Report Submitted to:
Marianne Janack
Washington DC, Project Center

By:

Bryan Doehr

Shirine Eslamdoust

Nicholas Sama

In Cooperation With

Marilyn J. Suiter, Lead Program Director

Natinal Science Foundation's Division of Undergraduate Education

Assessing Diversity in SMET Educational Projects

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This project report is submitted in partial fulfillment of the degree requirement of Worcester Polytechnic Institute. The view and opinions expressed herein are those of the authors and do not necesserily reflect the positions or opinions of NSF's Division of Undergraduate Education or Worcester Polytechnic Institute.

This report is the product of an education program and is intended to serve as partial documentation for the evaluation of academic achievement. The reader should not construe the report as a working document.

Abstract

This report was prepared for National Science Foundation's Division of Undergraduate Education (DUE). DUE is interested in finding methods used to address issues of demographic diversity in Science, Math, Engineering and Technology education projects. This project reviewed awards for the two programs: Course Curriculum and Development and Instrumentation and Laboratory Improvement for the period FY1992 through FY1997. The project investigated different distributions within these awards, and the techniques used. Analysis of the abstracts was done and recommendations were made.

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We would also like to thank all those people that participated in the football games on the mall.

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1. Executive Summary

This project was commissioned by the National Science Foundation's (NSF) Division of Undergraduate Education (DUE). The research study explored ways that projects awarded by the DUE attempt to increase the participation of traditionally underrepresented groups: women, minorities, and persons with disabilities (WMD), in the fields of science, mathematics, engineering, and technology (SMET) in undergraduate education. There were two objectives for this project, first to investigate and assess the techniques that are implemented by the DUE funded projects and second, to provide the DUE a statistical analysis of its awards.

Our study looked at the 677 DUE awards funded between FY1992 to FY1997 that specifically targeted women, minorities, or persons with disabilities within the two DUE programs, Course and Curriculum Development (CCD) and Instrument and Laboratory Improvement (ILI). To be able to investigate closely DUE awards during the restricted time that we had, it was necessary to decrease the number of awards. We accomplished this by using a set of carefully developed criteria.

These criteria provided us with a more realistic set of 51 awards. First, a content analysis of the award abstracts was performed to determine how often certain topics, issues, and techniques came up. Second, in order to be able to conduct phone interviews and obtain qualitative data, each group member then read the abstracts and assessed them, taking into consideration the following: if they mention their target audience; if the technique implemented was stated; and whether the project seemed to implement a technique or if NSF funds were used to buy a piece of laboratory equipment. Three lists were then created to help us select the projects that we were going to investigate more in-depth. The next step was to conduct phone interviews with the Principal Investigator (PI) of each chosen project and the corresponding Program Director (PD) at the NSF. These interviews were one of our main sources for data because the interviews were the best place we could turn for concise information on each award we targeted.

Along with our qualitative work, we conducted statistical analysis at three different levels. The levels were: all CCD and ILI DUE funded projects between FY1992 to FY1997, the 677 CCD and ILI DUE awards from FY1992 to FY1997 that targeted women, minorities and persons with disabilities, and finally the 51 awards that satisfied our criteria. Our statistical analysis focused on target audience distribution, focus level distribution, monetary distribution, and CCD and ILI comparisons.

After we gathered all of the information from the statistical data, the content analysis of the abstracts, and the interviews, we studied the results and formulated conclusions. Our first conclusion was that a lack of target on persons with disabilities exists, when looking at the CCD and ILI awards funded at DUE between FY1992 to FY1997. We also concluded that physical disabilities and learning disabilities are not separated. This can be very confusing when trying to identify how awards attempt to improve the learning experience of persons with disabilities at the undergraduate level.

Our second conclusion was that the target audience indication seems uncler. Our interviews showed that a majority of the PIs acknowledge that their projects were useful for all students enrolled in the class of laboratory. It was found that PIs tend to check WMD on the form that they fill out upon submission of a proposal because a majority of the students expected to participate in the class or laboratory will be WMD. We concluded that a portion of the CCD and ILI awards might implement passive mechanisms because they are working with a pre-existing population in a class or SMET department. It was also found that PIs liked the idea of being able to indicate that a project will benefit all students as well as stating a specific target audience.

After conducting the interviews with PIs and PDs we were able to provide DUE information on what techniques are most widely used. We also found additional methods that were not as frequently used, but were interesting because of the innovation that was used.

We formulated several recommendations to the DUE based on our conclusions. First, we recommended that DUE efforts be directed more towards the problem of the integration of persons with disabilities in SMET fields. We noticed during this study that not only proper data is not available regarding persons with disabilities but that, within the awards that we focused on, very little has been accomplished to improve the participation of this group in SMET. We recommended that the DUE identify the methods and mechanisms used to specifically target persons with disabilities and create a way of specifying what disability is addressed.

Our second recommendation was to make two additions to the "Project Data Form 1295" that PIs fill out upon submission of their proposal. The first suggested addition an "All Students Involved" to the target audience code list as an additional and maybe optional code to the others. This code could be used in cases where the project's accomplishments are profitable for all students taking the course, but the specific approach to education has proven to be very beneficial for WMD students. The other modification could be to add a code indicating a pre-existing pool of WMD that would enroll in a class even if the project is not funded or if the program aim to attract new WMD students in the SMET fields.

Our next recommendation was that DUE have more interaction with it's PIs. We suggested the implementation of periodic workshops for PIs where new methods, ideas, and successful awards could be discussed. This atmosphere would be ideal for brainstorming, which could prove to be very beneficial. In addition, we suggested the creation of a periodic newsletter that discusses the same issues. In addition, we recommended that DUE look more closely at the methods that were not frequently used and the additions or modification made to current programs.

Our next recommendation was to increase the knowledge that Program Directors have of the awards and their outcomes. We suggested that DUE encourage PIs to update the abstracts after the program had been implemented to reflect the actual program instead of the proposal. We also recommend that the PDs follow the outcomes of awards closer and we felt that more sit visits would be helpful.

Our final recommendation was that the foundation hires people with more time, money, and access to NSF information in order to continue this research study.

2. Introduction

The National Science Foundation (NSF) is an independent agency of the U.S. government that promotes science, math, engineering and technology (SMET). NSF supports these fields through grants and contracts of over 3.3 billion dollars per year in almost 20,000 research and education projects, which address many issues in our educational system. One of these issues is the lack of diversity and equity for students in SMET disciplines. NSF has been repeatedly asked by Congress to provide more opportunities for traditionally underrepresented students in SMET fields.

The problem that this project targets is the fact that Women, Minorities, and Persons with Disabilities (WMD) are grossly underrepresented in SMET fields when compared to their representation in the entire population. The NSF's Division of Undergraduate Education (DUE) funded this project in order to investigate how the funded educational projects in two programs, Course and Curriculum Development (CCD) and Instrumentation and Laboratory Improvement (ILI) are helping to improve the underrepresentation of WMD in SMET fields at the undergraduate level. Through our study, the DUE will obtain a demographic analysis of the awards targeting these underrepresented groups, as well as a better understanding of the methods used to address this issue.

For this project we implemented three data gathering techniques. For a quantitative analysis of DUE awards we conducted statistical work at the three levels of our research: all CCD & ILI awards granted between FY1992 and FY1997; those CCD & ILI awards that indicated WMD as a target audience; and those awards that satisfy all of the criteria that we developed. We then conducted content analysis of the abstracts from those awards that satisfied our criteria, in order to gain a better understanding of the techniques that are used and how these awards target WMD.

Our final data gathering technique was used to obtain qualitative information about a selected number of awards. We felt that interviewing both the Principal Investigators (PI) and the Program Directors (PD) would provide us the most in-depth information about those awards that we focused on.

This report is intended to provide valuable information about DUE awards and techniques that have been implemented. Portions of this report will be of more interest to certain audiences, however this information will be used by many people, including, but not limited to: PDs from DUE, PDs from NSF, current and potential PIs, and future researchers. The recommendations that we make and the results that we obtain will assist DUE and PIs in the design and implementation of future programs, as well as in the dissemination of materials obtained through their own research. It is also our intention to provide future researchers with a solid framework and methodology to further study this topic.

The Interactive Qualifying Project (IQP) is a requirement for degree satisfaction at Worcester Polytechnic Institute. The IQP allows undergraduate students to explore the relationship between science, technology and society by conducting research on a topic that is not related to their majors. This project aims to investigate how NSF's Division of Undergraduate Education is addressing the underrepresentation of women, minorities, and persons with disabilities in SMET at the undergraduate level. Since SMET education ultimately affects our society and its labor force, this project can be considered an Interactive Qualifying Project.

3. Literature Review

3.1. Diversity as Described by the National Science Foundation

The National Science Foundation recognizes that the concept of race/ethnicity is both biological and socially constructed. Richard Farley and Walter Allen (Farley, 1987) note that "the sociological reality of race is more important than its biological reality. Race exerts a profound influence over the lives of people in this society." The Federal Government recognizes the following five racial/ethnic categories in surveys of institutions: Black, non-Hispanic; American Indian or Alaskan Native; Asian or Pacific Islander; Hispanic; and White, non-Hispanic (NSF 97-334). According to the Federal Government, the ethnic category of Hispanic took precedence over racial categories. Also, in 1990, the category "Race/ethnicity unknown" was added to encompass nonresident aliens. This category was created so that nonresident aliens would not report under the other five categories.

The following are the definitions of the six racial/ethnic categories, according to the Federal Government:

- Nonresident Alien—A person who is not a citizen or national of the United States and who is in this country on a temporary basis and does not have the right to remain indefinitely. Resident aliens who are not citizens of the United States and who have been lawfully admitted for permanent residence (and who hold alien registration receipt cards—Form I-551/155) are to be reported in the appropriate racial /ethnic categories along with U.S. citizens.

- Black, non-Hispanic—A person having origins in any of the black racial groups of Africa (except those of Hispanic origin).

- American Indian or Alaskan Native—A person having origins in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition.

- Asian or Pacific Islander—A person having origins in any of the original peoples of the Far east, Southeast Asia, the Indian Subcontinent, or the Pacific Islands.

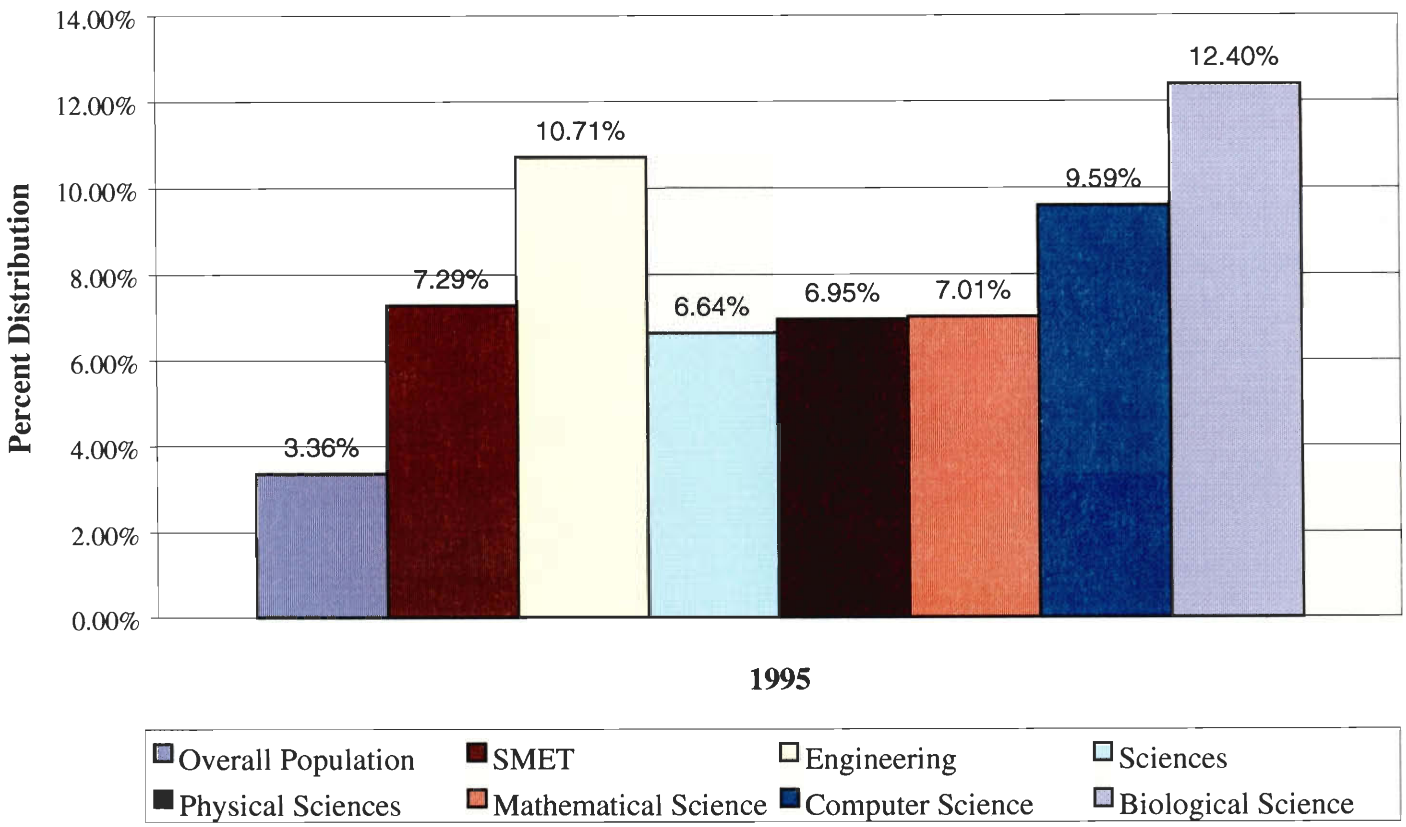
These areas include, for example, China, Japan, Korea, the Philippine Islands, and Samoa.

- Hispanic—A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
- White, non-Hispanic—A person having origins in any of the original peoples of Europe, North Africa, or the Middle East (except those of Hispanic origin).

> Hill, Susan T. Science and Engineering Degrees by Race/Ethnicity of Recipients, 1989-1995." National Science Foundation: Division of Science Resources Studies. NSF 97-334. Arlington, VA 1997.

For this project we will not be focusing on the categories of Asian or Pacific Islander and nonresident alien. The category of nonresident alien is not of interest to us because this category only consists of people that are not citizens of the United States, and although there certainly are students at U.S. institutions that are from foreign countries, it is not our intention to focus on these students. With regards to the Asian or Pacific Islander the representation of this group in SMET fields with respect to its representation to the population of people aged 18-24 in the country as a whole is generally equal and in some disciplines it is in fact higher, which can be seen in Figure 3.1 below. Therefore, the Asian or Pacific Islander classification can not be considered as underrepresented in SMET fields.

Figure 3.1
Percentages of Asian/Pacific Islanaders in 1995



"Women, Minorities and Persons with Disabilities in Science and Engineering: 1998." National Science Foundation. NSF 99-338. Arlington, VA 1999.

3.2. Undergraduate Enrollment Trends

The Fall Enrollment Survey of 1995, which was conducted by the Department of Education, shows us two things. First the number of men enrolled at Institutions of Higher Education (IHEs) has been and will continue to be smaller than the number of women enrolled at IHEs (Figures 3.2 and 3.3). Secondly the number of white students enrolled at IHEs is by far the majority of the students enrolled (Figure 3.4).

Figure 3.2
1970 Undergraduate Enrollment- Gender
(in millions)

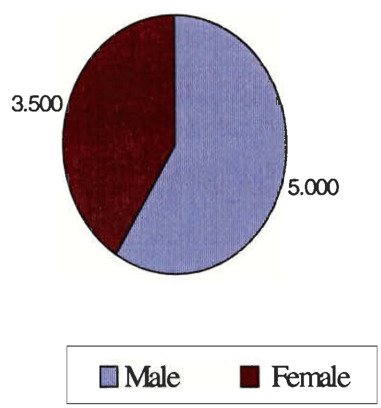
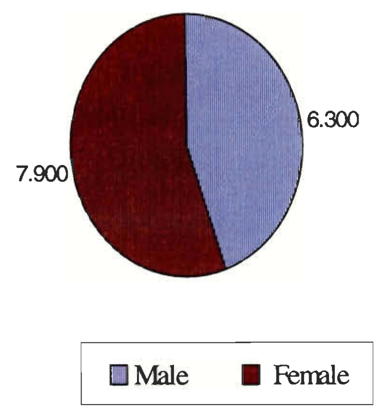


Figure 3.3
1995 Undergraduate Enrollment- Gender
(in millions)

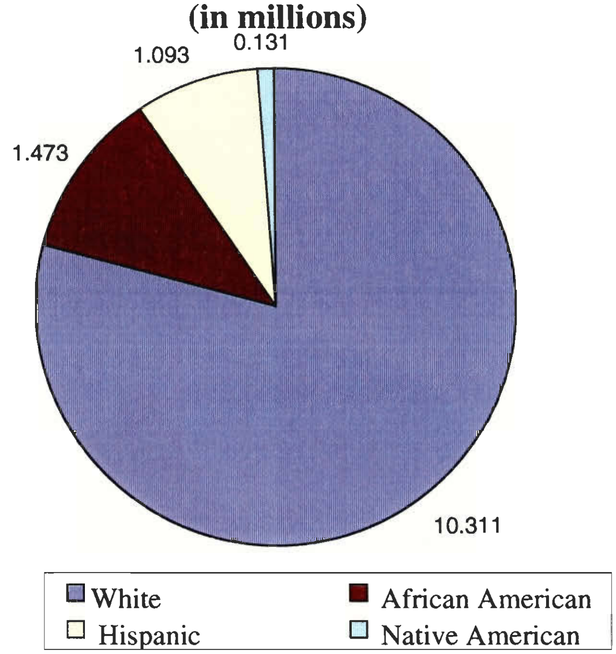


-Enrollment-NCES FastFacts." US Department of Education: Office of Educational Research and Improvement: National Center for Education Statistics.
- Barbett, Samuel F. and Korb, Rosyln A. "Enrollment in Higher Education: Fall 1995." US Department of Education: Office of Educational Research and Improvement: National Center for Education Statistics. NCES 97-440.

According to the Fall Enrollment Survey of 1995, college enrollment has steadily decreased, dropping an average of 1.5% per year, since 1992 (Barbett and Korb, 1997). This trend is evident in the male college population, which since 1979 has been lower than the female population. As shown in Figures 3.1 and 3.2, the number of males attending IHEs had grown 26%, from 5,000,000 to 6,300,000 from 1970 to 1995 (Barbett and Korb, 1997). However, over the same time period, the number of females had more than doubled, growing from 3,500,000 to 7,900,00 (Enrollment-NCES FastFacts). One of the contributing factors to this is the fact that the college going rate of males is the only going rate that has been steadily decreasing in recent years, while the going rate for females has increased over the past decade (Justiz, 1994).

The population of white college students has declined the most in recent years. The Fall Enrollment Survey of 1995 shows that the population of white college students had dropped 1.2% from 1994 to 1995 and 7.4% from 1991 to 1995 (Barbett and Korb, 1997). The number of white students participating in graduate programs increased over this time period 1.4%, however the minority representation in graduate programs grew 32.2% over the same time frame (Barbett and Korb, 1997). This trend can be attributed to many things, including a 16% decrease of white children in public schools over the last 20 years (Justiz, 1994). However, it must be noted that in 1995, the white college population, which was 10,311,000, constituted 72% of the entire population of students enrolled in IHE's (Digest of Education Statistics, 1997).

Figure 3.4
1995 Undergraduate Enrollment-Ethnicity
(in millions)



- Barbett, Samuel F. and Korb, Rosyln A. "Enrollment in Higher Education: Fall 1995." US Department of Education: Office of Educational Research and Improvement: National Center for Education Statistics. NCES 97-440.

The enrollment of African-Americans has increased steadily throughout the United States higher education system in recent years, with the largest increases in private, four-year institutions (Digest of Education Statistics, 1997) where this population increased 11.8% from 1991 to 1995. Figure 3.4 shows that the entire black student population rose 8.5% during this time period, growing to 1,473,000 in 1995 (Digest of Education Statistics, 1997). This surge in black college students can be attributed to the increase in high school graduations, which increased from 320,000 in 1991 to 356,000 in 1995.

Hispanic representation at the college level grew the most dramatically of any ethnic group, increasing 25.8% from 1991 to 1995. The Hispanic College population grew from 866,000 to 1,093,000 in 1995 (Figure 3.4). The largest percent increase was realized at four-year private schools, where the population grew 33.1%. However, at two-year private schools this number decreased 11.1% (Digest of Education Statistics, 1997). One of the largest contributing factors to this surge in Hispanic representation is the 87% increase, from 154,000 in 1991 to 288,000 in 1995, in high school graduates that this group has had (Justiz, 1994).

