

**FINAL REPORT**

**Summary Report**

**(see also Research Project Reports)**

Pilot Curriculum Evaluation Committee

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## EXECUTIVE SUMMARY

The Pilot Curriculum is a long-range experiment in the College of Arts and Sciences, designed to test an alternative to the College's current general education curriculum. Beginning with the class of 2004, students selected into the Pilot Curriculum were not required to meet the standard College degree requirements, but instead fulfilled an alternative set of requirements characterized by (1) a more concentrated and more compact set of general education requirements (four interdisciplinary courses instead of the ten-course General Requirement), (2) an increase in the number of free electives, (3) an emphasis on planning with an academic advisor (including development of an Academic Plan during the sophomore year), and (4) a required research experience, normally in the context of the student's major.

The Pilot Curriculum was implemented as a true, randomized experiment. Each year, beginning with the class of 2004, approximately 200 students were randomly selected for admission to the Pilot Curriculum from a pool of pre-freshmen applicants for the program, and the remaining applicants (ranging from 74 to 208) were designated as applicant non-Pilot.

The Evaluation Committee has obtained data through multiple methods, including interviews and meetings with faculty and advisors, focus groups of students, surveys of students, and analyses of student records and course evaluations.

Faculty instructors of Pilot General Requirement courses have generally expressed enthusiasm for these courses. In contrast, student ratings of these courses on multiple dimensions are very similar to ratings for the regular General Requirement courses. There was no difference by Pilot status in the rather high proportion of students who report taking General Requirement courses only because they are required and not because the student is interested. There was also no difference by Pilot status in the relatively low amount of learning reported by students who took General Requirement courses only because required.

Our evidence suggests only limited success in the goal of improved advising for students in the Pilot Curriculum.

Few differences in course choices were found in comparisons between Pilot and non-Pilot students in analyses of data from transcripts and students' self-reports. We found no consistent significant differences by Pilot status in the proportion of students who were earning double majors, dual degrees, sub-matriculation masters, or minors, and no significant differences were found in measures of study abroad, foreign language learning, and several additional learning experiences. As expected, more Pilot students reported research experience. However, the nature and quality of the research experience did not differ significantly between Pilot students and the non-Pilot students who did research.

Analyses of student records showed no significant difference between Pilot and non-Pilot students in the average number of science courses taken, both for all students and for non-science majors. Nevertheless, among non-science majors, Pilot students were significantly more likely than non-Pilot students to have taken fewer than two science courses and to have taken no mathematics or statistics courses. However, it should be noted that, among seniors, Pilot students were not more likely than non-Pilot students to have low scores on the scientific and

quantitative literacy test we developed. There also were no differences by Pilot status in mean scores for the scientific and quantitative literacy test, self-reported science learning, or a variety of measures of interest in science. Our findings suggest that science and quantitative learning is relatively weak for non-science majors in both the Regular Curriculum and the Pilot Curriculum.

There were no significant differences by Pilot status in seniors' ratings of their "entire educational experience at Penn". There was also little or no difference by Pilot status in seniors' rating of how much their Penn education had contributed to a broad variety of intellectual abilities and learning.

In summary, despite substantial differences between the requirements of the Pilot Curriculum and the Regular Curriculum, and despite our extensive evaluation of multiple sources of information on outcomes, we have found little difference in outcomes for Pilot vs. non-Pilot students. The only consistent, significant differences reflected direct effects of requirements: more of the Pilot students participated in research, and more of them took very low numbers of science and math courses. It is striking that extensive analysis did not reveal any other consistent significant differences between Pilot and non-Pilot students in course-taking patterns or self-reported learning.

## INTRODUCTION

The Pilot Curriculum is a long-range experiment in the College of Arts and Sciences that was designed to produce information that would be useful in determining the configuration of the next undergraduate curriculum. Developed by the Committee on Undergraduate Education (CUE) during the academic years 1998 to 2000 and introduced with freshman classes starting in 2000, the experiment tests an alternative to the College's current general education curriculum with a subset of students in each class. By tracking and evaluating the academic programs of those students over their entire undergraduate careers compared with students enrolled in the Regular Curriculum, the experiment seeks to understand the effects of the two curricula on the educational choices students make and on their academic achievements over the course of their entire undergraduate careers.

