETP and the Biology Computer Studio. The URL for this site is: http://www.voicenet.com/~bluesky/ccpbiology. html
- institutionalized all of the CETP courses (Biology 106, 107, Chemistry 105, 106, Math 155, STS 101).

Conclusion

What sets this program apart from other initiatives is the broad based support for and commitment to change. One of the main recommendations of the National Research Council is that "all students should have access to supportive, excellent programs in science, mathematics, engineering, and technology, and all students should acquire literacy in these subject by direct experience with the methods and processes of inquiry" [3]. The grant has ensured that this occurs for all students, but it has concentrated on pre-service teachers. The

Community College now plays an important role in the education of future teachers of the Philadelphia School System. The inter- and intra-institutional ties are in place and will remain so long after the grant money is gone. We have made a commitment to continuous improvement in the hope that this spirit is transferred to our future K-12 teachers.

The overall consensus is that the CETP is achieving its objectives. The National Science Foundation has recognized the curricular and pedagogical improvements that have been made. These improvements are summarized in the Shaping the Future report submitted as a review on undergraduate education [4]. As education majors at the Community College of Philadelphia transfer to Temple the will receive quality core courses as well as revised methods courses. Eventually, those students who have participated in multiple CETP courses will be tagged by the Philadelphia School System for placement at schools where they can most affect change. It is our hope that these teachers will enter their professional experience and mentor the type of teaching modeled by the instructors of their CETP courses.

Sample Question: DNA is the material of heredity because it: (a) stores genetic information (b) replicates (c) controls the cell's activities (d) all of these Correct response: D Level: content question or recall (N=10 classes, 188 students) 68% answered item correctly CETP groups Traditional group (N=11 classes, 176 students) 39% answered item correctly Sample Question: The following graph shows the relationship of plant growth to light intensity. light intents Which illustrates the relationship between light intensity and plant growth? (a) as light intensity increases, plant growth increases (b) as plant growth increases, light intensity increases to a point and then decreases (c) as light intensity increases, plant growth increases to a point and then decreases (d) as plant growth increases, light intensity increases Correct response C Level: interpretation/analysis CETP groups (N=10 classes, 188 students) 83% answered item correctly Traditional group (N=11 classes, 176 students) 53% answered item correctly Sample Question: A class wants t find out if temperature has an effect on the growth of bread mold. The mold is grown in nine identical petri dishes containing the same type and quantity of nutrients. Three containers are kept at 0° Celsius, three containers are kept at room temperature, and three containers are kept at 25° Celsius. The containers are examined and the growth of the bread mold recorded at the end of four days. The independent variable is the: (a) temperature of the containers (b) amount of nutrient in each container (c) growth of bread mold (d) number of containers at each temperature Correct response A Level: application (N=10 classes, 188 students) 71% answered item correctly CETP groups Traditional group (N=11 classes, 176 students) 45% answered item correctly (These three items all fell within acceptable discrimination limits of .25 - .75)

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Biology Course Community College of Philadelphia May 1996										
section		A	в	с	D	E	F	G	н	I
		R	R	Т	R	R	R	R	R	Т
	Item									
organization	1	4.46	4.80	3.64	4.43	4.44	4.07	4.62	3.82	4.00
content interesting	2	4.15	4.00	3.28	4.40	3.94	4.36	4.33	4.35	3.60
practical examples	3	4.92	4.86	3.86	4.80	4.44	4.28	4.62	4.59	4.10
valuable to career	4	4.23	3.34	3.00	3.67	4.12	3.00	3.52	4.12	3.10
content usefulness	5	4.77	4.57	3.43	3.80	3.87	3.71	3.89	4.59	3.10
course makes me think	6	4.31	4.28	4.00	4.20	3.93	4.43	4.33	4.35	3.90
class discussion	7	4.38	4.86	4.43	4.71	4.50	4.64	4.67	4.76	3.90
interaction with classmates	8	4.15	4.28	3.43	4.07	3.67	3.86	3.43	4.35	3.60
related to other courses	9	4.58	2.86	2.71	3.67	3.93	3.86	3.33	4.41	3.00
too much work	10	3.61	3.71	3.21	3.87	3.37	3.38	3.67	4.18	3.50
look forward to coming	11	4.54	5.00	3.07	4.57	3.56	4.21	3.90	4.95	3.30
active participant	12	4.50	4.43	3.69	4.53	4.06	4.07	3.86	4.65	3.80
text/lecture integration	13	3.92	4.00	3.86	4.27	4.07	4.07	4.43	3.88	3.90
theory and application mix	14	4.32	4.14	3.50	4.27	3.87	3.93	4.00	4.41	3.80
I am lost in the course	15	4.92	5.00	3.64	4.60	4.13	4.14	4.00	4.75	3.20
apply to real life	16	4.77	3.86	3.93	3.73	3.81	3.71	3.57	4.65	3.80
presentation clear	17	4.69	4.28	3.57	4.36	3.93	3.78	4.09	4.41	3.90
learn on my own	18	4.69	3.43	3.21	3.80	3.44	3.93	3.67	3.53	3.20
like subject more now	19	4.61	4.43	3.36	4.07	3.81	4.36	4.00	4.41	3.10
want to learn more	20	4.92	4.71	3.14	4.73	4.12	4.43	4.57	4.88	3.60
overall good course	21	4.85	4.57	3.64	4.27	4.25	4.43	4.48	4.59	3.60
	scale	4.44	4.17	3.49	4.17	3.91	4.02	4.03	4.43	3.55

Table 1. Science and Mathematics Course Survey: CCP biology course

R=CETP revised course T= course taught in traditional method Items are scored: 5=strongly agree through 1=strongly disagree. Scoring of items 2,5,7,10,15, and 20 was reversed. Items 1-21 averaged to form scale score.

Math Course Community College of Philadelphia May 1996								
section		А	В					
		R	Т					
	Item							
organization	1	4.21	3.65					
content interesting	2	4.00	3.20					
practical examples	3	4.43	3.16					
valuable to career	4	3.43	2.45					
content usefulness	5	3.86	3.10					
course makes me think	6	4.21	4.00					
class discussion	7	4.57	3.55					
interaction with classmates	8	4.07	2.55					
related to other courses	9	3.43	2.50					
too much work	10	3.43	3.40					
look forward to coming	11	3.50	2.50					
active participant	12	4.07	3.10					
text/lecture integration	13	2.71	3.00					
theory and application mix	14	3.71	3.25					
I am lost in the course	15	3.96	2.75					
apply to real life	16	3.78	2.15					
presentation clear	17	3.42	2.85					
learn on my own	18	3.28	2.60					
like subject more now	19	3.64	2.35					
want to learn more	20	4.00	3.40					
overall good course	21	4.14	3.25					
	scale	3.75	2.98					
R= CETP revised course T= course taught in traditional method Items are scored: 5=strongly agree through 1=strongly disagree. Scoring of items 2,5,7,10,15, and 20 was reversed. Items 1-21 averaged to form scale score.								

Table 2. Science and Mathematics Course Survey: CCP math course

References

- [1] AAAS Project 2061: Science for all Americans, American Association for the Advancement of Science, Washington, DC, 1989.
- [2] National Science Standards, National Research Council, Washington, DC, 1995.
- [3] From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology, Report of a Convocation. National Research Council, Washington, DC, 1996.
- [4] Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology, National Science Foundation, 1996.