The number of Native American students enrolled in college has experienced the third highest growth rate of any ethnic group, behind only Hispanics and Asian-Pacific Islanders. The Native American college population has grown 14.1% from 1991 to 1995, increasing from 113,000 to 131,000 overall. This population has increased the most at four-year institutions, where it grew 27.5% (NSF 97-335).

3.2.1. Persons with Disabilities in SMET

A comparison of the U.S. resident population with the percent of scientists and engineers in the labor force showed that even though 20.6% of the population is considered as "person with disabilities", only 4.9% of the science and engineering labor force is constituted of persons with disability, 3.9% being men and 1.0% being women (CEOSE, 1998).

According to NSF report "Women, Minorities and Persons with Disabilities in Science and Engineering: 1998" there is insufficient data about the number of persons with disabilities in undergraduate education to determine and measure the problems that they face. Often schools do not keep records of students with disabilities and if they do have these records they are often confidential. However, E. Seymour and A. Hunter (1998) conducted a survey in an effort to determine the lack of students with disabilities in SMET fields. In this survey five major areas of discussion where brought up: Faculty Attitudes, Financial Aid, Attrition and the Stop-Go Phenomenon, Disability as a "Disadvantage of Time," and Disability Services.

Many participants in the survey claimed that faculty attitudes had a negative effect on the students. The following situations were brought up as concerns to the students:

- Discounting the need for accommodation
- Refusing the accommodation as a way to 'prepare' the student for 'real world' competition
- Encouraging students to drop the class or change majors
- Placing the students in inappropriate testing places (subject to noise of periodic interruptions)

- Forgetting to send a test or not communicating changes or errors (if student arranged testing under disability services administration)

- Lowering grades for work done under accommodated conditions

- Insisting on knowing the nature of the student's disability, treatment, or medication in order to decide whether they will agree to the accommodation already requested and/or arranged by the disability services office.

- Embarrassing student by talking about the disability or accommodations in front of peers

> "Women, Minorities and Persons with Disabilities in Science and Engineering: 1998." National Science Foundation. NSF 99-338. Arlington, VA 1999.

It should be noted that many faculty members were reluctant to allow these students to take test under special conditions because they felt the student would be given an unfair advantage over the rest of the class (NSF 99-338). It can also be seen that many faculty only felt certain conditions were worthy of special treatment, which led many students to believe that the process in which accommodations were approved or denied was too unofficial and had little to do with academic issues.

The largest concern with financial aid was the fact that many students with disabilities can not handle a full course load, however in order to receive financial aid it is required to take a full course load. There are many factors that contribute to the inability of students with disabilities to handle a full course load. According to NSF report 99-338 these factors are the nature of the disability, its variability or unpredictability, the effects of particular medication, problems of fatigue, and unexpected crises of mobility and transportation. Some students that were talked to felt that "they would have spent less time energy and money repeating classes had they been allowed to work at a pace commensurate with the constraints of their disability" (NSF 99-338).

It is not uncommon for students with disabilities to take time off from school as a result of intermittent problems caused by the disability, financial trouble, accumulation of "incomplete" as a result of the disability, and accommodation difficulties. However, these students often resumed their studies after the problem had been resolved, which was usually no more than a semester. Since the break time is often no more than a semester, the average overall time taken to fulfill Bachelor's degree requirements in an SMET field was five years, which is similar to that of students without disabilities.

"The factor of time was raised in five different areas: speed of learning, comprehension and recall; problems of pace; temporal disruptions in physical and mental functions; time-related educational needs; and time expended in coping with difficulties related to their difficulties" (NSF 99-338). This slower pace becomes a larger issue because many faculty members often measure academic success by time-related criteria. These measures create a large disadvantage for students with disabilities, who often work at a slower pace. There are many reasons that a student with a disability may work at a slower pace than one without. These include:

- Students with learning and other disabilities must find alternative ways to absorb and apply class materials
- Fluctuations in a disability or the side effects of medication may prevent students from concentrating on their studies
- Basic educational requirements and activities of daily living take more time
- Coping with these difficulties can be frustrating and take valuable time away from studies

"Women, Minorities and Persons with Disabilities in Science and Engineering: 1998." National Science Foundation. NSF 99-338. Arlington, VA 1999.

Many institutions have services in place that help students with disabilities overcome all of these problems. These offices often play a large part in negotiating accommodations between students, faculty, university administration, and outside agencies. Many of the students praised the Disability Services Office for the following services: "pre-registration, arranging priority access to particular classrooms, changing inaccessible or remote classrooms, getting textbooks recorded prior to the start of classes, arranging special test accommodations, and assistance in locating and trying out assistive technology" (NSF 99-338).

3.2.2. Women and Minorities in SMET

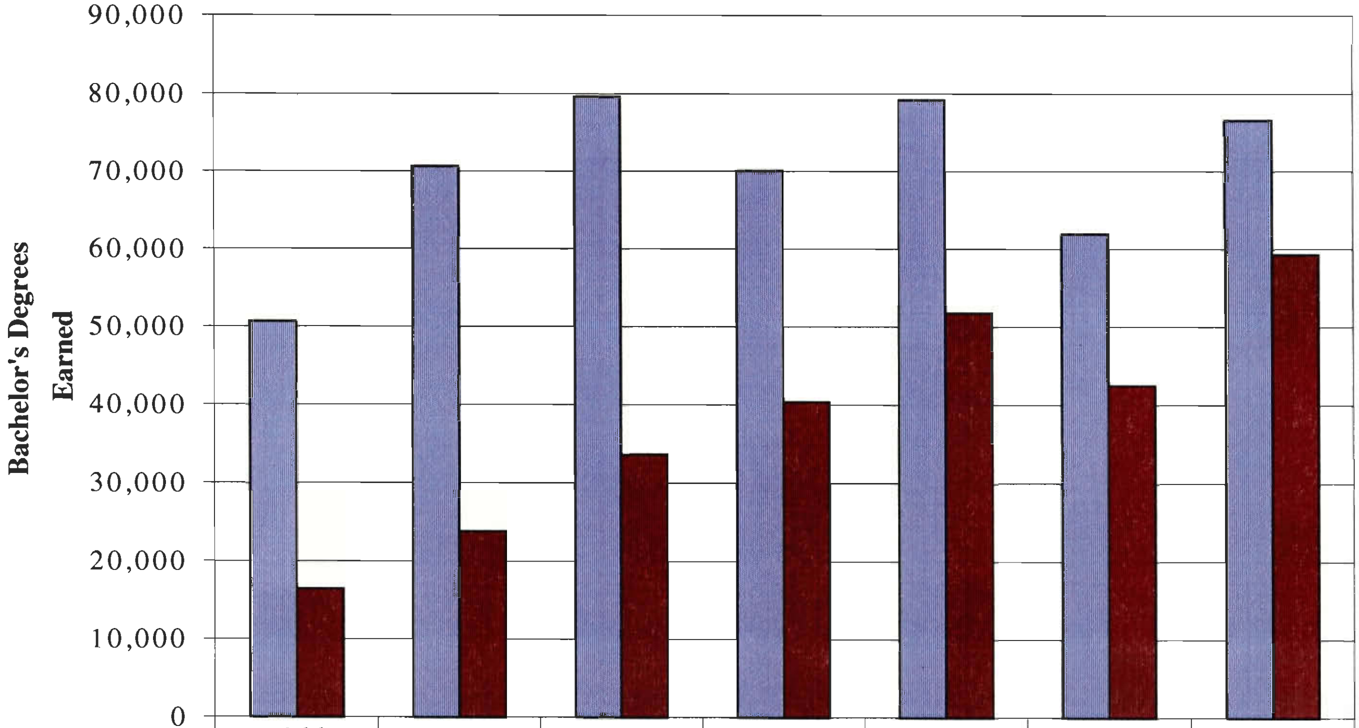
3.2.2.1. Student Representation in Sciences

Through NSF 99-330, Susan Hill shows that the male representation far exceeds that of the female with regard to students receiving degrees in a science related field (Figure 3.5). Also, according to Richard Zare, in his 1998 study "Science and Engineering Indicators," since 1977 the white representation in science fields has, by far been the largest of any ethnic group (Figure 3.6).

- **Sciences-Gender**

Figure 3.5 shows that, since 1966, the number of males receiving bachelor's degrees in scientific fields has been increasing steadily. However, the number of women receiving bachelor's degrees in these fields has increased at a much higher rate over the same time period (NSF 99-330). The number of women receiving bachelor's degrees in sciences has more than tripled since 1966, growing from 16,500 to 59,320 in 1996. While the number of male students receiving degrees in this field has grown over 25,000 since 1966, the representation of males has fallen from 75% in 1966 to 56% in 1996 (Figure 3.5). It is interesting to note that in 1986 the total number of bachelor's degrees awarded in science reached 131,027. However since then there has been a decrease in the number of males receiving bachelor's degrees and a total increase of only 4,000.

Figure 3.5
Sciences-Gender



	1966	1971	1976	1981	1986	1991	1996
Male	50,657	70,696	79,643	70,102	79,218	61,906	76,623
Female	16,500	23,848	33,653	40,366	51,809	42,477	59,320

Year

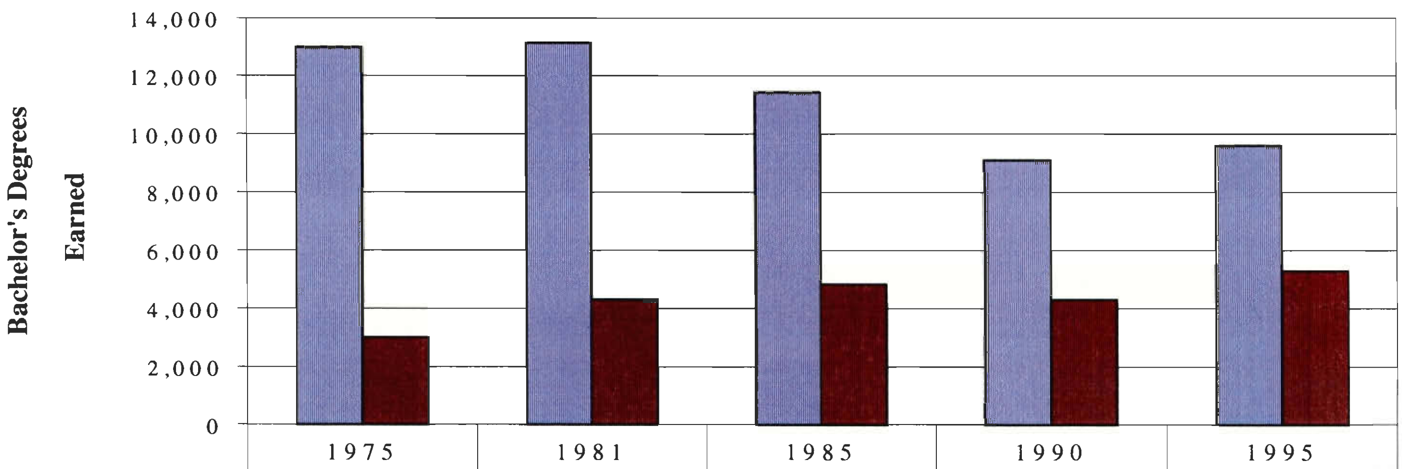
Hill, Susan T. "Science and Engineering Degrees: 1966-96." National Science Foundation: Division of Science Resources Studies. NSF 99-330. Arlington, VA 1999.

Now let us look at the differences between genders in the fields of: physical science, computer sciences, biological and agricultural sciences and earth/atmosphere/ocean sciences.

– *Physical Science*

The physical science tends to be comparable to that of the science in general, when looking at gender (Figure 3.6).

Figure 3.6
Physical Science-Gender



	1975	1981	1985	1990	1995
Male	12,990	13,137	11,434	9,106	9,605
Female	3,011	4,309	4,836	4,319	5,292

Year

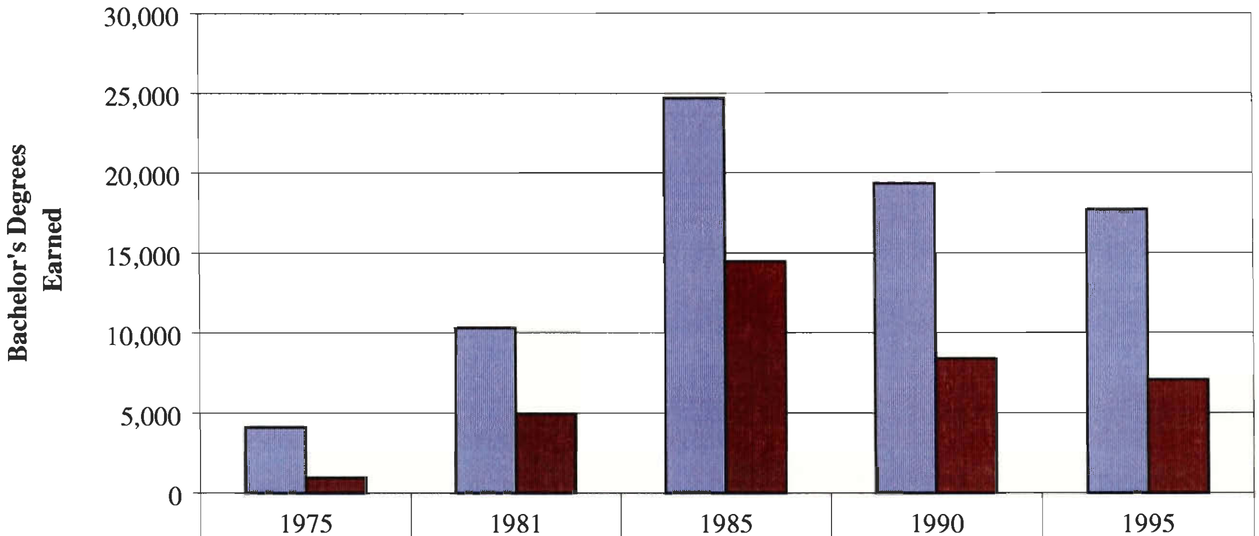
Zare, Richard N "Science and Engineering Indicators – 1998" National Science Foundation-National Science Board. Arlington VA, 1999.

In 1975, 18% of the16,001 bachelor's degrees awarded in physical science were awarded to women (Figure 3.6). As can be seen by the figure, although the number of bachelor's degrees earned by women in this field oscillates, the percentage increases continuously. For instance, from 1975 to 1981 the amount of women in physical science increased by about 1,300 women but since the representation of men only went up by about 150, the percentage of women increased to 24% (Figure 3.6). In 1985, the amount of men receiving degrees in the physical science dropped off will the representation of women continued to increase, women were then awarded 4,836 of 16,270 the bachelor's degrees (Figure 3.6). Of the 13,425 physical science bachelor's degrees awarded in 1990, 4,319 were given to women. Although this was a decrease from 1985, the percent increased to 32% due to the larger decrease in males earning degrees in this field (Figure 3.6). Then in 1995, both the male and female earned degrees increase yet there is a higher increase of women thus causing the percentage to increase to 35% of the total 14,897 bachelor's degrees awarded in physical science (Figure 3.6).

– *Computer Sciences*

Of all the sciences, computer sciences are least like sciences as a whole. In 1975, 18% of the computer science bachelor's degrees were awarded to women (Figure 3.7). The increase from 1975 to 1981 was more than five times, which nearly doubles the percentage of women to 32% (Figure 3.7). In 1985, the number of women who received bachelor's degrees in computer sciences reached an all time high of 14,431, but the percentage of women's degrees only went up to 36% because of the dramatic increase by men in the field (Figure 3.7). After 1985, the number of degrees of both the males and females begin to decrease. Of the 27,695 degrees awarded, in 1990, 30% of them were given to women (Figure 3.7). Then, in 1995, the representation of women went down to 28% or 7,063 of all the bachelor's degrees that were awarded that year in computer sciences (Figure 3.7).

Figure 3.7
Computer Sciences-Gender



	1975	1981	1985	1990	1995
Male	4,083	10,280	24,690	19,321	17,706
Female	956	4,953	14,431	8,374	7,063

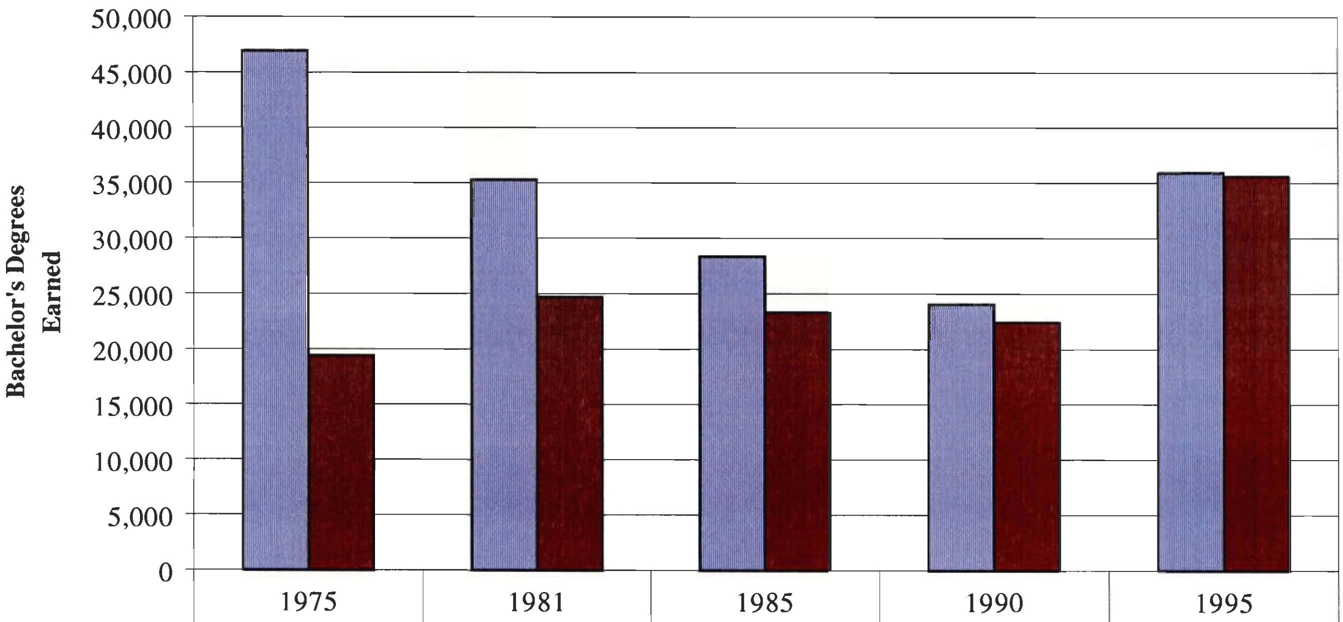
Year

Zare, Richard N "Science and Engineering Indicators – 1998" National Science Foundation-National Science Board. Arlington VA, 1999.

– *Biological and Agricultural Sciences*

The biological and agricultural sciences have been and continue to be the most diverse of all the sciences, when looking at gender.

Figure 3.8
Biological and Agricultural Sciences-Gender



	1975	1981	1985	1990	1995
Male	46,937	35,265	28,298	24,050	35,915
Female	19,384	24,657	23,285	22,401	35,555

Year

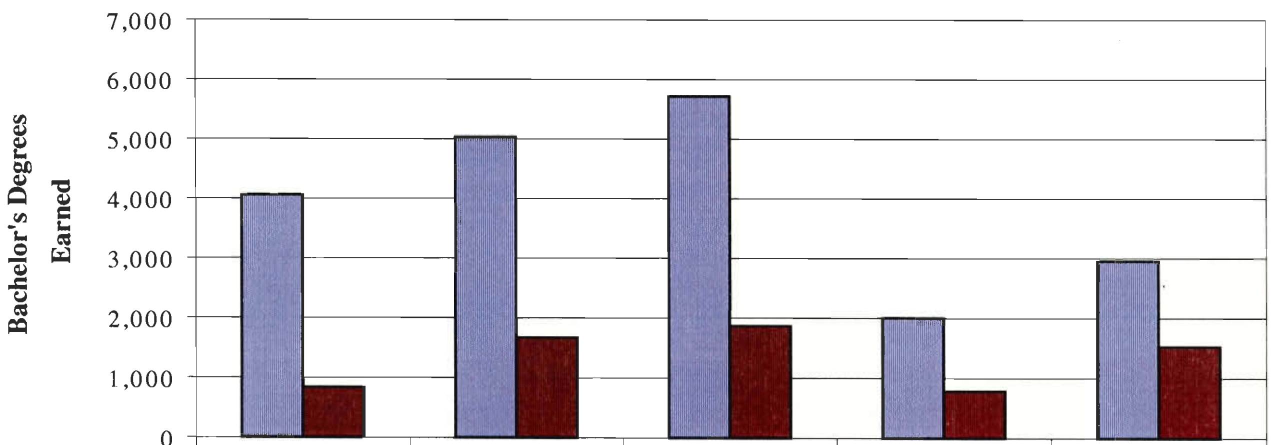
Zare, Richard N "Science and Engineering Indicators – 1998" National Science Foundation-National Science Board. Arlington VA, 1999.