For students in the Pilot Curriculum, the College suspended its standard degree requirements. In their place, it imposed an alternative set of requirements characterized by (1) a more concentrated and compact set of general education requirements, (2) a corresponding increase in the number of free electives, (3) an emphasis on planning with an academic advisor, and (4) a research experience, normally in the context of the student's major.

1. Pilot General Requirement. In place of the ten-course General Requirement of the Regular Curriculum, Pilot students take four courses specially designed to introduce students to interdisciplinary study and to open up a variety of modes of inquiry. Relatively few such courses exist in the regular General Requirement. However, the General Requirement courses taken by the majority of College students are designed to provide a comprehensive introduction to a single major, to cover the territory of that field from a certain vista, and to draw students into further study in that field.

2. Free Electives. Theoretically, the decrease in required General Requirement courses should afford Pilot students a corresponding increase in free electives. In practice, however, this increase is offset to some degree for some students by the fact that there are fewer opportunities to double count Pilot general requirement courses toward major and pre-medical requirements. Also, Pilot students were not able to substitute AP credit for their General Requirement courses, as students in the Regular Curriculum often could. Consequently, some Pilot students found that they had no more free electives or flexibility in their schedules than they would have had if they had enrolled in the Regular Curriculum.

3. Academic Plan. In general, arrangements for academic advising for students in the Pilot Curriculum are similar to arrangements for students in the Regular Curriculum. Like students in the Regular Curriculum, Pilot students are required to meet with their academic advisors at least three times during the freshman year. Unlike students in the Regular Curriculum, however, Pilot students are expected to prepare a written Academic Plan in consultation with their advisor. Discussions about the plan are normally concluded in the second semester of the sophomore year, which is also the time by which all students are expected to declare a major. The advisor's signature is required, not to indicate approval of the plan but rather to signify that the student has been sufficiently reflective about his or her goals to commit them to writing, has discussed them with a more mature scholar and has responded to observations and suggestions the advisor may have about the plan.

4. The Research Requirement. The purpose of the research requirement is to ensure that all students in the Pilot gain some degree of hands-on experience with the processes of discovering and validating knowledge in at least one field of study. The normal expectation is that this experience takes place within the field that one has studied most thoroughly, namely, the major. Nevertheless, some students arrange to meet this requirement outside their major.

In summary, the objective of the experiment is to see how Pilot students as compared with students in the Regular Curriculum make use of this alternative curriculum to shape interesting, intellectually engaged and coherent programs of study.

### **Experimental Design**

It is unusual for a college to implement a new curriculum on an experimental basis for only a subset of potential students. It is, perhaps, unique that the College chose to implement this curriculum as a true, randomized experiment. Each May starting in 2000, the College sent brochures to the approximately 1600 matriculating freshmen describing the Pilot and the Regular curricula and inviting them to apply for the Pilot Curriculum or to indicate that they would pursue the Regular Curriculum. The brochure explained that 200 students admitted each year to the Pilot Curriculum would be selected at random from the applicants. Comparison of the applicants versus the non-applicants revealed no significant differences in the standard academic indicators (SAT-V, SAT-M, and a “Predictive Index” computed by the Penn Admissions Office to predict students’ first semester GPAs). No bio-demographic differences (sex, ethnicity, etc.) were evident except for a slightly higher proportion of first-year Pilot applicants whose country of origin was outside the United States.

In each year, the goal was to recruit a pool of 400 applicants, from which to randomly select 200 for the Pilot Curriculum and 200 for the primary control group, namely, those who applied for the Pilot Curriculum but who were not selected. In some years, as shown in Table A.1, the number of applicants was substantially less than 400, leaving a control group somewhat smaller than 200. In all years, the selection method was by simple random sampling.