In 1975, 29% of all the biological science bachelor's degrees were awarded to women (Figure 3.8). This begins the convergence of the total awards given to men and those given to women over this time period. Between 1975 and 1981, the number of males earning degrees decreased while the number of women earning degrees increased. This increased the percentage of women earning bachelor's degrees to 41% (Figure 3.8). Both the male and female earned degrees decreased from 1981 to 1985, but since the male earned degrees decreased more the percentage of women's bachelor's degrees increased to 45% (Figure 3.8). Again in 1990, both genders decrease further, but since the male representation decreases much more the percentage of women increase to 48% (Figure 3.8). Finally, in 1995, both representations increase significantly, and almost become equal to one another, the difference between the two genders here is less than 400 degrees, which gives females a representation of 49% (Figure 3.8).

– *Earth/Atmosphere/Ocean Sciences*

Earth/atmosphere/ocean sciences have changes that are very close to the changes that occur in sciences in general.

Figure 3.9
Earth/Atmosphere/Ocean Sciences-Gender



	1975	1981	1985	1990	1995
Male	4,050	5,028	5,715	2,001	2,954
Female	827	1,666	1,861	775	1,524

Year

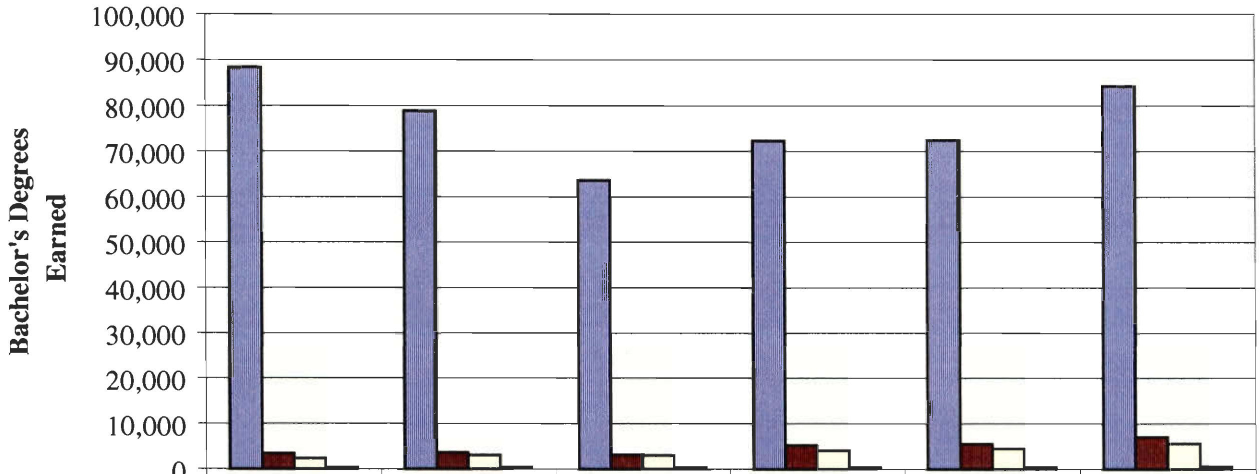
Zare, Richard N "Science and Engineering Indicators – 1998" National Science Foundation-National Science Board. Arlington VA, 1999.

In 1975, the number of women earning bachelor's degrees in earth/atmosphere/ocean sciences was only 827 of the total 4,877 that were awarded that year. From 1975 to 1981 the number of women earning degrees doubles, this gives the women a percentage of 25% in 1981 (Figure 3.9). In 1985, the number of women earning bachelor's degrees in earth/atmosphere/ocean sciences continues to grow, reaching a high of 1,861; but since the number of male awarded bachelor's degrees also reaches a high over this time period the percentage of female awarded degrees goes down to 24% (Figure 3.9). In 1990, there is a tremendous drop off of over a half of the previous numbers in 1985. Even though the drop is quite large the percentage of women earning degrees in these fields actually increases to 27% (Figure 3.9). Finally in 1995, both genders experience a increase in the number of bachelor's degrees they were awarded in earth/atmosphere/ocean sciences. At this time women were awarded 1,524 of the 4,478 bachelor's degrees given that year (Figure 3.9).

- **Sciences-Ethnicity**

Between the years of 1977 and 1985 the number of white students receiving bachelor's degrees in a scientific fields dropped over 25%. This, however, is characteristic of the other ethnic groups during the same time period, although their drops were not nearly as large. The Hispanics were the only group to increase their numbers during this time, growing more than 700. The next ten years, from 1985 to 1995, showed an increase in all ethnic group representation in scientific fields. The largest percent growth was realized by the African-Americans, increasing over 125%, with the percent increase shown by the white students, increasing 32%. However, the white students showed the largest growth by number, increasing over 20,000.

Figure 3.10
Sciences-Ethnicity



	1977	1981	1985	1989	1992	1995
White	88,308	78,778	63,592	72,291	72,410	84,232
African American	3,416	3,561	3,096	5,213	5,497	7,026
Hispanic	2,271	2,958	2,979	4,044	4,410	5,583
Native American	338	298	313	355	383	617

Year

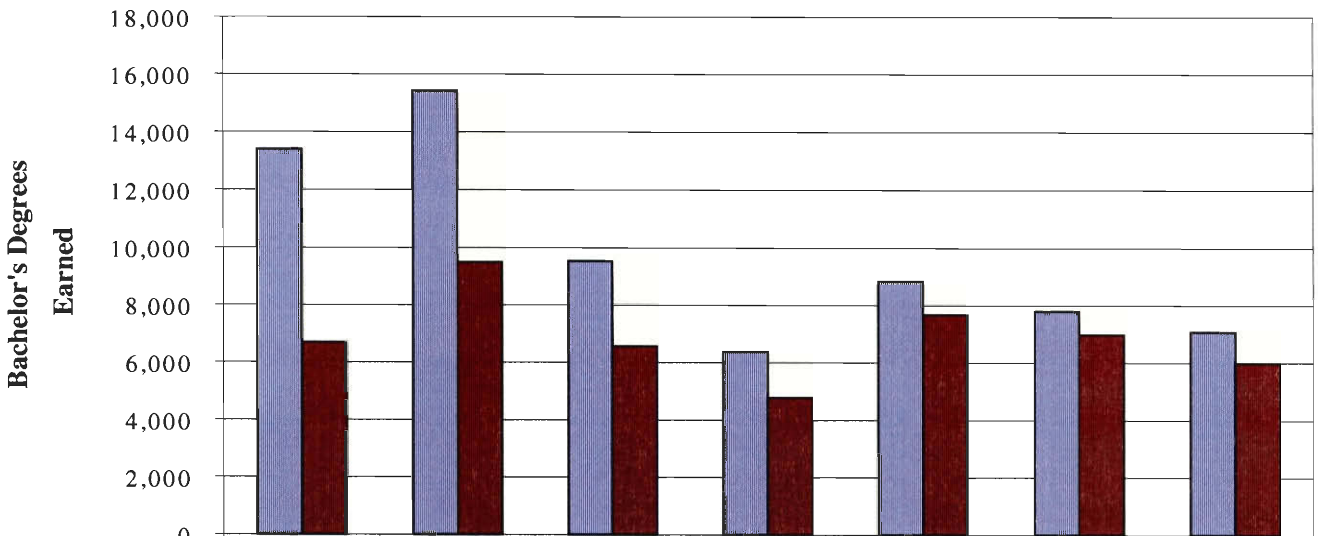
Zare, Richard N "Science and Engineering Indicators – 1998" National Science Foundation-National Science Board. Arlington VA, 1999.

3.2.2.2. Student Representation in Mathematics

In the field of mathematics, dominance in representation by males has begun to decline, with an ever-increasing percentage of females receiving the mathematics degrees (Figure 3.11). However, the representation according to ethnicity has not shown the same leveling out. The white student representation still far exceeds that of any other ethnic group (Figure 3.12).

- **Mathematics-Gender**

Figure 3.11
Mathematics-Gender



	1966	1971	1976	1981	1986	1991	1996
Male	13,401	15,424	9,531	6,392	8,851	7,804	7,084
Female	6,689	9,494	6,554	4,781	7,680	6,980	5,992

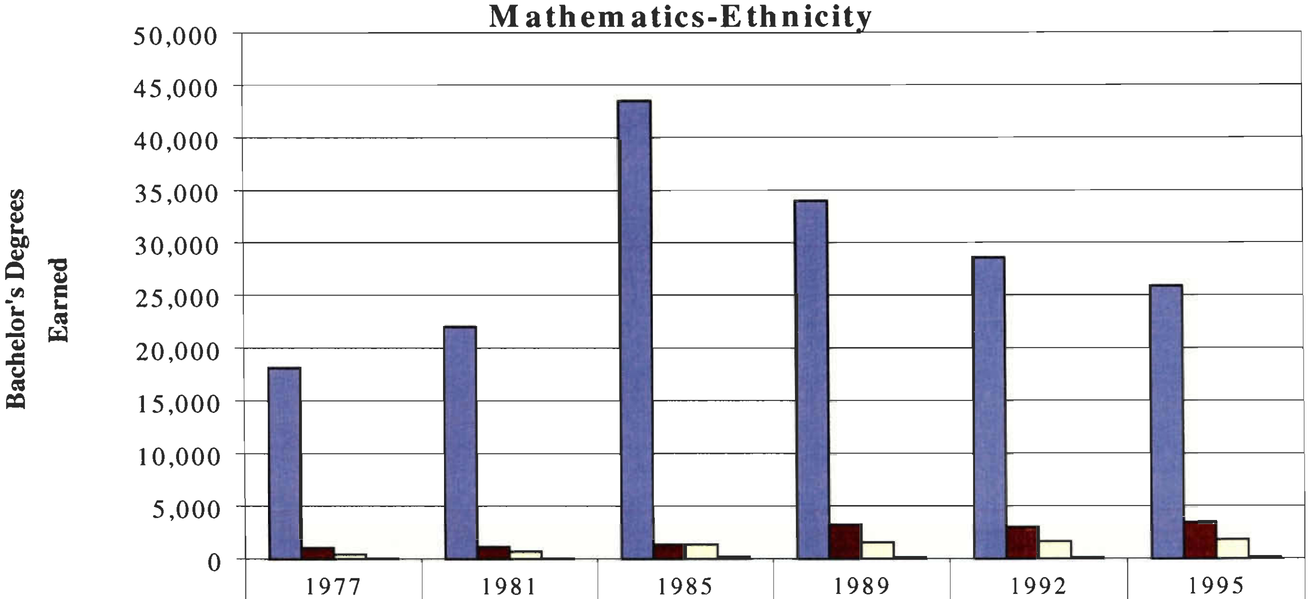
Year

Hill, Susan T. "Science and Engineering Degrees: 1966-1995." National Science Foundation: Division of Science Resources Studies. NSF 97-335. Arlington, VA 1997.

The number of bachelor's degrees awarded in 1966, 20,090, was significantly greater than the 13,851 given out in 1995 (NSF 97-335). The male population has showed the greatest decline in interest in the mathematical field, lowering the number of bachelor's degrees earned from 13,400, or 66%, in 1966, to 7,360, or 53% in 1995 (NSF 97-335). The interest of women in the mathematical field has fluctuated greatly over the last 30 years. The number of bachelor's degrees awarded in 1966 was 6,689, while in 1996 it was 5,992, a drop of 697. However, the percentage of degrees awarded to females in this field has risen from 33% in 1966 to 47% in 1995 (NSF 97-335). It is interesting to note that in 1971 the number of degrees awarded to women had grown to 9,494, but in 1981 it had fallen to 4,781 (NSF 97-335).

- **Mathematics-Ethnicity**

Figure 3.12
Mathematics-Ethnicity



	1977	1981	1985	1989	1992	1995
White	18,110	22,013	43,484	33,998	28,567	25,875
African American	1,073	1,159	1,371	3,249	2,994	3,493
Hispanic	435	688	1,380	1,568	1,655	1,843
Native American	41	39	198	143	125	168

Year

-Hill, Susan T. "Science and Engineering Degrees by Race/Ethnicity of Recipients, 1989-1995." National Science Foundation: Division of Science Resources Studies. NSF 97-334. Arlington, VA 1997.
- Zare, Richard N. "Science and Engineering Indicators – 1998." National Science Foundation-National Science Board. Arlington VA, 1999.

The number of bachelor's degrees awarded in mathematics has changed greatly since 1977, especially among white students, where this number reached a high of 43,484 in 1985, an increase of 140% in eight years. However, as Figure 3.12 shows, in the next ten years this number dropped 40%, to 25,875 in 1995. African-American representation in mathematics is the highest of any minority ethnic group. In 1989, African-Americans received 3,249 bachelor's degrees in mathematics, over 65% of the total degrees awarded to underrepresented groups in mathematics (NSF 97-334). In 1995, African-Americans over 60% of the degrees awarded to minorities in mathematics, increasing the total number of degrees earned to 3,493.

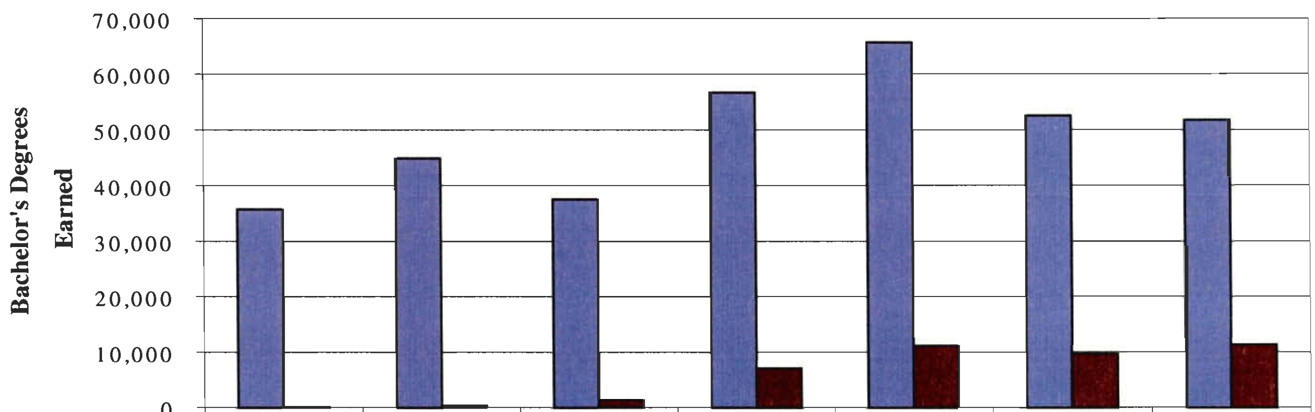
Hispanic representation in mathematics has steadily increased since 1977, more than quadrupling their number in less than 20 years. In 1989, 373 Hispanics received bachelor's degrees in mathematics, 30% of the total degrees earned. By 1995 over 33% of all bachelors' degrees given to underrepresented groups in mathematics were awarded to Hispanics (NSF 97-334). The growth rate of Hispanics in this field has remained relatively constant with the other underrepresented groups in mathematics. The Native Americans, whose percentage growth form 1977 to 1995 in obtaining bachelor's degrees in mathematics has been very consistent with the other minority groups, is vastly underrepresented in this field (NSF 97-334). Figure 3.12 shows that Native Americans received only 168 bachelor's degrees in 1995, which was not even 1% of all the bachelor's degrees awarded in mathematics in 1995.

3.2.2.3. Student Representation in Engineering

Engineering has proven to be one of the least diverse fields with respect to both gender and ethnicity, even though over the past few years the field of engineering has shown a decrease in enrollment and an increase in diversity (Zare, 1998). It can be seen that both the male representation when looking at gender (Figure 3.13) and the white representation when looking at ethnicity (Figure 3.18) are the largest in the engineering discipline.

- **Engineering-Gender**

Figure 3.13
Engineering-Gender



	1966	1971	1976	1981	1986	1991	1996
Male	35,680	44,887	37,473	56,654	65,682	52,522	51,798
Female	146	361	1,317	7,063	11,138	9,665	11,316

Year

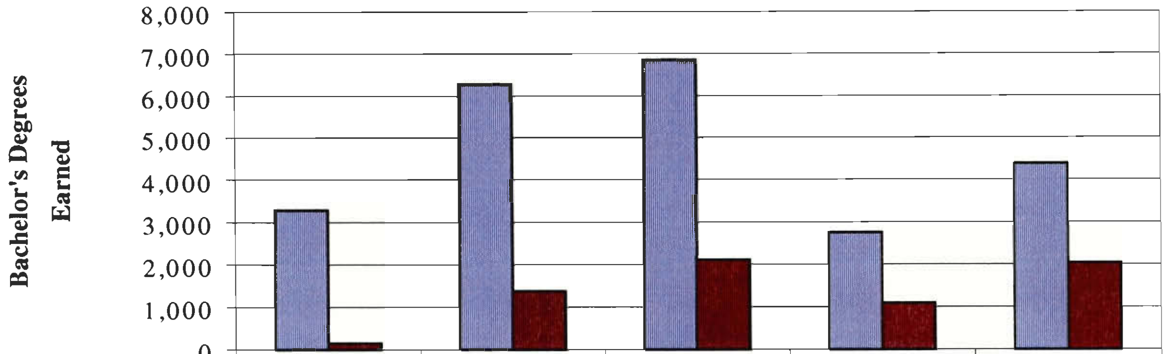
Hill, Susan T. "Science and Engineering Degrees: 1966-96." National Science Foundation: Division of Science Resources Studies. NSF 99-330. Arlington, VA 1999.

In 1966, of the 35,826 engineering bachelor's degrees awarded, 35,680 went to men compared to the 146 that women received. That means that 99.6% of all engineering degrees awarded in 1966 were given to males. However, by 1980 5,953 women received bachelor's degrees, which was 10% of the total awarded degrees (NSF 99-330). According to Figure 3.13 the number of males receiving a bachelor's degree in engineering reached an all time high of 65,682 in 1986, but that was only 85% of the total number of bachelor's degrees given out in engineering that year. This is due to the fact that at this time the female representation was near a high point in the years from 1966 to 1996, reaching 11,138. In 1996, however, after increasing the number of males receiving bachelor's degrees by over 16,000 since 1966, the percentage of all engineering degrees that were awarded to men had dropped to 82% (NSF 99-330). From 1986 to 1996 the total number of women receiving bachelor's degrees had increased only 178, but 18% of the degrees awarded were to women (NSF 97-335 and NSF 99-330).

It is also of interest to see trends in the different engineering fields based on gender. The fields that will be targeted are the four major fields of engineering Chemical, Civil, Electrical and Mechanical. This will give a better idea of the differences and similarities that occur.

– *Chemical Engineering*

Figure 3.14
Chemical Engineering-Gender



	1975	1981	1985	1990	1995
Male	3,273	6,274	6,848	2,745	4,367
Female	147	1,365	2,093	1,089	2,024

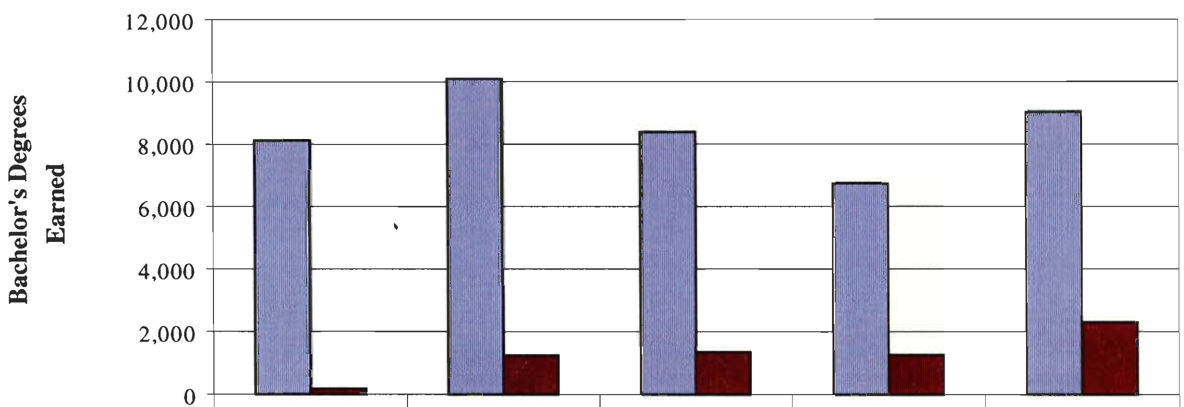
Year

Hill, Susan T. "Science and Engineering Degrees: 1966-96." National Science Foundation: Division of Science Resources Studies. NSF 99-330. Arlington, VA 1999.

Among the different engineering fields chemical engineering has become the most diverse with respect to gender. As can be seen from Figure 3.14, in 1975 the field was not very diverse for women, only 147 of the bachelor's degrees that were awarded were given to women, or only 4%. As time progressed more and more women were awarded bachelor's degrees in this field. In 1981, 1,365 of the bachelor's degrees in chemical engineering were awarded to women, which represents nearly a ten fold increase. At this time the degrees that were awarded to males were also on the rise, but not as much as the increase in women. In 1985, both the number of degrees awarded to men and women reached highs of 6,848 and 2,093 respectively (Figure 3.14). Then, in 1990, both dropped significantly: the male representation was approximately one-third of what it was in 1985, while the female representation was nearly half of its high from 1985. At this point women account for a large percentage of the bachelor's degrees in chemical engineering at around 28%. This was similar in 1995 as well, because both groups nearly doubled from their numbers from 1990 (Figure 3.14). In 1995, 2,024 of the bachelor's degrees awarded were given to women of the 6,391 given that year. That is approximately 31%, up from only 4% in 1975. This is by far the most diverse field of engineering, when looking at gender.

– *Civil Engineering*

Figure 3.15
Civil Engineering-Gender



	1975	1981	1985	1990	1995
Male	8,116	10,100	8,388	6,730	9,031
Female	173	1,231	1,342	1,262	2,298

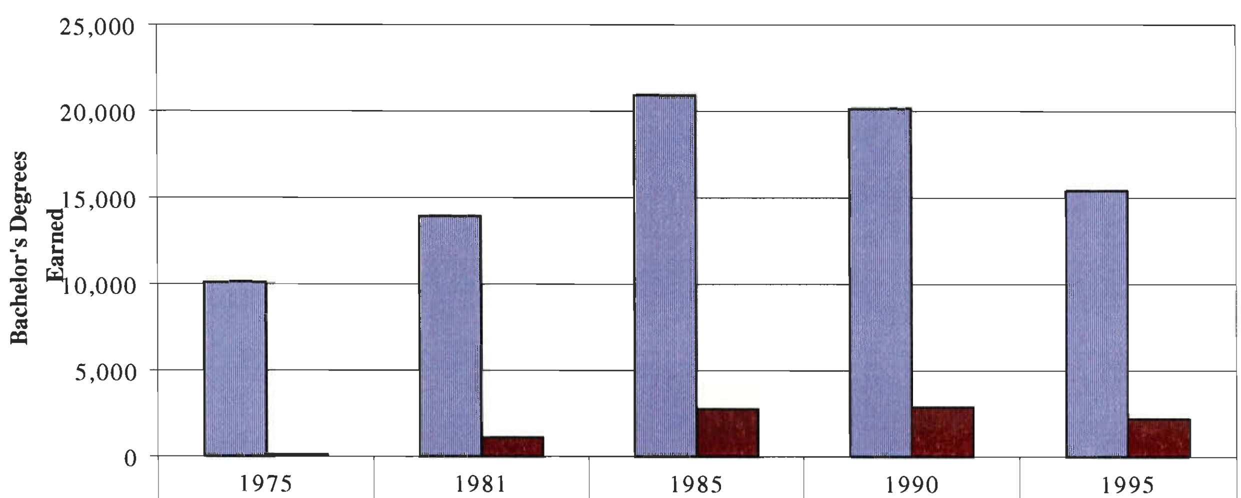
Year

Hill, Susan T. "Science and Engineering Degrees: 1966-96." National Science Foundation: Division of Science Resources Studies. NSF 99-330. Arlington, VA 1999.

Although civil engineering is not nearly as diverse as chemical engineering, it is the second most diverse field of engineering of the ones being considered here. In 1975, as can be seen by Figure 3.15, the field of civil engineering was not very diverse at all, with only 173 of the 8,289 bachelor's degrees awarded to women, or only two percent. In 1981, the number of bachelor's degrees increased almost ten times. Over the next ten years the number of civil engineering degrees awarded to women did not fluctuate all that much while the degrees given to men fluctuated to a much larger extent (Figure 3.15). In 1995, the number of bachelor's degrees awarded to women reached a high of 2,298, or 20% of the 11,329 total civil engineering bachelor's degrees awarded that year. Thus, the change in bachelor's degrees in the field of civil engineering went from only 2% in 1975, to 20% in 1995 and increased of more then ten times.

– *Electrical Engineering*

Figure 3.16
Electrical Engineering-Gender



	1975	1981	1985	1990	1995
Male	10,116	13,940	20,936	20,148	15,409
Female	130	1,100	2,732	2,867	2,170

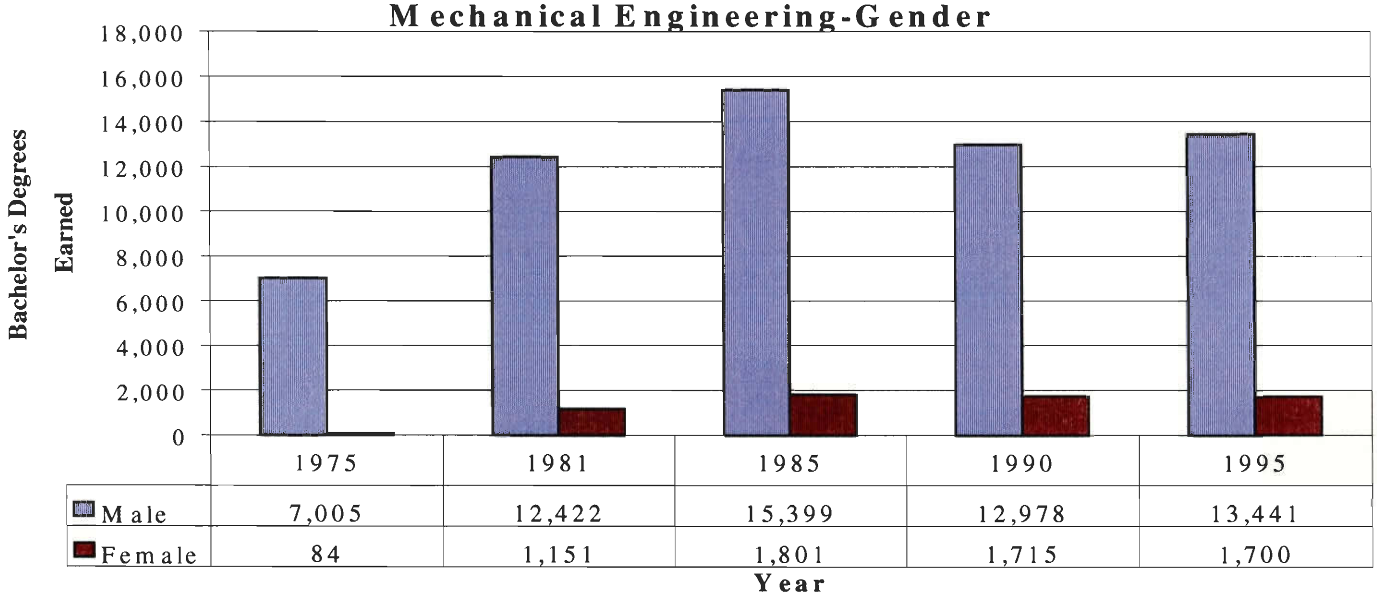
Year

Hill, Susan T. "Science and Engineering Degrees: 1966-96." National Science Foundation: Division of Science Resources Studies. NSF 99-330. Arlington, VA 1999.

Of all the engineering fields electrical engineering is one of the least diverse of the four main fields that are looked at when discussing gender. In 1975, only 1% of all the electrical engineering bachelor's degrees awarded went to women (Figure 3.16). The percent increase in women from 1975 to 1981 was more then that of men in this field, as can be seen in Figure 3.16. The number of women in 1981 was nearly ten times that of 1975, which increased their representation in electrical engineering to 7%. In 1985, the amount of women in this field more than doubled, but since male representation also increased, the percentage of females receiving bachelor's degrees in electrical engineering only increased to 11% of the 23,668 awarded that year (Figure 3.16). Both in 1990 and 1995 the representation of women in this field stayed around 12% although the total numbers of degrees awarded decreased from 1990 to 1995 (Figure 3.16). These two years give the highest percentage of women in the electrical engineering field, while in 1990 the number of women obtaining bachelor's degrees in this field reached a maximum of this time period, as shown in Figure 3.16.

– *Mechanical Engineering*

Figure 3.17
Mechanical Engineering-Gender

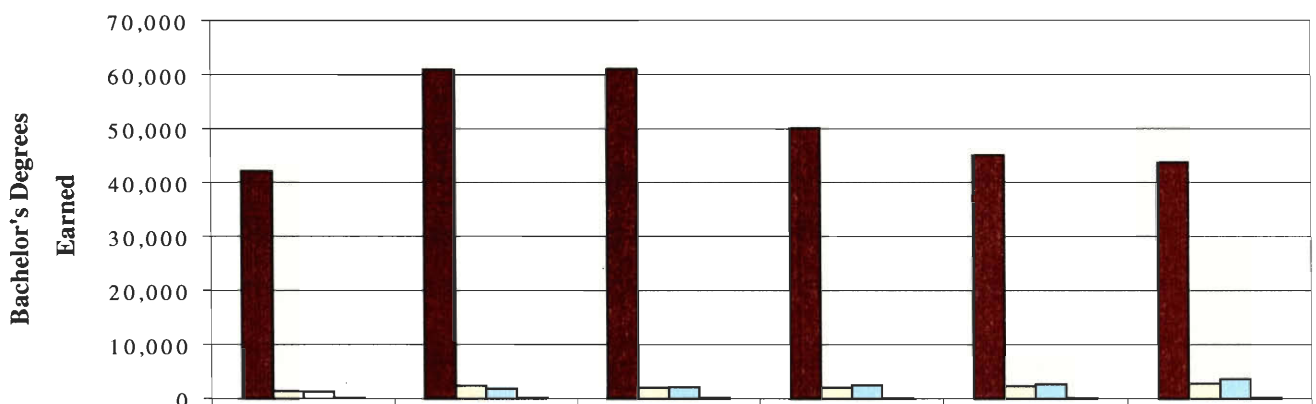


Hill, Susan T. "Science and Engineering Degrees: 1966-96." <u>National Science Foundation: Division of Science Resources Studies</u>. NSF 99-330. Arlington, VA 1999.

Mechanical engineering has been seen as being the least diverse of the four fields of engineering that were discussed. Of the 7,089 bachelor's degrees awarded in mechanical engineering in 1975 only 84 were given to women, which is only 1% (Figure 3.17). In 1985, the number of female awarded mechanical engineering bachelor's degrees increased significantly, well over ten times as many females were awarded bachelor's degrees here as in 1975 (Figure 3.17). Both the male and female representations in this field continued to increase until they reach high points in 1985. At this point the degrees awarded to women were 10% of the total 17,200 bachelor's degrees awarded, as can be seen in Figure 3.17. From 1990 to 1995 there is not too much of a change in the percentage of bachelor's degrees that were awarded to women, it stayed at around 11% over this span (Figure 3.17). The number of degrees awarded to women in 1990, dropped from its high in 1985, by nearly one thousand to 1,715 degrees. Since the degrees awarded to males fell as well the percentage of women receiving bachelor's degrees in this field was not hurt, in fact it grew to 11% from the previous 10% (Figure 3.17). In 1995, of the 15,141 bachelor's degrees awarded, women obtained 1,700, which was around 11% as before in 1990 (Figure 3.17). Since, mechanical engineering has the smallest percentages of women receiving bachelor's degrees it can be seen as the least diverse field of engineering, with respect to gender.

- **Engineering-Ethnicity**

Figure 3.18
Engineering-Ethnicity



	1977	1981	1985	1989	1992	1995
White	42,072	60,856	60,992	50,081	45,026	43,726
African American	1,385	2,449	2,039	2,067	2,362	2,845
Hispanic	1,290	1,820	2,187	2,561	2,733	3,651
Native American	135	195	209	177	182	221

Year

-Hill, Susan T. "Science and Engineering Degrees by Race/Ethnicity of Recipients, 1989-1995." National Science Foundation: Division of Science Resources Studies. NSF 97-334. Arlington, VA 1997.
-Zare, Richard N "Science and Engineering Indicators – 1998." National Science Foundation-National Science Board. Arlington VA, 1999.

The total number of bachelor's degrees in engineering fields obtained by white students increased sharply from 1977 to 1985, but since then has declined. In 1977, a total of 42,072 engineering degrees were awarded to white students, over 90% (Zare, 1999). In 1985, the 60,992 bachelor's degrees engineering that white students received still comprised over 90% (Figure 3.18). By 1995, the number of white students receiving engineering degrees had dropped nearly 17,000 and the percentage had dropped nearly 10 points (Zare, 1999). This means that white students are still the vast majority in the engineering, but the gap is beginning to shrink (Justiz, 1994).

The number of African-American students entering the engineering field and obtaining degrees has been steadily increasing over the past few decades. This increase has been keeping pace with the other minority groups in the engineering field. In 1977, African-Americans accounted for 1,385 of 2,810 bachelor's degrees awarded in engineering to underrepresented ethnic groups, or 49% (Zare, 1999). In 1995 the total number of African-Americans receiving engineering degrees had grown to 2,845, a 37% increase from 1989, which accounted for 42% of the total degrees awarded to minority groups (NSF 97-334).

Figure 3.18 shows that the Hispanic student representation in the engineering field has continued to grow since 1977. Increasing from 1,290 bachelor's degrees in 1977 to 2,561 in 1989 to 3,651 degrees earned in 1995 (NSF 97-334). The Hispanic population has proven to be the most represented ethnic group in the engineering field. In 1989, Hispanics received 53% of all bachelors' degrees awarded to underrepresented groups and in 1995 that number increased to 55% (NSF 97-334).

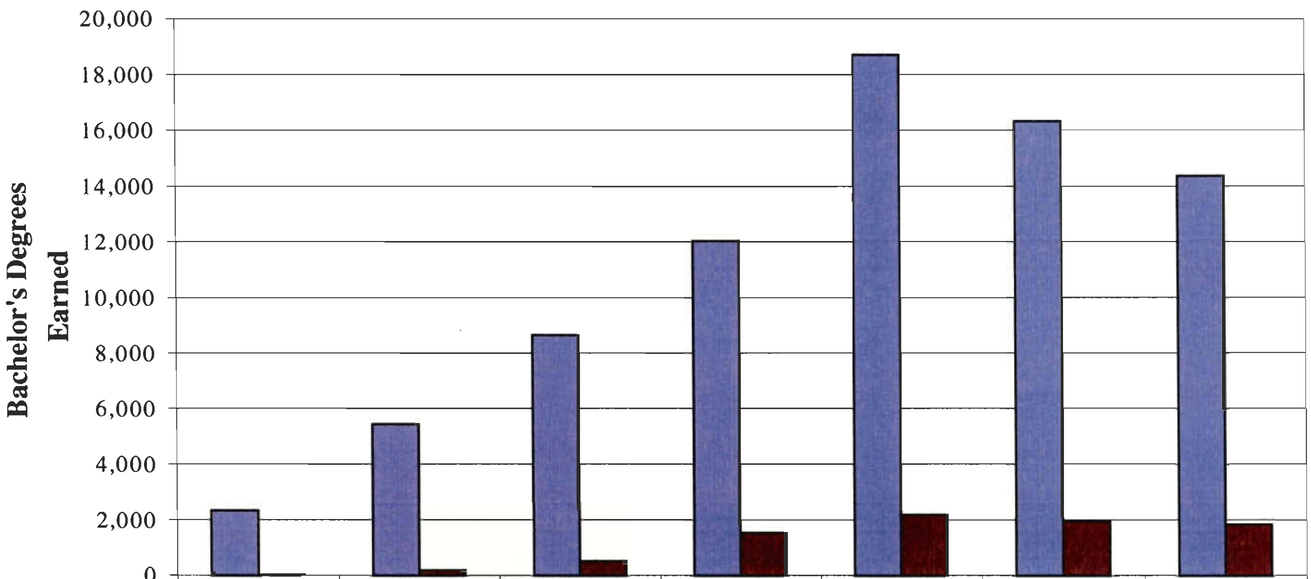
The Native Americans, on the other hand, are by far the most underrepresented ethnic group in engineering, however their rate of growth in this field is consistent with the other ethnic groups. From 1977 to 1985, this group showed exceptional growth, percentage wise, however a decline from 1985 to 1989 proved to be a major setback, as shown by Figure 3.18. In 1989, there were only 177 Native Americans that received engineering bachelor's degrees, accounting for only 4% of the degrees awarded to minority ethnic groups (NSF 97-334). In 1995, their representation had grown to 221, still right around 4% (Zare, 1999).

3.2.2.4. Student Representation in Technology

The white (Figure 3.19) and male (Figure 3.20) representations are by far the largest in the technological fields. However, this gap is becoming smaller, largely due to the fact that both of these representations have decreased in the past decade, while the female representation (Figure 3.12) and the number of African-Americans, Hispanics, and Native Americans receiving degrees have both increased over this time (Figure 3.13).

- **Technology-Gender**

Figure 3.19
Technology-Gender



	1966	1971	1976	1981	1986	1991	1996
Male	2,334	5,436	8,656	12,034	18,706	16,329	14,382
Female	23	190	524	1,533	2,194	1,965	1,846

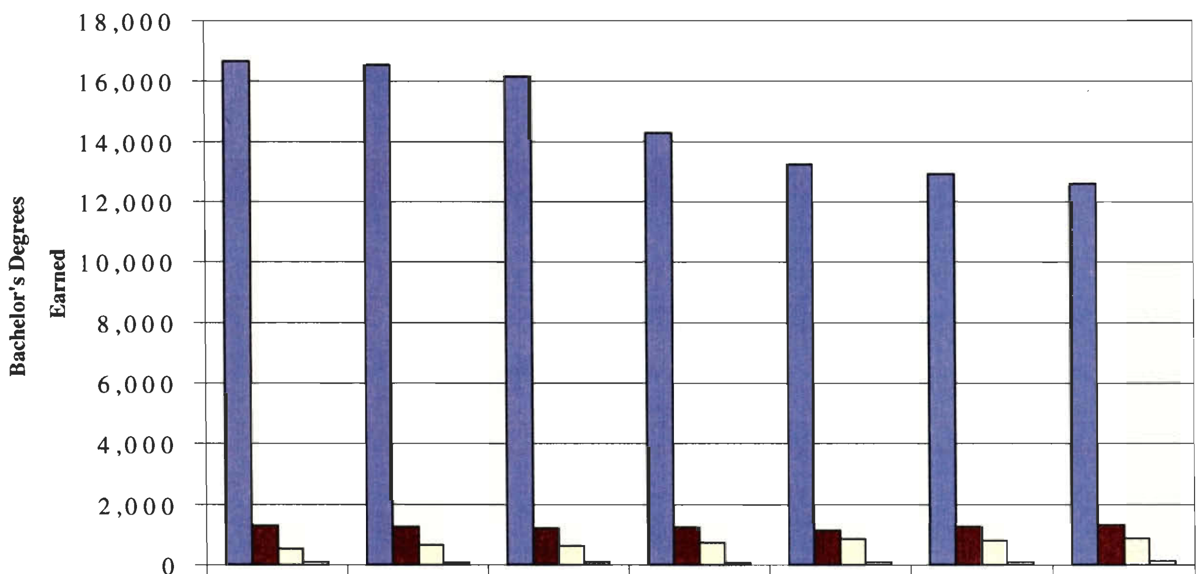
Year

Hill, Susan T. "Science and Engineering Degrees: 1966-96." National Science Foundation: Division of Science Resources Studies. NSF 99-330. Arlington, VA 1999.

The male population in the technology field far outweighs that of the females. In 1966, males received 99% of the technological bachelor's degrees awarded. Although the male representation has remained relatively constant, peeking at 18,706 in 1986, the number has begun to fall, dipping to 14,382 in 1996. However, this growth rate has kept pace with the female growth rate. The females also reached a peek in 1986 of 2,194, which constituted 11% of the total. Even though the total number of females receiving bachelor's degrees in technology dropped to 1,846 in 1996, the percentage of the total stayed at 11% (Figure 3.19).

- **Technology-Ethnicity**

Figure 3.20
Technology-Ethnicity



	1985	1987	1989	1991	1993	1994	1995
White	16,673	16,541	16,156	14,279	13,245	12,909	12,616
African American	1,277	1,269	1,208	1,227	1,132	1,249	1,319
Hispanic	525	664	634	731	853	813	883
Native American	103	78	105	75	111	98	115

Year

Zare, Richard N "Science and Engineering Indicators – 1998." National Science Foundation-National Science Board. Arlington VA, 1999.