Although the virtues of a randomized experiment will be evident to many, it is worth emphasizing what this methodology accomplishes. If we had merely selected the first 200 applicants in each cohort and compared them with all other students in their cohort, any differences we observed in their educational experiences and achievements could potentially be attributed to differences in such things as attitudes, motivations, and abilities that existed prior to their arrival at Penn. On the other hand, since participants in the Pilot Curriculum were randomly chosen from among all who applied, differences in their educational experiences and achievements and those of the applicants who were not chosen can be only be attributed to their differing curricular regimes .

In many of our research projects, we compared three groups of students: Pilot students, students who applied for the Pilot Curriculum but were not selected, and students who did not apply for the Pilot Curriculum. These comparisons are referred to as comparisons by Pilot status.

**Table A.1 Numbers of Applicants and Non-applicants to Pilot Curriculum**

	Applicants	Non-applicants	Total Responses to Invitation	Selected for Pilot	Not Selected
Class of 2004	279	975	1254	205	74
Class of 2005	416	944	1360	208	208
Class of 2006	350	930	1280	206	144
Class of 2007	362	1005	1367	200	162

### **Evaluation Committee**

In the spring of 2000, CUE called for the creation of a separate and independent Pilot Curriculum Evaluation Committee consisting of four faculty members and a student. Three faculty candidates for the Committee were vetted by the Undergraduate Chairs. The fourth candidate was selected by CUE from among those of its own members whose terms were about to expire and who were intimately acquainted with the formulation and development of the idea for the Pilot Curriculum. A member of the College Dean's staff served ex officio.

The Evaluation Committee has been accumulating data from this experiment over the past four years, primarily from the first and second cohorts of Pilot students. In April of this year we submitted an interim report of our findings to date. Since then we have undertaken the following additional studies.

- Additional statistical analysis of student records:
  - Courses taken outside of SAS by Pilot status.
  - Number of courses taken in major subject by Pilot status.
  - Analysis of data for the class of 2005.
- Additional surveys of seniors in the spring and fall of 2004 which included questions concerning students' research experience and required courses, as well as replications of our earlier evaluations of students' educational experiences and the Science Survey. Our analyses of these survey data included not only comparisons by Pilot status, but also some comparisons between science and non-science majors.
- Analysis of Course Evaluation Form data to evaluate how reported amount learned relates to whether students are taking a course to satisfy a requirement.
- Content analysis of Academic Plans for the class of 2005.

- Identification of regular General Requirement courses that are similar in structure and content to Pilot General Requirement courses.
- Analysis of trends in Pilot General Requirement course offerings and ratings for individual courses.

This report is organized in the following way. We begin with a Summary Report that presents our findings in each of several content areas: Pilot General Requirement courses, pre-major advising, patterns of course choices, students' assessment of their education, science education, and the research requirement. This is followed by Research Project Reports which provide more detailed descriptions of the various projects we conducted over the past four years, along with discussions of specific findings. In the Summary Report, numbers in parentheses refer to the section numbers of the research projects that provided the relevant information.

Note that in some sections of the report, we have not only evaluated the Pilot Curriculum, but have also investigated some related issues concerning general education, including the effectiveness of required courses and science learning by non-science majors. We believe that our findings in these areas will contribute to a discussion of possible curricular changes in the College of Arts and Sciences.

## SUMMARY REPORT<sup>1</sup>

### *Pilot General Requirement Courses*

For the General Requirement component of the Pilot Curriculum, students choose from a small set of interdisciplinary courses selected and designed for the purpose of general education. Unlike most courses in the regular General Requirement, Pilot Curriculum General Requirement courses are designed to suggest a variety of areas for further study and modes of inquiry rather than to introduce students to the field and disciplinary methods of a single major. Students are required to take fewer of these courses, four instead of the ten General Requirement courses students must take in the Regular Curriculum.

The first four Pilot General Requirement courses were offered in the fall of 2000 and had a total of 10 faculty instructors. These faculty were interviewed in spring 2001 about their experiences in the courses (5). Faculty were generally very positive about the courses. Those who taught in teams were particularly enthusiastic about the quality of the intellectual experience, but mentioned the additional work required to prepare for the classes and coordinate their efforts with other members of the team. Similar views were expressed in a forum of faculty who taught Pilot courses in 2000 or 2001.