Figure 3.20 shows that white students are by far the majority in the technology field, however, this gap is becoming smaller. It is not so much due to an overwhelming growth in the other ethnic groups, but instead because of an alarming decrease in the white representation. In 1985, 16,673 white students received degrees, nearly 90% of all the technology degrees awarded. By 1991, all ethnic groups had suffered a loss in this area, with the total number of degrees dropping from 18,578 in 1985 to 16,312. From 1991 to 1995 the white representation was the only one that suffered a loss, dropping by nearly 2,000. Native Americans representation grew over 50% even though there was an actual increase of only 40 students. The number of degrees that Hispanics and African-Americans received grew a very small amount from 1985 to 1995, however the percentage of technology bachelor's degrees awarded to African-Americans and Hispanics grew immensely, to 8% and 5% respectively, due in large part to the drop in white representation.

3.3. Retention

One major aspect of the problem of minority participation is how to retain, those who enroll in a college or university. Even though, as seen earlier in this paper, the representation of minority students in the scientific fields has increased during the past 20 years, the number of African American and American Indian graduates "actually declined for the first time in almost a decade" (Georges, 1999). Thus, institutions are now looking more at how to retain the minority students that have been successfully enrolled in higher education. In the study "Keeping What We've Got: The Impact of Financial Aid on

Minority Retention in Engineering", Annie Georges based her analysis on the entering freshman classes from 1991-92, 1992-93, and 1993-94; and the graduating classes of 1995-96, and 1997-98; she found that the minority enrollment in engineering programs had increased 1.6% between 1992-93 and 1993-94 but the percentage of minority graduates grew only 1.0% between 1995-96 and 1996-97. These numbers show that there is a disparity between the enrollment and the graduation numbers of minority students. The so-called "retention rate", which is the comparison of the rate at which minority students graduate with the rate at which non-minority students graduate, is used to compare aggregate enrollment with aggregate graduation data. This measure accounts for the time it takes to complete a bachelor's degree, the point at which students can declare their major, and the possibility that students transfer to other institutions. The study showed that "a minority student entering a college engineering program is only half as likely (53.4 percent) to obtain a bachelor's of science degree in engineering as a nonminority student." The comparison of the freshman classes of 1991 to 1993 with the graduating class of 1996 to 1998 showed that 36% of freshmen students are retained through the bachelor's degree. There has been an increase since 1995, when the relative retention was 59.1% (Georges, 1999). Table 3.1 shows the evolution of these numbers from 1980 to 1998.

Table 3.1 National Engineering Retention Rates and Relative Retention Index

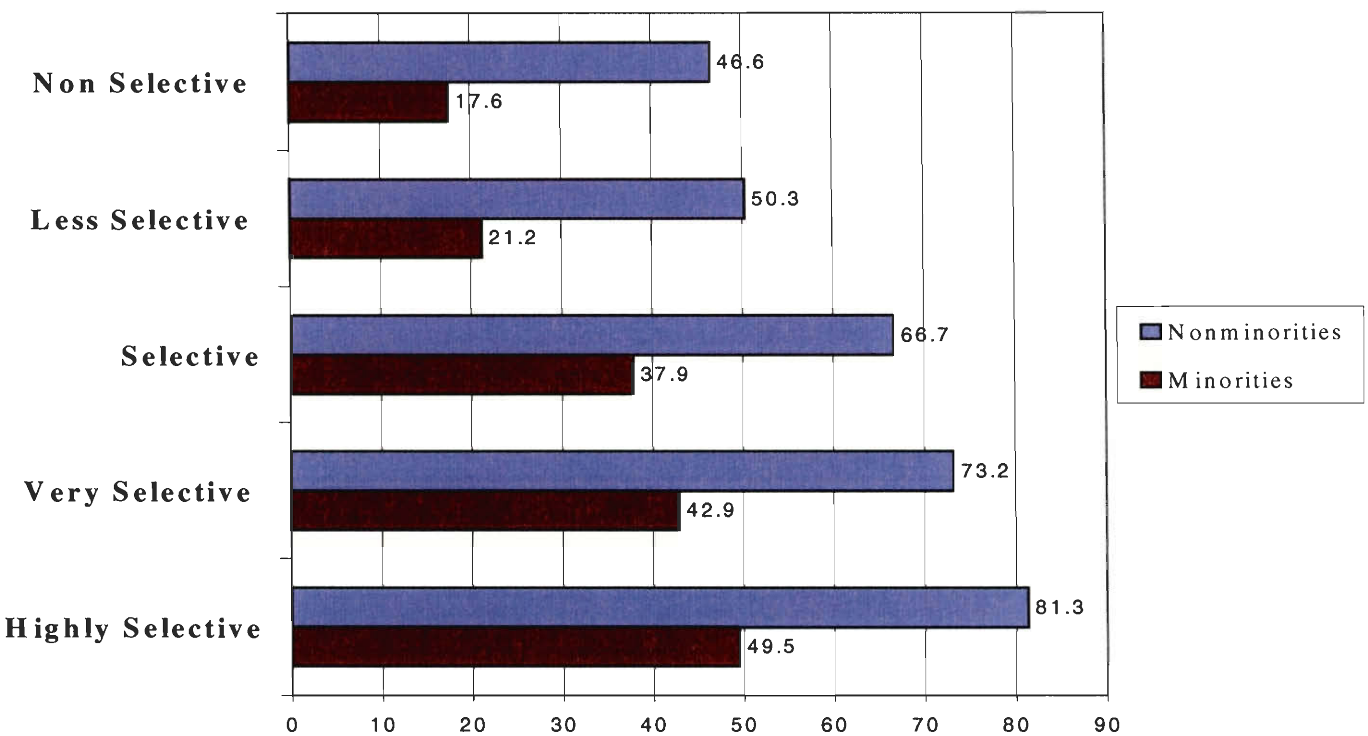
Study Period	Retention Rate Minorities (%)	Retention Rate Nonminorities (%)	Relative Retention Index (%)
1980-81 – 1989-90	35.6	68.4	52.0
1986-87 – 1992-93	35.0	59.3	59.0
1991-92 – 1997-98	36.5	68.3	53.4

Annie Georges Keeping What We've Got: The Impact of Financial Aid on Minority Retention in Engineering NACME Sept 99.

Regarding different ethnicity, African Americans graduate at less than half the rate of white students, American Indians at nearly half of the rate of white students and Hispanic graduates at almost two-third the rate of white students (Georges, 1999).

Some interesting outcomes of this study were first, that minority students are retained much more in private institutions than in public institutions and second, that minority students perform extremely well in highly selective engineering schools. In these highly selective institutions, the retention rate 49.5% is well above the national average of 36% (Figure 3.21).

Figure 3.21 1998 Retention Rates by Academic Selectivity



Annie Georges Keeping What We've Got: The Impact of Financial Aid on Minority Retention in Engineering NACME Sept 99.

Finally, the study found that one of the key elements in improving the retention rate of minorities in institutions is the financial aid resource available. "The correlation between minority retention rate and the average scholarship and fellowship is positive and statistically significant. That is, the minority retention rate tends to be higher at those institutions with high average financial aid awards" (Georges, 1999). This indicates that to increase the number of minority engineers, investment must be taken very seriously.

3.4. Mechanisms/Techniques

3.4.1. Targeting Minorities

The lack of diversity has many universities trying to attract minority groups. But there is a conflict between quality and diversity: "Quality and diversity conflict in two types of organizational cultures: a selectivity culture (low concern for diversity, high concern for achievement) and an open-access (high concern for diversity, low concern for achievement)."(Richardson, 1996) To minimize this conflict, colleges and universities make internal changes and adapt their environment by moving through three stages "that have been labeled [...] as 'reactive,' 'strategic,' and 'adaptive'"(Richardson, 1996). This model is allowing institutions to keep high standards of achievement for all students and to stay concerned for diversity. When an institution wants to implement these three-step method, it uses techniques such as multi-lingual programs, active recruiting, specific financial aid, improving campus facilities and social life, alternative admissions and helping high schools better prepare their students.

The reactive stage is when active student recruitment, financial aid, admissions and scheduling issues are involved. The goal in this stage is to increase the participation rates of minority group in an institution to ensure that the composition of a class reflects more accurately the composition of the population from which the students come from, which is done by adopting recruitment strategies and admission practice. The strategic stage is when mentoring & advising, environment, outreach, and residence hall issues are involved. Finally, the adaptive stage is when student assessment, learning assistance, curriculum content and teaching are involved.

The educational institutions follow a process to achieve diversity: assessment, goal setting, and intervention that correspond to the three stages reactive, strategic and adaptive. The techniques used in these different stages are summarized in Tables 3.2, 3.3, and 3.4.

Table 3.2 Interventions for Increasing Diversity

Activity	Examples
Student recruitment	High schools with high concentrations of AA/H/AI students are priority targets for recruiting efforts.
	Currents AA/H/AI students participate in institutional recruiting efforts.
	AA/H/AI students are recruited through the personnel and training offices of employers.
	Outreach staff provide community college transfer students with accurate and timely advice about course planning, financial aid, and other transfer requirement.
Financial aid	College staff conduct workshops in high schools for AA/H/AI students and their parents.
	College staff help prospective AA/H/AI students fill out financial aid form.
	Institutional resources are used to fund need-based financial aid for AA/H/AI students.
	AA/H/AI students receive a proportional share of scholarships based on merits.
Admissions and scheduling	Undergraduate admission standards are frequently waived to increase enrollment by AA/H/AI students.
	Institution provides open admissions to one or more major academic units.
	Regular admission requires only a specified GPA or class rank for a prescribed distribution of high school classes.

Table 3.2 (continued)

Activity	Examples
	Admission to the institution is also admission to the major of choice. There is a concurrent or cross-registration agreement with an institution enrolling a higher proportion of AA/H/AI students. Classes are scheduled so that degrees can be earned through evening attendance only.

Richardson, Richard and Skinner, Elizabeth. Achieving Quality and Diversity. Oryx Press. Phoenix, AZ. 1996.

Table 3.3 Outreach and Student Support Interventions

Activity	Examples
Outreach	On-campus summer enrichment programs for AA/H/AI junior high or high school students are conducted as part of an institution-wide outreach program. A professional program (e.g., engineering, business) provides instruction in mathematics, science, computers, or communication skills, along with academic advising and summer enrichment for selected AA/H/AI students in the ninth to eleventh grades. A collaborative program with high schools identifies promising AA/H/AI sophomores, juniors, and seniors, and strengthens their college readiness through academic enrichment, advising, tutoring, and instruction in test-taking skills. A collaborative program with a junior high school enrolling a high proportion of AA/H/AI students provides academic advising, role model presentations, university visits, and parental involvement.
Transition	A special access program provides outreach, counseling, financial support, special course work, and tutoring to a limited number of low income first college students who do not meet regular admission requirements. First-time access AA/H/AI students are enrolled in the same course sections as others in the same majors, to facilitate networking and mutual assistance.

Table 3.3 (continued)

Activity	Examples
	Most new students participate in an orientation program that emphasize cultural sensitivity as part of its contents.
	AA/H/AI students are invited to participate in a special orientation, piggybacked on the regular orientation, in which they work intensively with support staff.
	A summer bridge program provides newly admitted AA/H/AI students with courses for college credit, tutorial assistance, study skills, and assistance in academic and career decision making.
Mentoring and advising	Students in danger of failing are identified by an early alert system and receive timely advising and assistance.
	New students have immediate contact with the orientation and advising programs of their declared majors.
	"Intrusive" academic advising and mentoring is provided to all AA/H/AI students for at least their first year of attendance.
	Environment A cultural center or AA/H/AI students union provides a gathering place for underrepresented groups.
	Institutional publications emphasize the contribution and achievement of V students.
	Campus social, cultural, and educational organizations produce a year-long calendar of programs celebrating the international, multilingual, and multicultural heritage of undergraduate students.
	Residence hall AA/H/AI students receive priority in residence halls
	Residence halls provide special options or programming for AA/H/AI students (e.g., all AA/H/AI floors, AA/H/AI scholars, etc.).
	A summer bridge program provides a residential experience to introduce newly admitted AA/H/AI students to the institutions, as well as providing programs designed to enhance academic success.

Richardson, Richard and Skinner, Elizabeth. Achieving Quality and Diversity. Oryx Press. Phoenix, AZ. 1996.

Table 3.4 Interventions Involving the academic Program

Activity	Examples
Student Assessment	Admission requirement and assessment procedure ensure that students enrolling in entry-level classes have the academic competencies required for success.
	All students must pass an academic examination before achieving upper-division status.
Learning Assistance	Students identified as lacking the competencies required for entry-level courses receive appropriate instruction in basic skills, academic advising and tutoring.
	Tutoring is widely available to students who need it.
	Assistance with reading, writing, and math skills is available on walk-in basis.
	Instruction in study skills, note taking, and test preparation is provided to all students as needed.
	Departments offering prerequisite courses for admission to majors have developed approaches to avoid screening out disproportionate numbers of AA/H/AI students.
	Students who need extra assistance in mastering beginning degree-credit skill courses can enroll in sections that provide extra hours of classroom instruction supplemented by tutoring and learning laboratories.
	Students who follow nontraditional patterns of attendance have access to an educational service center that provides counseling, developmental course work, tutoring, critical reading and library research skills, time management, and study skills.
	AA/H/AI students of high scholastic ability participate proportionately in honors programs.
	AA/H/AI undergraduates receive paid internship with faculty members conducting research.

Table 3.4 (continued)

Activity	Examples
Curriculum Content	Courses in AA/H/AI cultures are available to students who wish to take them as electives. All students must complete at least one course that focuses on sensitivity to minority cultures.

Richardson, Richard and Skinner, Elizabeth. Achieving Quality and Diversity. Oryx Press. Phoenix, AZ. 1996.

3.4.2. Targeting Women

A number of strategies exist that are implemented to increase the participation of women in SMET. In her article "Bringing Girls into SMET in 1999 – "The State of Art", Patricia B. Campbell provides the following list:

Strategies:

Research Internships
Doing Hands-on Science Activities
Leading Hands-on Science Activities
Mentoring
Being Mentored
E-mentoring
SMET Career Field Trips
In Person Discussion Groups
Electronic Discussion Groups
Lab Instruction
Tutoring
Being Tutored
Community Service Projects

It appears that the strategies that are the most successful are hand-on activities ranging from one time after school activities, to longer-term internships (Campbell, 1999). When mentoring is also involved, and combined with hand-on activities, women's self-confidence, interest in SMET and skills in SMET improves. Another aspect to increase women's participation in SMET is to affect the teacher's preparation. Teachers who possess an understanding and knowledge of gender issues can affect the learning experience of women students. Training seminars, gender related projects and team work on gender issues are some of the techniques used to educate teachers (Campbell, 1999).

There are also some strategies such as small group work, single gender female groups and parent involvement, but these are more debatable. Small group work can be beneficial but male usually dominates in these situations, which lead to a less productive experience. Regarding single gender female group work, there are a lot of different results on how well this technique is assessing women participation, in addition "there is some indication that fewer resources are given to single gender female schools and groups (Campbell, 1999). Finally, parent involvement seems to have a negative impact because they tend to encourage the traditional believe that SMET fields are more for males (Campbell, 1999).

3.4.3. Targeting Persons with Disabilities

Although there are not a lot of information of how disabled students are assisted at the undergraduate level, some information is available on students of age 6-21 with disabilities receiving education services. Table 3.5 shows percentages of students receiving help, by type of disability and education environment for the year 1993-1994 school year.

Table 3.5 Students age 6-21 with disabilities receiving special education services, by type of disability and educational environment: 1993-1994 school year

(Percent Distribution)

Disability	Regular Class	Resource Room	Separate Class	Separate School	Residential Facility	Homebound/ Hospital
All disabilities	43.4	29.5	22.7	3.1	0.7	0.6
Specific learning disabilities	39.3	41.0	18.8	0.6	0.1	0.1
Speech or language impairments	87.5	7.6	4.5	0.3	0.0	0.1
Mental retardation	8.6	26.1	57.0	7.0	0.7	0.5
Serious emotional disturbance	20.5	25.8	35.3	13.4	3.2	1.8
Multiple disabilities	9.1	19.8	44.1	21.8	3.2	2.0
Hearing impairments	30.6	20.0	30.6	7.0	11.6	0.2
Orthopedic impairments	37.4	20.7	33.3	5.3	0.5	2.9
Other health impairments	40.0	27.0	21.3	1.8	0.4	9.4
Visual impairment	45.2	21.3	18.3	4.1	10.6	0.5
Autism	9.6	8.1	54.5	23.4	3.9	0.5
Deaf-blindness	7.7	8.0	34.6	24.3	23.2	2.2
Traumatic brain injuries	22.3	23.5	30.2	18.3	2.6	3.0

"Women, Minorities and Persons with Disabilities in Science and Engineering: 1998." National Science Foundation. NSF 99-338. Arlington, VA 1999.

3.5. Background of NSF

The National Science Foundation (NSF) is an independent agency of the federal government. Established by Congress in 1950, the agency was created to promote the progress of science, to advance the health, prosperity, and welfare of the United States, and to secure the national defense (The Encyclopedia, 1995). NSF promotes the national science policy by supporting basic research and education. It supports the development of improved science curricula and fosters the exchange of scientific ideas nationally, as well as internationally.

The foundation is responsible for developing and encouraging a national policy for promoting basic research and education in the sciences (The Encyclopedia, 1995). It does not conduct research, instead it provides grants and fellowships to scientists and institutions that are qualified (The Encyclopedia, 1995). The projects that it supports are in the areas of mathematics, physics, medicine, biology, social sciences and engineering in general. The governing body for NSF is the National Science Board. The board consists of twenty-four members, all of which are appointed by the President of the United States. The head of the board, the director, also chosen by the president, serves for six years (The Encyclopedia, 1995).

NSF has different divisions, one of which is the Directorate for Education and Human Resources (EHR). EHR also has different divisions as well; these include the Division of Human Resources Development (HRD) and the Division of Undergraduate Education (DUE).

3.5.1. Directorate for Education and Human Resources (EHR)

EHR is responsible for the health and continued prosperity of the nation's science, mathematics, engineering, and technology education. It also provides support to improve the leadership of those areas (EHR Mission, 1999). EHR has five major long-term goals, which are the focus for the various activities of the directorate's seven divisions and offices (EHR Mission, 1999). The first goal is to help ensure that a high quality education is available to every child in the United States, also to enable those who are interested to pursue technical careers at all levels, as well as to provide a base for understanding by all citizens. The second goal regulates the educational pipelines that carry all students to careers in science, mathematics, and engineering to ensure that individuals are qualified to meet the needs of the US technical workplace (EHR Mission, 1999). The third goal is to help ensure that those who select a career in science or engineering have the best professional undergraduate and graduate education (EHR Mission, 1999). Furthermore, the EHR makes certain that opportunities are available at the college level for all interested students to allow them to broaden their scientific backgrounds. The fourth goal of the EHR is to encourage the development of an organization of professionally educated and trained teachers to ensure excellence in education for every student (EHR Mission, 1999). The final goal of the EHR is to support informal science education programs and to maintain public interest in and awareness of scientific and technological developments (EHR Mission, 1999). These goals give an idea of what the EHR does, but this department of the NSF also has smaller divisions that specifically handle the goals more in depth.

The Division of Graduate Education (DGE) promotes the early career development of scientists and engineers by offering support at critical junctures of their career (EHR Divisions, 1999). The Experimental Program to Simulate Competitive Research (EPSCoR) brings participant states' science and engineering research endeavors at academic institutions to nationally competitive levels (EHR Divisions, 1999). The programs in the Division of Elementary, Secondary, and Informal Education (ESIE) seek to enable all students to succeed in science, mathematics, and technology, as well as to increase the scientific and technological literacy of students and adults of all ages (About ESIE, 1999). The Division of Educational System Reform (ESR) efforts consist of managing large-scale programs designed to strengthen the science, mathematics and technology education (SMETE) infrastructure of states, urban centers, and rural areas (ESR Systematic Strategy, 1999). The Division of Research, Evaluation and Communication (REC) contributes to the broad field of educational research and improvement by funding projects through grants, contracts, and cooperative agreements. It also provides conceptual and technical assistance to various EHR programs and principal investigators, through project and program evaluation, dissemination and implementation of knowledge and effective practices, and the utilization of technology in education (EHR Divisions, 1999). The EHR Division also includes the Division of Human Resource Development (HRD) and the Division of Undergraduate Education (DUE).

3.5.1.1. Division of Human Resources Development (HRD)

HRD supports programs that focus on student achievement, teacher development, and research-oriented training activities. These three aspects aim to increase the participation and advancement of institutions and underrepresented groups at every level of science, mathematics, engineering, and technology (SMET) education and research. The programs of HRD reflect NSF's commitment to developing the resources of the scientific and technical community as a whole (HRD Welcome, 1999).

The approach used by the HRD to accomplish its purpose includes four areas. First, it uses a coordinated set of efforts to prepare, attract, and retain increased numbers of minority students in SMET at the undergraduate and graduate levels (HRD Welcome, 1999). Next, HRD uses activities for females that can produce immediate and long-term positive changes in the infrastructure of research and education in SMET (HRD Welcome, 1999). Also HRD increases efforts to facilitate greater involvement of students and faculty with disabilities in SMET and especially in NSF-supported activities. Finally, the HRD supports activities to strengthen research and training capabilities of academic institutions with significant minority student enrollment (HRD Welcome, 1999).

3.5.1.2. Division of Undergraduate Education (DUE)

The other division of the EHR, most important for this project, is the DUE, which serves as a focal point in undergraduate education. The programs of the DUE aim to strengthen and ensure the vitality of the undergraduate education in SMET for all students (About DUE, 1999). This specifically includes science, mathematics and engineering majors; students in science and engineering technology programs; future teachers at elementary and secondary schools; and non-science majors seeking scientific and technical literacy (About DUE, 1999). Programs within this division enhance the quality of instruction in the diverse institutions of higher education, two- and four-year colleges and universities. Particular emphasis is placed on improving enrollment for all segments of U.S. society, including people with disabilities and populations previously underrepresented in SMET fields or in technical and teaching careers.

All the projects funded at the DUE are designed to :

- Provide opportunities for all undergraduate students to attain a higher level of competence in SMET.
- Improve the quality of undergraduate SMET instruction in all the nation's institutions of higher education: two-year colleges, four-year colleges, and universities.
- Engage talented, dedicated students in high quality programs preparing citizens knowledgeable in science, mathematics, and technology, as well as future technicians, K - 12 teachers, scientists, and engineers.
- Develop and maintain diverse, intellectually vigorous faculty committed to improvement of undergraduate education.
- Develop and implement curricula, courses, and laboratories that incorporate advances in science and technology, interdisciplinary perspectives, and creative learning experiences.
- Use computer and communication technologies to enhance learning.
- Integrate research and education to provide students the opportunities to learn through direct experience with the methods and processes of inquiry.
- Improve educational experiences for students based on an increased understanding of how they learn.
- Promote effective linkages among K - 12 schools and colleges, colleges and graduate schools, and colleges and the workplace.

"Undergraduate Education: Science, Mathematics, Engineering, and Technology: Program Announcement and Guidelines." National Science Foundation, Directorate for Education and Human Resources, Division of Undergraduate Education. NSF 97-29. Arlington, VA 1997

Two of the categories of programs funded at the DUE, that will be looked at in this project, are Course and Curriculum Development (CCD) and Instrument and Laboratory Improvement (ILI).

- **Course and Curriculum Development (CCD) programs**

The purpose of these programs is to improve the quality of undergraduate courses and curricula in SMET. The targeted areas of the funded projects are:

- Course and Curriculum Development
- Leadership in Laboratory Development
- Systematic Changes in the Chemistry Curriculum
- Mathematical Sciences and their Applications throughout the Curriculum
- Science and Humanities: Integrating Undergraduate Education

The CCD programs aim to encourage the use of new technology that intend to develop innovative pedagogical techniques, and the design of curricula to attract, encourage, and retain groups currently underrepresented in SMET enrollment. They support introductory-level courses as well as upper-level courses. The priorities of these CCD programs are: first, to promote the development of multidisciplinary and interdisciplinary courses that will better prepare students for the science- and technology-based environment of the future; second, to encourage SMET faculty to take leadership roles in developing educational experiences that enhance the competence of prospective teachers and encourage students to pursue teaching careers (NSF 97-72).

- **Instrument and Laboratory Improvement (ILI) programs**

The objective of the ILI program is to support the development of experiments and laboratory curricula which improve the SMET education of undergraduate students, both SMET majors and non-majors (NSF 97-29). The programs are sought for the development of innovative methods for using laboratory experiences to improve student understanding of basic scientific principles (NSF 97-29). Also, ILI seeks to encourage the creative adaptation of the best existing experiments and laboratory techniques that result in substantial improvement in student learning (NSF 97-29). The ILI programs provide the financial aid for equipment needed to carry out a proposed project, and are sometime matched with a CCD program.

In addition to these programs there are other programs that target teacher preparation in order to improve the quality of education.

- **Undergraduate Faculty Enhancement (UFE) programs**

These programs aim to develop and implement activities that assist faculty to learn about recent advances and new experimental techniques in their fields in order to improve their instructional capabilities (NSF 97-29). They allow the faculty members to adapt and introduce new content into courses and laboratories, to investigate innovative teaching methods, to synthesize knowledge that cuts across disciplines, to learn new experimental techniques and evaluate their suitability for instructional use, and to interact intensively with experts in the field and with colleagues who are active scientists and teachers.

3.5.2. Process of Award Funding at the DUE

There are three steps to the funding of a proposal by the NSF: first, the Principal Investigator (PI) writes a proposal and submits it to the DUE, second, a panel reviews the proposal, finally the Program Director (PD) decides whether or not to fund the project.

3.5.2.1. Procedure

- **Proposal Writing**

The NSF asks any person who wants to get a funding for a project to write an official Proposal and to submit it to the Foundation. NSF accepts proposals from all qualified scientists and engineers. The DUE specifies additional criteria for eligibility regarding the field and institution types:

- "Projects involving fundamental scientific, mathematical, or engineering concepts within technical, professional, or pre-professional programs are appropriate. Multidisciplinary and interdisciplinary proposals are especially encouraged" (NSF 99-53).
- "Proposals are invited from organizations in the United States and its territories: two-year colleges, four-year colleges, universities, professional societies, consortia of institutions, and nonprofit and for-profit organizations that are directly associated with educational or research activities. Proposals from a formal consortium should be submitted by the consortium; proposals from an informal consortium or coalition may be submitted by one of the member institutions" (NSF 99-53).

There are also some restrictions:

- "Specifically excluded are projects that address clinical fields such as medicine, nursing, clinical psychology, and physical education, and those that primarily involve social work, home economics, the arts, and the humanities" (NSF 99-53).

The PI is asked to write a proposal that will explain in a clear way what is the goal of the project, if the people who will be involved have the "necessary expertise to accomplish the goals and objectives" (NSF 98-91), how the project will improve the undergraduate education, what will be the impact of the project at a national level, how resources will be used (e.g. budget, timeline), and how the project will be evaluated and disseminated. The DUE provides the PIs a specific outline of what a proposal must include in the "Program Announcement and Guidelines, NSF 99-53" of the DUE that is available to the public.

- **Review Process**

For the majority of proposals, the next step is the review process. A panel of scientists, engineers, mathematicians, technologists, and educators in related disciplines review proposals and provide NSF with advice and guidance that will help support the decision of funding or declining the project. These reviewers are mostly individuals who are working in "two- and four-year colleges and universities, secondary schools, industry, foundations, and professional societies and associations (NSF 98-91). "The purpose of the review is to provide NSF with a written critique and an individual rating from each reviewer as well as a summarized analysis from the panel." Each reviewer will first write an individual evaluation of the proposal and provides a rating. Next, all the participants of a panel discuss the proposal together, which allows the group to brainstorm. Finally, one panelist writes a summary of the discussions.

- **Program Directors**

NSF provides its Program Directors with these reviews, which will be used to guide the funding decision. The PD will review the proposal and the results of the review session, he/she might contact the PI to clarify or to change some aspects of the proposal, and after scientific, technical and programmatic review, he/she will make the funding recommendation to the Division Director. These recommendations will ultimately go to the Division of Grants and Agreements for "review of business, financial and policy implications and the processing and issuance of a grant or other agreement" (NSF 00-2).

3.5.2.2. Criteria for Evaluation

The DUE gives its reviewers two general criteria to evaluate the merit of a proposal. First, the intellectual merit of a proposal must be considered. This is to take into account how the activity will aid to promote the knowledge and understanding in the SMET undergraduate education (NSF 98-91). Second, the broad impact of the proposed activity is examined to look at how "the activity advances discovery and understanding while teaching and learning, and how well it broadens participation of underrepresented groups" (NSF 98-91).

In addition, the DUE asks its PI to indicate the target audience of the proposal. The component that will help the participation and learning experience of these groups must also be clarified, and the mechanisms used must be explained.

4. Methodology

4.1. Preliminary Project Selection

4.1.1. NSF Mainframe Research

The first set of research was done on the NSF Mainframe, which is an IBM 3090 relational database. The mainframe contains information from every proposal, review, and award, such as budget, institution, and demographic information, dating back to 1974. The NSF mainframe contains over 250 tables with information on all of these subjects. It is required for the researcher to use a Structured Query Language (SQL) to write, setup and run queries that will extract the relevant data. While writing these queries it is necessary to relate tables to other tables using common themes, or primary keys, from the different tables in order to extract the information that is needed.

For this project, since we did not have access to the NSF mainframe ourselves, a Science Education Analyst, worked with the NSF mainframe for us. We asked him to extract all of the awards meeting the following criteria:

- Only awards with Organizational Codes of 11040XXX
  - This organizational code means that the award was given by DUE. We restricted our search to only DUE awards because these are the only NSF awards of relevance to this study.

- Discriminate awards with Organizational Code 1140101
  - Organizational Code 1140101 means that the award is from the Teacher and Faculty Development Section (TFDS). These awards deal only with teacher and faculty development, and therefore not with increasing the number of underrepresented students in SMET directly. In addition, our project description states that we should focus on CCD and ILI programs.

- Only awards with Program Element Codes (PEC) of 7410 or 7400
  - PEC 7410 means that the award is in the CCD program, while PEC 7400 means that the award is in the ILI program. This criteria discriminated all awards with PEC code 7412 (Advanced Technological Education).

- Only awards with a target audience code that contains some combination of Women, Minorities, or Persons with Disabilities (WMD).
  - Our project specifies that we shall identify ways to improve the representation of WMD in SMET, therefore it is only necessary for us to look at awards focusing on these groups.

- Only look at awards between FY1992 and FY1997
  - We chose this as our time frame because we felt that awards conducted after FY1997 would not have had enough time to formulate results that would be useful to us. We felt that awards conducted before FY1992 would be outdated with regards to the techniques that were used and the smaller possibility of having faculty members, PIs, and PDs involved in the program, still at either the institution or the NSF office.

When we got this information back, it was in the form of a Microsoft Excel © spreadsheet containing 677 awards.

This spreadsheet provided us with valuable information, including the following (Appendix B):

- Proposal ID number
- Program Element Code (PEC)
- Target Audience Code
- Discipline Code
- Focus Level
- Highest Degree Code
- Requested Amount of Money
- Total Awarded Amount of Money
- Last name of PI
- First name of PI
- Institution name
- Awarding PD

- Current PD
- Award Title

4.1.2. Purposive Sampling of the Remaining Awards

Since our research had to focus on a smaller number of awards than the 677 remaining, we purposively sampled our data to define our frame of work.

4.1.2.1. Background of Purposive Sampling

Researchers use purposive sampling when they have a special knowledge or expertise about a group and have to choose a subgroup that will represent a population that exhibits certain characteristics. A purposive sample is selected after some research is done, including field investigations of some group to "insure that certain types of individuals or persons displaying certain attributes are included in the study" (Berg, 1998). It should be noted that the limitation of a purposive sampling method is that the research has a very defined frame and generalization from the research cannot be made extensively (Berg, 1998).

4.1.2.2. Procedure

Because of time and money constraints our research had to be focused on a small sample of all awards that we got using our first criteria for selection. We chose purposive sampling to be able to get valuable results about a small portion of all awards. The conclusions and recommendations that we made were specific to our frame of work that will be described in the next section.

First, we discriminated all awards with Discipline Codes 71-92, which are the codes for Social, Behavioral, and Economic Sciences (Appendix B). It is widely perceived that these fields have a more diverse student body, therefore, we felt that it was not necessary for us to look at programs within these disciplines. We also discriminated all the awards where the discipline code was "blank".

Second, we discriminated all awards with Focus Level Codes that were not Lower Level (LO). The reason for this discrimination was to focus on one section of awards in order to be able to obtain valuable information. Lower Level was chosen because it was decided that we wanted to look more at programs targeting recruitment than retention. Also we felt that Lower Level awards would more directly increase the number of women, minorities and persons with disabilities.

Next, we discriminated all awards with Highest Degree Codes of Associate (A) (Appendix B). These degree codes show the highest degree attainable in any SMET field at the institution where the award is funded. In our project, we decided to look at four-year and comprehensive institutions only, thus awards that focus on institutions where only Associate's degree can be obtained were omitted.

Finally, since we were looking at active intervention projects funded at the DUE, the colleges and universities where a large number of an underrepresented group exists were not of interest to us. The "active" mechanisms are those that assert a specific intervention designed to increase recruitment and retention versus "passive" interventions that merely engage in more sound educational practice for a pre-existing underrepresented population. Therefore, our next step was to discriminate the DUE awards funded at Historically Black Colleges and Universities (HBCU), Tribal Colleges and Women's Colleges. To find the school names of Women's Colleges we used the list provided by The Library Network (See list Appendix D). For HBCUs institutions we used the list provided by the Minority On-Line Information Service (See list Appendix

D). To find Tribal Colleges we used the list provided by the American Indian Higher Education Consortium (See list Appendix D). Institutions that are members of the Hispanic Alliance of Colleges and Universities (HACU) (See list Appendix D), do not fall into the same category as HBCUs, Tribal Colleges and Women's Colleges because the percentages of underrepresented groups attending the institution are relatively small. For this reason, we decided not to discriminate all awards conducted at institutions member of the HACU.

After these discriminations, our sample size was 53 awards. Our next step was to analyze all 53 award abstracts and conduct interviews with Principal Investigators (PI) and Program Directors (PD) of 10 to 15 awards.

4.2. Secondary Project Selection

After we sampled the awards to get the number down to 53, the next few steps were to analyze the abstracts and to reduce the number even further.

4.2.1. Analysis of Abstracts

We first had to look at all the abstracts to narrow the number of down further, in order to conduct phone interviews with the PIs and face to face interviews with the PDs. Individually, each member of the group read and assessed each abstract. It was kept in mind that we were looking to see if the abstract stated the target audience, the project's methods for accomplishing its goals, and also the method of self-evaluation of the project. Next, the group came together and discussed the data given found in the abstracts.

One item of importance that came from reading the abstracts was that two more programs could be eliminated because one was a Women's College and one was a Tribal College. All of these were eliminated earlier, however these two specific institutions were connected to a larger college that was not a Women's College or a Tribal College.

The next step was to create three categories to prioritize the order that the awards would be considered and the interviews would be scheduled. The main reason for this process was that in the time given to us for the completion of our study it was not possible to conduct proper research for all 51 awards.

When we created the three subgroups, we looked at the programs that specifically stated their target audience and techniques of the project. These criteria defined our first group. The second group of awards was comprised of those that either stated the target audience and no technique, the technique and no target audience or was not specific on either the target audience or technique. The final subgroup of awards consisted of the awards that did not mention a target audience or technique in their abstract.

We decided to first contact the PIs of the awards that were in the first group. If we were unable to contact a PI after many attempts, their program was dropped and awards from the second list were used. This method was used due to severe time constraints.

In addition to this process, more in depth statistical analysis was conducted for the content of the abstracts. We looked to see if the abstract actually stated the target audience; if the program used a hands-on approach or group work-collaborative learning; if the evaluation method of the program was stated; and if retention of students was mentioned as one of its goals. We carefully searched all 51 abstracts to see if the elements listed above were present or not. It should be noted that we looked for manifest and obvious presence of these elements.

4.2.2. Interviews

4.2.2.1. Background of Interview

The interview, according to Bruce Berg (1998), is a conversation with the specific purpose of gathering information. When conducting an interview it is important to stay on track and keep in mind the goal of the interview. It is necessary that the interviewer not allow the interviewee to stray too far from the topic; if this happens it is detrimental to both parties involved. Before conducting an interview it is important to understand what type of interview it is going to be. It is widely recognized that there are three major types of interviews: standardized, unstandardized, and semistandardized (Berg, 1998).

The standardized, or formal, interview follows a set order of questions. The interviewer asks each interviewee the same questions in the same order in an effort to create the same atmosphere for each interviewee. This will ensure that the interviewer does not influence the answers of any respondents (Berg, 1998). The question schedule is very important here because the interviewer does not introduce any new questions or follow up on any interesting comments made because it would alter the responses of a subject. Therefore, it is necessary for the interviewer to be confident that the wording and content of each question is sufficient enough to elicit the information that is wanted (Berg, 1998).

The unstandardized, or informal or non-directive, interview does not follow a predetermined set of questions. The reason for conducting an unstandardized interview would be if the interviewer did not feel confident that he or she knew the correct questions to ask in order to obtain the necessary information. It is required that interviewers "develop, adapt, and generate question and follow-up probes appropriate to the given situation and the central purpose of the investigation." (Berg, 1998 Pg. 61) The unstandardized interview is most commonly used to supplement field research or when the interviewer is unfamiliar with the respondent's background.

The semistandardized interview is based loosely on a set of predetermined questions. During this type of interview the questions are typically asked in the same order for each interview, however the interviewer is allowed to ask follow up questions on topics that they find interesting (Berg, 1998). The theory behind the semistandardized interview is that the interviewer has some background about the situation and how to obtain the information, but can follow leads on information he or she may have overlooked in the research.

When composing a questionnaire for any type of interview it is very important to implement a funnel design. The funnel design assumes that there are four types of question: essential, extra, throwaway, and probing. The essential questions are those that focus on drawing out the desired information. Extra questions are similar to essential questions, however they are worded slightly differently, these are used to check the consistency of the interviewee. The throwaway questions are unnecessary questions that are used to set the pace of the interview or to change the focus; however, these questions are invaluable to the interview as a whole. The last type question, the probing questions, provides a method of drawing out a more complete story, or is used to follow up on a topic (Berg, 1998).

When using a funnel design it is necessary to order the questions effectively, in order to elicit the most informative responses. A few simple throwaway questions should begin the interview. These questions allow the interviewer to establish a rapport and the interviewee to become more comfortable with the interview. These are generally followed by a set of essential and extra questions. This will force the interviewee to invest time and thoughts to the interview so it will be less likely that they will begin to lose interest. The final questions that should be asked are the probing questions. These are the questions that are the most complex and sensitive to the interviewee. These usually require the most thought by the respondent and are the most important to the research (Berg, 1998).

4.2.2.2. Program Director and Principal Investigator Interviews

For this study two sets of people were interviewed. We talked with the current Program Directors (PD), as well as the Principal Investigators (PI) for each award.

We chose to interview the PDs because they could give us general information about the awards at which we were looking. This allowed us to gain valuable information about: the techniques that where used in the project; how the program was implemented; the outcomes of the project; whether or not the project has been replicated at other institutions; and recommendations about information that we should look to obtain from the PI.

We conducted phone interviews with the PIs because we felt they would be a necessary portion of our frame, and would be able to provide us with valuable information about their award. We first asked them to restate the goals of the project, what it aimed to accomplish, and what techniques were used. We also inquired about what in the project was designed specifically to improve the participation of women, minorities or persons with disabilities in the SMET fields and why they felt that their project targeted these groups. We then investigated the actual implementation of the award in the institution and asked them to clarify why they decided to use a specific technique. We wanted to better understand the background of the project and what the conviction of the PIs were about addressing the issue of diversity in education and what should be done. Furthermore, we investigated how the reality differed from the intentions expressed in the proposals, and more specifically for our research, in the abstracts, by asking the PIs what they would remove, change or improve in the project after seeing it in progress or completed.

The questionnaires that we used to interview PIs and PDs (Appendix C) were designed with the purpose of obtaining general information about the project and its mechanisms, as well as finding any discrepancies between how the PDs and PIs viewed the project, and how the project's outcomes might have been different from what was intended in the proposal. We did this by creating the questionnaires for both the PIs and PDs in such a way that a set of the same questions would appear at the same point in both questionnaires.

From the results of the interviews, we felt that one of the topics that we investigated was not clarified enough. We decided to follow our interviews with the PDs by sending an additional question by electronic mail to all the PDs at the DUE (Appendix C). We gathered the information that we got and were able to improve our final conclusions and recommendations.

4.3. Statistical work

To better understand the distribution within the awards funded at the DUE that targeted women, minorities and persons with disabilities, we decided to conduct statistical analysis. We looked at the three different levels of our research: the overall number of CCD and ILI projects within FY1992 and FY1997; the 677 awards that were targeting women, minorities and persons with disabilities; and the 51 awards that we obtained after our discrimination. The goal was to see the percentages of several subcategories among the awards.