Students had less favorable views about the Pilot General Requirement Courses. Focus groups of randomly chosen Pilot students held in 2000 and 2001 expressed both positive and negative opinions about the courses (6). Complaints centered on the workload, which some students found excessive, and the lack of integration in the team-taught courses. Many students were unhappy with the limited choice of courses.

To get a quantitative assessment of student satisfaction, supplementary course evaluations were distributed in all Pilot General Requirement courses (2). For courses taught in 2002, we used both standard and supplemental evaluation forms to compare 15 Pilot general requirement courses with a selected sample of 28 General Requirement courses taught in the Regular Curriculum. Based on the standard evaluation forms, there was little if any difference between courses in the two curricula with regard to students' overall evaluation of either the course or the instructor. For the supplemental evaluation (for which we had reports from only 12 Regular Curriculum courses), none of the differences between Pilot courses and regular courses was statistically significant.

### *Pre-Major Advising*

One goal of the Pilot Curriculum was to improve academic advising during the first two years. Specifically, two consequences were hoped for: (a) that the reduced number and complexity of general education requirements would allow more time for advisors and Pilot students to have

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<sup>1</sup> Numbers in parentheses refer to the section numbers of the Research Project Reports that provided the relevant information.

meaningful conversations about academic goals and planning;( b) that the required Academic Plan during the sophomore year would focus thoughtful attention on planning and achieving academic and intellectual goals.

Academic advisors for Pilot students reported that they felt these goals were achieved to some extent, and they indicated that advising Pilot students was more satisfying and challenging than advising non-Pilot students. At the same time, the advisors often felt unprepared to provide practical recommendations in response to questions about academic interests (7). Correspondingly, both Pilot and non-Pilot seniors complained about poorly informed advisors (3). Seniors reported considerable dissatisfaction with advising during their first two years at Penn and this did not differ significantly by Pilot status (3).

Among the advisors of Pilot students who responded to our e-mail survey, most viewed the writing of the Academic Plan as a beneficial exercise. These advisors felt that the preparation of this Plan made students focus on the educational opportunities available at Penn and it helped guide discussions between the student and the advisor. Most of these advisors recommended that this requirement be extended to all undergraduate students in the College (8). Pilot students were not as positive about the Academic Plan. About half of the students believed that the Plan had not helped them make better course choices (8), and some students considered it redundant with planning for the major (6). The usefulness of the Academic Plan may have been limited by the tendency of students to focus on courses that had already been taken, with relatively little attention devoted to plans for future selection of elective courses (8).

In summary, our evidence suggests only very limited success in the goal of improved advising for students in the Pilot Curriculum. One pervasive problem is how to provide advisors and students with helpful information on the enormous array of academic options available to students in the College. Advising in the Pilot Curriculum framework might be improved by efforts to focus the Academic Plans on the future more than the past.

### *Patterns of Course Choices*

One of the major goals of the Pilot Curriculum was to allow students greater freedom to choose courses to pursue their intellectual interests by reducing the number of general education courses required. In student focus groups, students often said that they had applied for the Pilot Curriculum because it has fewer general education requirements and thus provides greater freedom to choose electives than the Regular Curriculum (6). Nevertheless, few differences in course choices were found in comparisons between Pilot and non-Pilot students in analyses of data from transcripts and students' self-reports (1).

No significant differences by Pilot status were found in the proportion of students who were earning double majors, dual degrees, sub-matriculation masters, or minors, and no significant differences were found in measures of study abroad, foreign language learning, and several additional learning experiences (3). One significant difference was that more of the Pilot students reported a "research-oriented independent study or other research experience" but this is unsurprising since the Pilot Curriculum requires a research experience. Another difference was

that more Pilot students reported a “culminating senior experience (comprehensive exam, capstone course, thesis, etc.)”, which probably relates to the research experience requirement, since research experience correlated strongly with participating in a culminating senior experience.

One concern about the Pilot Curriculum has been that non-science majors in the program might take fewer natural science and math courses, given that they have fewer requirements in that area. Analyses of student records showed no significant difference between Pilot and non-Pilot students in the average number of science/math courses taken, even among the subgroup of students who were not science majors. Nevertheless, among non-science majors, Pilot students were significantly more likely than non-Pilot students to have taken fewer than two science courses and to have taken no mathematics or statistics courses (1).