4.3.1. Goals

Our goal was to be able to provide the DUE actual data about the awards that they had funded between FY1992 to FY1997. This was important because it allowed us to make general conclusions and recommendations about the entire population of awards. The statistical data was also generated for the smaller group of 51 awards that we focused on more closely. We did this to be able to make conclusions, that were representative of the whole group of programs. Also, the statistical data gave the DUE previously uninvestigated information about the distribution of its awards. Our statistical work gave the DUE information about: how funding was given to different categories of programs such as CCD or ILI, what population of undergraduate students were mostly targeted by the awards, and which areas or audiences are less likely to be targeted.

4.3.2. Method and Procedure

The first set of statistical data was taken from all 3,358 DUE awards in CCD and ILI from FY1992 to FY1997. The statistics taken were the distribution of target audience code, the distribution of focus levels, those being lower level, upper level and both levels of undergraduate education, and the comparison between CCD and ILI programs (Figure 4.1)

The second set of data was done by taking the spreadsheet of 677 awards pulled from the NSF Mainframe. We gathered the data by counting the projects in different subgroups of interest. The main subgroups that were used were programs targeting only women, only minorities, only persons with disabilities, both women and minorities, and all three groups. The next separation of the subgroups was by money which went into four areas $>100,000; 50,000<$<100,000; 25,000<$<50,000; and $<25,000, with the symbol $ indicating the total awarded amount (Figure 4.2).

At the same level, CCD awards and ILI awards were looked at separately. The target audience distribution, focus level distribution (Lower Level, Upper Level, Both or None), and monetary distribution (as described above) were investigated. Then, within each focus level subgroup of the total 677, we got statistics for target audience, monetary, and CCD/ILI distribution (Figure 4.2).

The same type of data was generated for the 51 awards (Figure 4.3). The criteria for the reduction were discussed above and the subgroups of the statistical data are slightly different. Some of the same data was done as before with the 677, target audience distribution, comparison of CCD and ILI, the monetary distribution, using the same levels as previously described, and the distribution of target audience among the CCD and the ILI programs (Figure 4.3).

Figure 4.1 Statistics: Procedure for All CCD and ILI Awards

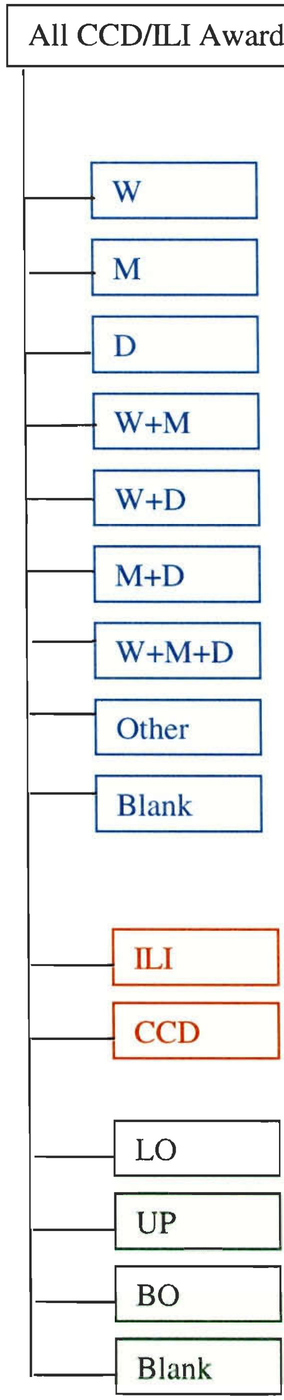


Figure 4.2 Statistics: Procedure for 677 Awrads

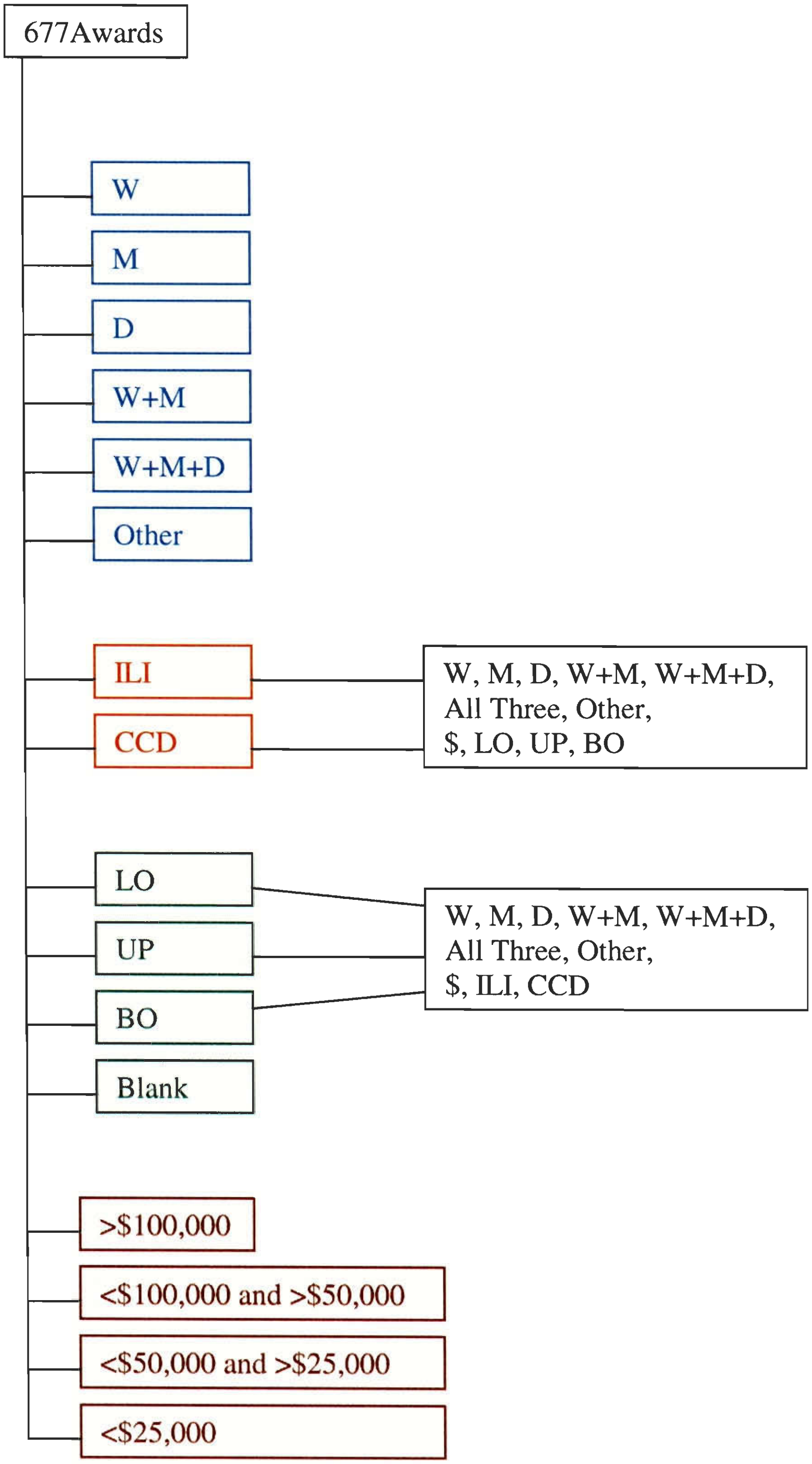
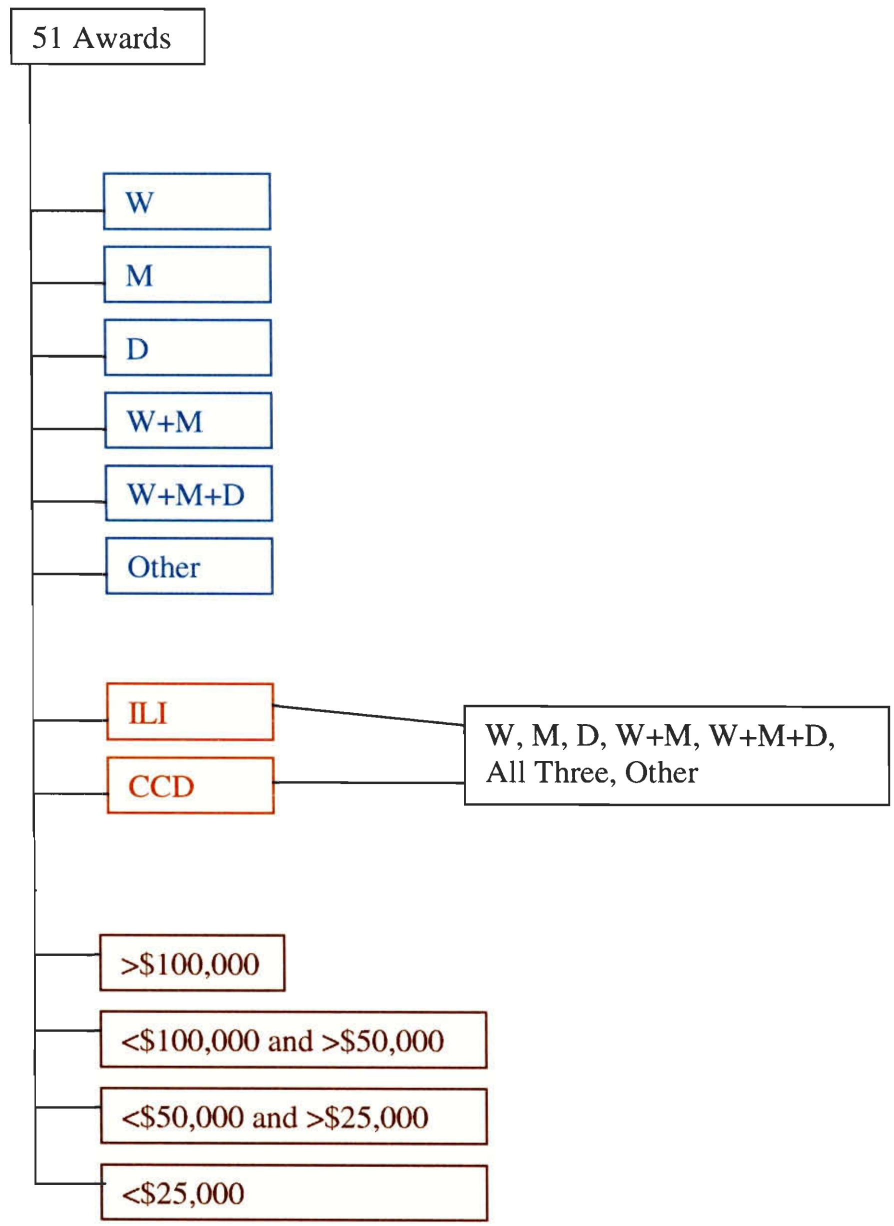


Figure 4.3 Statistics: Procedure for 51 Awards



5. Results and Conclusions

5.1. Conclusions about DUE awards

Our first major conclusion regarding DUE awards was that there is a lack of target on Persons with Disabilities (PwD). From the statistical data and through our interviews and content analysis we found that PwD, which comprise 20% of the U.S. population, were not targeted as much as women or minorities.

However, one reason for this is that a disability poses very different learning problems than gender or ethnicity does. The assistance to PwD is usually provided on a personal basis because the problems that a disability poses to the student vary so greatly from student to student. Also, through our background research we found that there are not a lot of widely implemented programs at the undergraduate level that focus on improving the participation of PwD in SMET. We also learned, through our interviews with PIs, that when an award happens to help the learning experience of a disabled student; it is usually not the first priority of the program.

Our statistical analysis of the CCD and ILI awards further pronounced this claim.

Figure 5.1
Distribution of 677 DUE CCD and ILI Programs
1992-1997

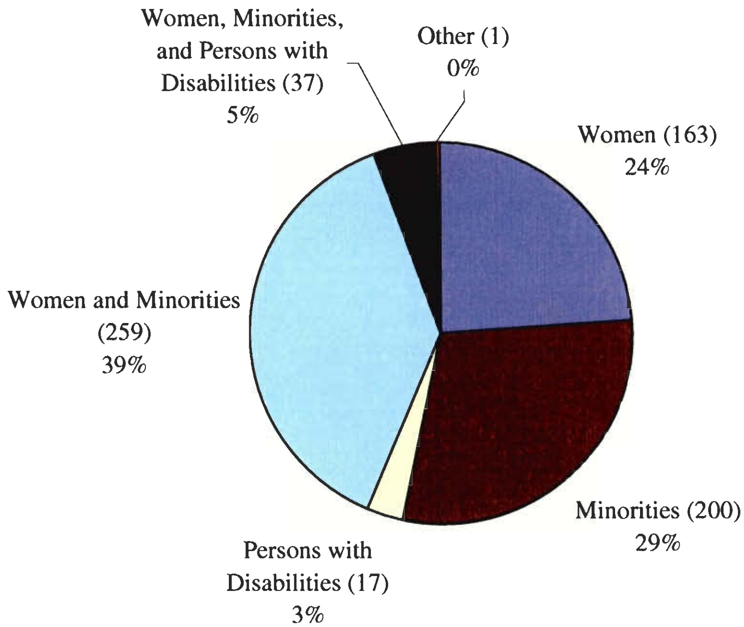


Figure 5.1 shows the target audience distribution of the 677 CCD & ILI awards granted between FY1992 and FY1997 that had some combination of WMD in the Target Audience Code. Only 55 awards contained a D, indicating PwD as a target audience. In comparison, 496 had an M and 459 contained a W. Out of these 55 awards, only 17 awards had PwD as their only target audience, indicating that they exclusively focused on PwD. Again, we can compare this number to the 163 awards indicating women and 200 indicating minorities as their only target audiences. There is an obvious discrepancy in the targeting of PwD with comparison to that of women and minorities.

It is also interesting to note that only 2 out of the 51 awards that comprised our frame had a D in the Target Audience code and zero indicated that PwD was their lone target audience.

When conducting content analysis of the 51 abstracts we discovered that only one abstract mentioned PwD as a target audience and no abstracts indicated a method that was specific to PwD. However, it should be noted that the one abstract that did mention PwD did not have PwD as an indicated target audience. Also, only one PI mentioned PwD during the interviews that we conducted, and again this PI did not indicate that PwD was a target audience of the project.

In addition to the lack of focus on PwD, we noted that PIs do not indicate the type of disability that is being addressed. There are two different types of disability, learning disabilities and physical disabilities, and these can not be approached in the same manner. The DUE does not identify the different disabilities that exist and which disability the change of a curriculum or the modification of a laboratory class will address.

The second conclusion we drew from the data was a problem with the indication of the targeted audience of DUE awards, which was found through few different observations. First, as can be seen from Figure 5.2, over two-thirds of the CCD and ILI awards funded between FY1992 and FY1997, do not have an indicated target audience code in the "Project Data Form 1295". Part of the explanation for this is the fact that in the DUE program announcement covering proposal deadlines up to FY1993, the instruction regarding the code F designation (target audience code) given to PIs was:

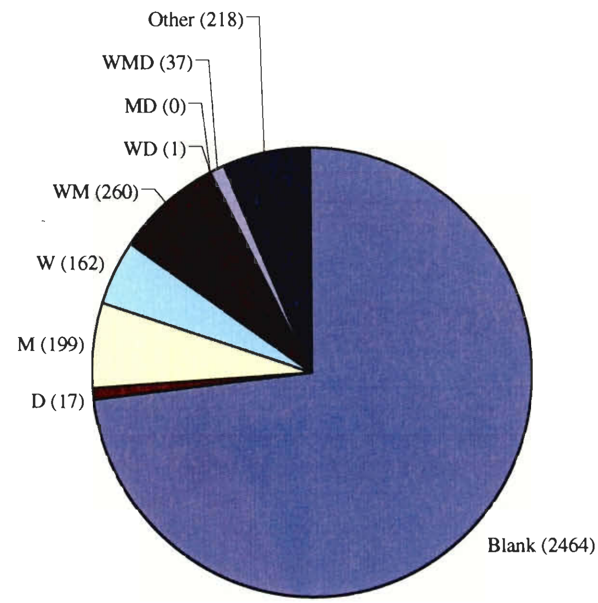
> "**On most proposals this item will be left blank.** For those proposals where a significant component of the project is the education of the following groups, indicate the proper Audience Code(s). **Indicate codes also if the institution has as its mission the education of one or more groups**. Each group claimed must be discussed **explicitly** in the proposal narrative."

In the DUE program announcements covering proposal deadlines between FY 1994 and FY 1997, the same instruction read:

> "For those proposals where a **significant** component of the project is the education of the following groups, indicate the proper Audience Code(s). **Indicate codes also if the institution has as its mission the education of one or more groups**. *Each group indicated must be discussed explicitly and substantively in the proposal narrative.*"

It is commonly understood in the DUE that a "blank" would indicate that all students were being targeted by the award. However archiving this kind of data is going to be a very difficult work in the future and is already causing problems to researchers such as ourselves who are attempting to study DUE awards. This problem is magnified by the fact that a lot of PDs from the DUE only work at the agency for one or two years, therefore, if there is any doubt about an award the PD might be very difficult to contact. When we conducted our study, we only analyzed a little over one-fourth of the awards because we only focused on awards that indicated a target audience. By doing this, we felt that some very relevant awards might have escaped notice because the target audience was undefined.

Figure 5.2
Target Audience Distribution of CCD and ILI Awards 1992-1997



W: Targeting women
M: Targeting minorities
D: Targeting persons with disabilities

Another point that should be made regarding this problem is that a large number of the methods used to improve the participation of WMD in SMET are helpful to all students, but traditionally these are used to single out WMD students. The justification for indicating a specific target audience is then very unclear. The interviews that we conducted led us to two conclusions on this topic. First, many of the PIs said that, if provided the opportunity, they would have indicated that the submitted proposal aimed to be beneficial to all students. It should be noted that some PIs specified that, in addition to indicating that the proposal was helpful for all students, they would like to emphasize that the techniques used were traditionally helpful for WMD. Another fact was found after the content analysis of the abstracts (Table 5.1). We observed that, while projects do indicate that they target an underrepresented group, many did not mention what population the project was focusing on in the abstract. From this data and the phone interviews conducted with PIs where the issue of target audience indication discussed, we concluded that some of the awards do not consider the increased participation of underrepresented groups in SMET as the focal point of the project.

The final fact that we discovered through our interviews was that some of the PIs would state a target audience because a majority of the students traditionally enrolling in the class or present in the department are from these underrepresented groups. We discovered that the presence of women, minorities and persons with disabilities in the class or department is an important factor that guides how the PIs will declare the targeted audience.

There are two aspects to the explanations for this. First, the school is already involved in the recruitment of underrepresented students, and second the techniques that are used are passive. If the school is already making an effort to actively recruit underrepresented students, then the project's main focus will most likely be the retention of these students because the recruitment aspect is already being addressed. The second aspect can be drawn from the fact that active recruitment leads to the presence of a pre-existing population of underrepresented group in the class or department, we can then assume that the techniques being used will tend to be passive. However, passive techniques may also be implemented at a school with a traditionally high number of underrepresented students, but that does not actively recruit these students. From this we concluded that there is a problem related to the fact that some projects claim to target

WMD only because there is a pre-existing population of these students and, therefore, they will benefit from the award. There is not an easy way of knowing this fact just from the "Project Data Form" or the abstracts, which leads us, once again, to think that the "Project Data Form" does not provide enough information.

5.2. Outcomes of Interviews

5.2.1. Common Techniques

While analyzing the interviews that were conducted with PIs and PDs from the awards that we focused on there were many ideas that we found repeatedly. Four of the techniques that we discovered were used in a significant amount of the awards. These techniques included: laboratory and hands-on experience, group work–collaborative learning, the use of visual aids and the development of materials, and providing mentors, tutors and role models for students.

- ***Laboratory Experience/Hands-on Experience***

Laboratory experience or hands-on experience was the most common technique that was found through the interviews with PIs, appearing in 9 out of 11. This technique was also found the most in the abstracts, appearing in 37 out of 51 abstracts.

Providing students with laboratory and hands-on experiences was seen as a very effective way to increase student understanding of the principles that were taught in lecture sessions. By providing laboratory experience the students are allowed to see and feel how these principles are applied to real life. The laboratory also provides students with an atmosphere that is non-threatening and more comfortable than a traditional lecture classroom, allowing students to be more relaxed with their surroundings.

Introducing computer resources into the laboratories is one way to enhance the laboratory experience. The computer is a familiar tool for many students and gives the student a sense of security. Also, the computer allows students to conduct further analysis of results that could not have been conducted otherwise.