We found no evidence for differences between Pilot and non-Pilot students in the average number of courses taken in the major and the average number of courses taken outside the College of Arts and Sciences.

### *Students’ Assessment of Their Education*

There were no significant differences by Pilot status in seniors’ ratings of their “entire educational experience at Penn”. There was also little or no difference by Pilot status in seniors’ ratings of how much their Penn education had contributed to a broad variety of intellectual abilities, including “thinking critically and analytically”, “ability to formulate original ideas and solutions”, “writing clearly and effectively”, “using quantitative tools”, and understanding in humanities, social sciences, or natural sciences (3).

Self-reports in our Senior Surveys indicate that a substantial number of courses are taken only to fulfill a requirement, with relatively little self-reported learning in many cases (3). These problems were especially serious for the General Requirement (both regular and Pilot) and for the Quantitative Data Analysis Requirement and Writing Requirement. These problems did not differ by Pilot status. In contrast, Course Evaluation Form data suggest more learning by students who took courses to satisfy the General Requirement (3). One likely reason is that the Course Evaluation Form data include students who took a course not only to satisfy a requirement, but also for interest. There was a great deal of variation in reported amount learned in different General Requirement courses, with some courses receiving quite low ratings. These findings suggest that the effectiveness of general education might be increased if we could develop required courses that stimulate the interest of more of our students, and either improve less effective courses or remove them from the General Requirement.

### *Natural Science and Quantitative Skills Education*

To evaluate scientific and quantitative literacy, we developed and validated a multiple-choice “Science Survey” which assessed scientific reasoning, understanding of concepts, and knowledge of important facts and terminology in the natural sciences and math/statistics. There were no significant differences between Pilot and non-Pilot seniors in either the mean score or the proportion with low scores on this scientific and quantitative literacy test (4). Data for

seniors also indicated no significant difference by Pilot status in several measures of science interest, including scores on a Science Interest scale, average number of science and math courses taken at Penn, or whether or not students had a natural science or math major (1, 4). Thus, we found no difference by Pilot status in science and math education outcome measures, although, as mentioned above, Pilot students were more likely than non-Pilot students to take fewer than two science courses and no math or statistics courses. Our findings also suggest relatively weak science and quantitative learning by non-science majors in both the Regular Curriculum and the Pilot Curriculum (3,4).

### *Research Requirement*

One of the goals of the Pilot Curriculum is to offer students significant opportunities for individual research, scholarship and/or creative projects, and all Pilot students are expected to engage in research prior to graduation. In contrast, research is optional for many students enrolled in the Regular Curriculum, although it is required in some majors. As expected, more Pilot seniors than non-Pilot seniors reported that they had conducted research, and that they had done so as a Pilot requirement (3, 9). The most common reasons that non-Pilot students reported for not doing research included not having enough time due to other course requirements or non-academic activities and not being interested in doing research (9).

Pilot students can fulfill the research requirement in a number of ways – by taking upper level research seminars, independent studies, writing a senior thesis, or conducting lab research or experiments – and they can usually do so in the context of their major. Unfortunately, this was not always clear to first and second-year Pilot students who expressed some frustration about lack of information regarding how they could fulfill the research requirement.

Given considerable variation in departmental undergraduate research opportunities, which are related to disciplinary considerations and the number of undergraduate majors, the nature of students' research experiences are likely to vary substantially. A survey of graduating seniors in the spring of 2004 confirmed the expected diversity in types of research, with substantial proportions of Pilot students reporting laboratory research, interview or questionnaire collection of data, ethnographic or observational field research, archival research of original documents, and/or textual analysis. This survey also showed that the type of research Pilot students engage in does not differ significantly from the type of research conducted by non-Pilot students, and the average rating of the quality of the research experience did not differ by Pilot status.

In summary, the research requirement in the Pilot Curriculum resulted in a higher proportion of students engaged in research. The self-reported nature and quality of the research experience was similar for Pilot and non-Pilot students.