Another effective tool for increasing a student's laboratory experience is to allow the students to design and implement the laboratory experiment themselves. In the traditional laboratory many of the experiments follow set guidelines for all students, which does not allow the student to experiment, explore, and learn on their own. Allowing students to design and implement their own experiments on a topic forces the student to think the entire experiment through and to understand how each phase of the experiment will be conducted. This forces the student to understand the principles that are used in the experiment and allows the student to make mistakes and find ways to solve those mistakes without the answers directly in front of them.

- ***Group Work–Collaborative Learning***

Group work-Collaborative learning was the second most common technique found in both the interviews with PIs and through the content analysis that we conducted of abstracts. This technique was mentioned in 8 out of 11 interviews and 22 out of 51 abstracts.

Group work–Collaborative learning is seen as a very effective way of getting students involved with lecture and laboratory material. Allowing students to work in groups forces them to cooperate and compromise with other students' ideas and theories. This provides the students the opportunity to brainstorm and problem solve with ideas that they may not have thought of on their own. This atmosphere tends to be less threatening and intimidating than the traditional lecture session because students are working with students and they tend to be more open and relaxed. Group work also allows students to be more active in the class and participate much more than in a traditional lecture course. This gets the student more involved with the class and makes it easier for the student to become acquainted with and understand the material that is being taught.

- ***Visual Aids and Development of Materials***

The use of visual aids and the development of materials for a specific class was the third most common technique obtained from the content analysis, appearing in 20 out of 51 abstracts. However these techniques were mentioned the fewest times in the interviews with PIs, appearing in 3 out of 11 interviews.

The incorporation of visual aids has become a very effective tool for increasing the success of students in SMET fields. It has been found that a lot of students understand material much better when they are able to see the material at work, instead of just reading it in a book or hearing a professor lecture about them.

Another technique that has worked rather well is the development of materials (e.g. textbooks, laboratory manuals, etc.) that are specific to the class. This allows for the professor to incorporate visual aids and laboratory techniques, which he or she is implementing, directly into the literature that the students are reading. This further reinforces the ideas and concepts behind the laboratory experiences, which will, in turn, let the student make connections between the laboratory work and the class work much easier.

- ***Mentors, Tutors, and Role Models***

The use of mentors, tutors, and role models was mentioned in 5 out of the 11 interviews that we conducted with PIs, and only 10 out of the 51 abstracts that we studied.

Using mentors, tutors, and role models has been seen as a very effective tool for increasing the comfort level of students in SMET fields. These people act as assurances about the future for the students, giving them confidence that they can succeed. Also, the tutors and mentors act as guides and assistants for the students and provide support when the student reaches a problem they can not handle or a theory they can not understand. The tutor or mentor is usually an upperclassman, which further reassures the student and makes them feel more comfortable with the situation because they are not talking to a professor about their difficulties, they are talking to a student who had the same problems and concerns just a few years ago.

The role model is, more often than not, a professor or person from the professional society who acts as a sign to the student that they can succeed in the field. The role model gives the student a goal to reach, making it easier for the student to succeed and excel in the class and the field. The role model can also allow the students to see how the problems and principles that they are learning in classes and laboratories are incorporated into the 'real world.'

5.2.2. Additional Methods

We also found many additional methods that were only mentioned by one PI during the interviews. However, even though these methods may not have been used as frequently as those mentioned above, we feel that they are very beneficial to students and can not be ignored.

Introducing a discussion session between students and the instructor of a laboratory course is very beneficial and greatly helps students to understand the observations, results, and outcomes of the performed laboratory session.

It is necessary to work on retention at the beginning of the undergraduate cycle: freshmen usually take general science courses, therefore if these courses are made more interesting by integrating a laboratory component then the discipline will be more attractive to students. If the class already contains a laboratory, the structure of the laboratories could be modified, in order to keep the interest of the freshmen students, which would reduce drop out rates.

Inviting guest speakers who work in the field related to a class allows students to be introduced to real world topics. They would then be able to understand how the material they are learning is related to the professional environment.

Forcing students who are completing a group project to give group presentations to the class allows the students to develop their oral communication skills and forces all members of the group to participate throughout the project.

In a lab environment, it is often found that men dominate the group and women tend to sit back and watch. The laboratory classes should force each member of the team to participate. One effective way of accomplishing this is to assign a specific role to each student for a laboratory exercise. These roles can then be rotated for each experiment. By doing this, the professor accomplishes two things, he/she forces each student to participate in the experiment. This practice also forces the students to work at and understand all aspects of a laboratory experiment.

It is essential that in a laboratory environment, the instructor talk to each student individually. A one on one relationship between the student and the instructor is very important to help the students be successful because the professor is able to deal with a specific problem that a student may have with the material and it allows the student-professor relationship to develop.

Traditionally, in a course with a laboratory component, the instructor lectures and then the laboratory sessions are performed by the students. It is beneficial when this order is reversed, allowing the students to discover the principles themselves before the instructor discusses the principles. By doing this the professor allows the students to explore and experiment with the principles that will be taught. This provides the students with a more in-depth understanding of the principles and ideas that will be discussed.

Implementing a writing course that teaches students to write in a scientific manner is very beneficial because it provides students the opportunity to disseminate the material that they have come up with in laboratory experiments in a professional manner.

Sequencing courses in a discipline in a way that allows the material that is being taught to be easily followed and understood by students allows students to more readily relate the material that is learned in different classes.

All of our statistical analysis can be viewed in Appendix E.

6. Recommendations

Based on the conclusions that have been made, we have five specific recommendations for the DUE: provide more consideration to persons with disabilities, make additions to "Project Data Form 1295," increase interaction with PIs, look further into the methods that were not used frequently, and for PDs have a continuous knowledge of the awards. In addition, our final recommendation is that this project be continued on a larger scale.

It was seen earlier that not very much is done, through DUE projects, to target persons with disabilities. Although we can not provide the DUE with a solution, we recommend two ways that the DUE attempt to have its awards more effectively target persons with disabilities (PwD). One way is to recognize that, like women and minorities, there are specific techniques that target PwD and it is necessary to identify and implement these. Another way would be to require the PIs to specifically identify the type of disability they aim to target. This would distinguish between those projects that benefit PwD specifically and those that only have a component that could be helpful to persons with disabilities but targeting them is not the main focus of the project. We believe that the identification of these two areas will allow the DUE to target PwD more effectively. However, we also recommend that the DUE make a conscious effort towards increasing the number of these projects.

Our next recommendation is the addition of two codes to the "Project Data Form 1295." First, we suggest that an "All Students Involved" code be added to the target audience code, Code F (Appendix B). We feel that implementing this code will accomplish two major goals. First, it will provide all future projects that would have a "blank" in the target audience code to have a defined target audience. This would be helpful to researchers such as ourselves, who are using the target audience code to identify awards on which they will base their study. We also feel that the implementation of this new code will help separate projects targeting women, minorities and persons with disabilities (WMD) into three main categories. The first category would contain those projects that focus on an underrepresented group by implementing a technique that has been found to be specifically beneficial to that group. The next category would consist of the awards that intend to help one of the underrepresented groups, but implement a technique that is helpful for all students involved in the course or laboratory. The final category would include the awards that checked WMD because the department traditionally has a high population of underrepresented students and does not implement a technique that is particularly beneficial them.

Our other recommended addition is for a new code, which would indicate if there is a pre-existing population of underrepresented students in the department or if the course or laboratory traditionally has a large enrollment of women, minorities or persons with disabilities. We feel this addition will help to better indicate the purpose of a program in two similar scenarios. First, it would show that the institution is making an effort to recruit WMD or the school has a traditionally large representation of these students, such as an HBCU or Women's College, indicating that retention would be a larger goal of the project. This addition would also hint towards the use of more passive mechanisms to target these underrepresented groups. This proposed additional indication would be extremely beneficial to studies such as ours, because we were more concerned with active ways of targeting WMD. We also recommend that both these additions be implemented on a trial basis of three to four years at the end of which the outcomes be evaluated.

Our next recommendation is to increase interaction between the DUE and the PIs. One suggestion we have is to create a workshop for PIs that would have two main goals. First, it would introduce them to techniques that they might not have considered or known, which would help their project more effectively target underrepresented groups. The second goal for implementing a workshop is that it will create an environment for brainstorming among the different PIs. Through discussions, PIs would be able to refine and create techniques to improve the representation of WMD in SMET. Going along with the idea of connection between PIs, another idea would be to create a newsletter that explains and discusses new or successful techniques. It would be very interesting also, to include interviews of PIs and PDs that have implemented and supported successful projects. This would provide PIs attempting to write a proposal for the DUE a resource for ideas, which would allow the proposal to be more effective.

Our next recommendation is for DUE to study more in depth, those methods that were not found to be used to a great extent among the projects. We recommend that DUE interact more with the PIs after funding a project to get their opinions and points of view on the awards in progress. This would allow the DUE to identify any weak areas of a project and obtain the insight of PIs about changes that were made in order to improve the program.

Our final recommendation is that the PDs should have more knowledge of the projects. We suggest encouraging the PIs to update the abstract of the project, which would allow it to more accurately depict what the project is rather than what the proposal was. If all versions of the abstract are kept, the PDs would be able to read the abstracts and quickly see how the project has changed. Also we suggest that the PDs be required to follow the outcomes of the awards much closer by talking with PIs more frequently and conducting more site visits. This will help PDs to recall the details of the project and will provide the DUE with a much better understanding of the outcomes from their awards.

Our overall recommendation is for this study to be continued, this time taking into account problems with time, money and access. We feel that this study would be more effective if it encompassed a much larger frame of awards, which would allow the study to make more generalizations on the DUE efforts. Also, we suggest that the researchers continuing this study be granted more time and access to NSF information, therefore they could conduct a more in depth analysis of each of the awards. The follow up study could build on our outcomes and learn from our recommendations to give the DUE an abundance of valuable information.

Finally, after working on this project for seven weeks we have our own intuitions concerning what the DUE is accomplishing through its funded educational projects, with regards to the improvement of participation of ALL students in SMET fields. This point might not be backed up through the data we obtained but we feel that researching this topic during our time at the DUE gives us a judgement and a point of view that should be acknowledged. We believe that the DUE funds projects that mostly address, in a very effective way, the issue of different learning styles amongst students, but we were not able to identify how this was directly connected to the issue of equity between gender and ethnicity at the undergraduate level. We feel that the important factors for the underrepresentation of women, minorities and persons with disabilities are due more to existing problems in the U.S. society instead of learning differences among ethnicity and gender.

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Appendix A Mission Statement of NSF

The National Science Foundation is an independent agency of the U.S. Government. The primary goal of NSF is to promote the progress of science, to advance the national health, prosperity, and welfare, and to secure the national defense (About NSF, 1999). In order to accomplish these goals, the NSF has been broken up into many different divisions which have been illustrated in the Organizational Chart.

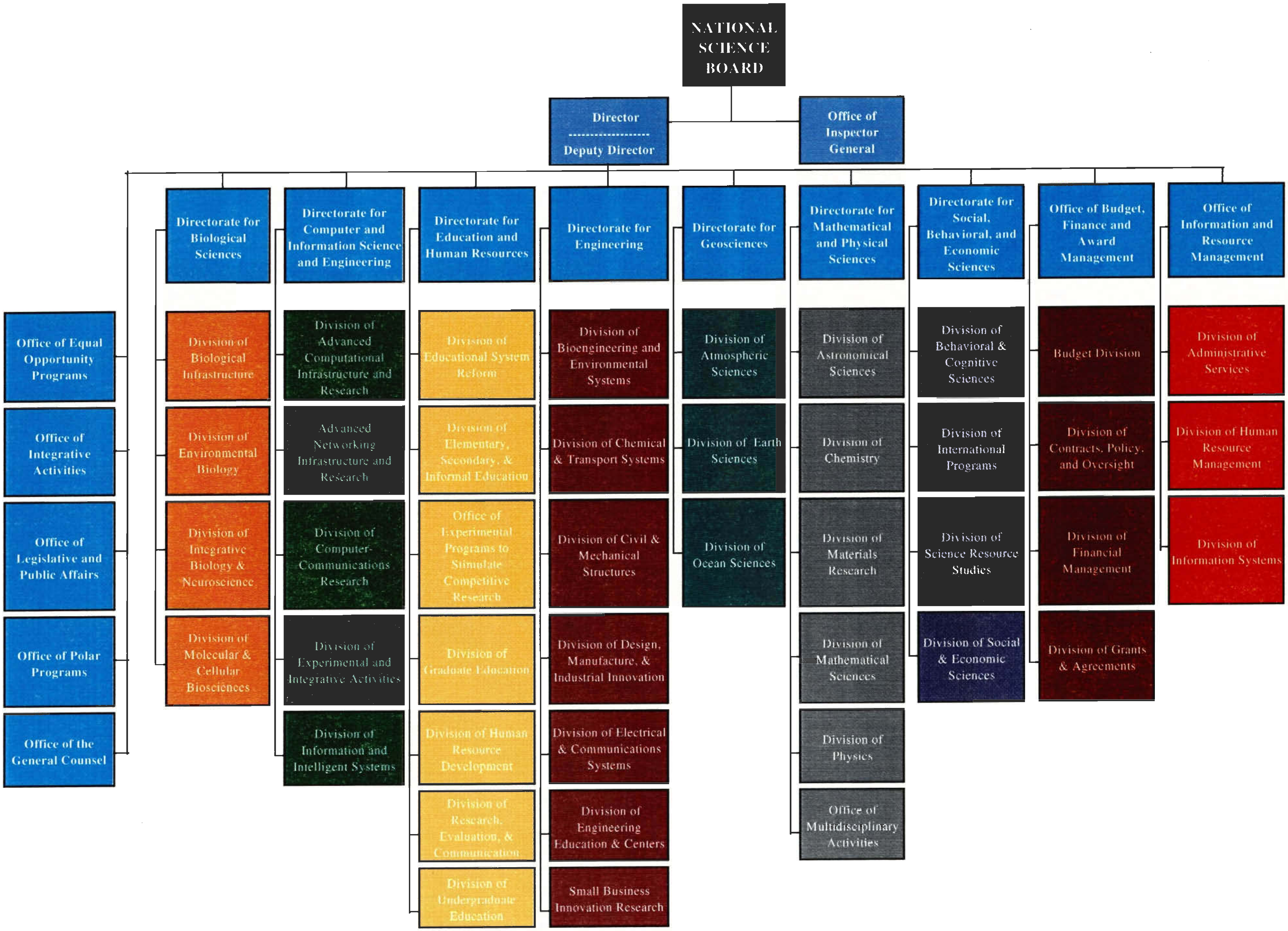
NSF has also created a National Science Board consisting of 24 part time members, each appointed by the president and approved by the U. S. Senate. They provide the President with reports involving policy matters relating to education, science and engineering. They are also required to submit additional reports through the President to Congress regarding the state of science and engineering in the United State.

The Division of Undergraduate Education, which is a subdivision of the National Science Foundation under the directorate of Educational and Human resources, is mainly interested in proving and strengthening the learning science, mathematics, engineering, and technology education to all students including:

- Science, mathematics, or engineering majors;
- Students in science and engineering technology programs;
- Future teachers at the elementary and secondary school levels; and
- Non-science majors seeking scientific and technical literacy.

The mission of the DUE is unique because the focal point of the division is devoted to funding undergraduates science, math, engineering, and technology (SMET) education. A particular emphasis is placed on improving access for all segments of U. S. society, including paraprofessionals, persons with disabilities, and populations previously underrepresented in SMET studies or in technical or teaching careers.

Organizational Chart of the National Science Foundation



Appendix B Excerpt from "DUE Program Annoucements and Guidelines" NSF 99-53

Instructions and Codes for Completing NSF Form 1295: Project Data Form

Item 1 Indicate the **program-track** to which the proposal is being submitted:

CCLI:	Course, Curriculum, and Laboratory Improvement
CCLI-EMD	Educational Materials Development
CCLI-A&I	Adaptation and Implementation
CCLI-ND	National Dissemination
CETP:	NSF Collaboratives for Excellence in Teacher Preparation
CETP-IF	Collaborative: Institutional Focus
CETP-SF	Collaborative: System-wide Focus
ATE:	Advanced Technological Education
ATE-PR	Project
ATE-CE	Center of Excellence

Item 2 Enter the **Name of the Principal Investigator/Project Director**.

Item 3 Enter the **Name of the Submitting Institution**, including the branch or campus.

Item 4 List any **Other Institutions Involved**: directly, through subcontracts, or through shared use of equipment.

Code A Select a two-digit **Discipline Code** that is most descriptive of the general area for your proposal.

11	**ASTRONOMY**
61	**BIOLOGICAL SCIENCES**
12	**CHEMISTRY**
	COMPUTING
31	Computer Science
32	Computer Engineering
33	Information Science and Systems
34	Software Engineering
35	Computing—Other; includes Computational Science & Systems. Note: Computer applications should be coded under specific disciplines.
	EARTH SCIENCES
40	Earth Systems Science
41	Atmospheric Sciences
42	Geology
43	Oceanography
	ENGINEERING
51	Aeronautical Engineering
53	Chemical Engineering
54	Civil Engineering
55	Electrical Engineering
56	Mechanical Engineering
57	Materials Science & Engineering
58	Engineering Technology
59	Engineering—Other; includes Agricultural; Bioengineering; Industrial & Management; Nuclear; Ocean; Manufacturing; Systems Engineering; and Inter- or Multi-disciplinary projects involving Engineering disciplines only.
99	**INTERDISCIPLINARY / MULTIDISCIPLINARY**
21	**MATHEMATICAL SCIENCES**
13	**PHYSICS**
	SOCIAL, BEHAVIORAL, & ECONOMIC SCIENCES
71	Biological Psychology
72	Social Psychology
73	Cognitive Psychology
81	Anthropology
82	Economics
83	History
84	Linguistics
85	Political Science
86	Sociology
88	Geography
89	Social Sciences—Other
91	Science & Technology Assessments; Effects of Sciences & Technology On Society; Ethical Considerations; Science Policy

Code B Enter the **Academic Focus Level Code** of the project. That is, the project will develop, implement, or disseminate curricular or laboratory material for eventual presentation at what academic level: **LO** = lower division undergraduate courses; **UP** = upper division undergraduate courses; **BO** = both divisions of undergraduate courses; **PC** = pre-college courses (preK-12); **AL** = pre-college and undergraduate courses.

Code C Enter the **Highest Degree Code** to indicate the highest degree offered in science, mathematics, or engineering by any department on the campus submitting this proposal: (**A** = Associate; **B** = Baccalaureate; **M** = Masters; **D** = Doctorate; **N** = Non-academic institution).

Code D Enter the proper **Category Code** depending on the program:

CCLI: Indicate whether the project scope is at the **X** = EMD "proof-of-concept" or A&I single course/lab level; or at the **Y** = EMD full development or A&I comprehensive curriculum level. For CCLI-ND proposals, leave blank.

CETP: Indicate whether the project focuses on preparing **ET** = elementary school teachers; **MS** = middle school teachers; **SS** = secondary school teachers; or is **CM** = comprehensive.

ATE: Indicate whether the project focuses on **A** = adaptation and implementation, **B** = curriculum and educational materials development, **C** = teacher and faculty preparation and enhancement, **D** = technical experiences, **E** = laboratory improvement, or **F** = special activities

Code E If the project has major participation by the private sector (commercial or industrial organizations), indicate by entering **PS**; otherwise leave blank.

Code F For those proposals where a **significant** component of the project is the education of the following groups, indicate the proper **Audience Code(s)**. ***Each group indicated must be discussed explicitly and substantively in the Project Description.*** Codes: **W** = Women; **M** = Minorities; **D** = Persons with Disabilities; **H** = Technicians and Technologists; **T** = Pre-Service Teachers; **I** = In-Service Teachers; **S** = Secondary School Students; **F** = Faculty Professional Development

Code G Enter the **Institution Control Code** to indicate whether the performing institution is: **PUBL** = Public; **PRIV** = Private; **CONS** = Consortium; **NACD** = Non-academic.

Code H If applicable, indicate that the project has a **Strategic Area** focus by entering an appropriate code according to the following: **GC** = Global Change; **HPC** = High Performance Computing; **EN** = Environment; **MA** = Manufacturing; **BT** = Biotechnology; **AMP** = Advanced Materials and Processing; **CI** = Civil Infrastructure Systems; **KDI** = Knowledge and Distributed Intelligence.

Code I If applicable, indicate whether the project involves any of the following activities. Include up to **five** of the following **Project Features**:

1 = Research on Teaching and Learning

2 = Integration of Research and Education (e.g., direct undergraduate student research; research processes and/or data integrated into coursework; sharing research results via training courses for faculty, teachers, or industry groups; and encouraging greater balance in faculty teaching and research activities by altering rewards, review policies, and resources)

3 = Educational Uses of Technology (e.g., computers, portable instrumentation, distance learning, e-mail and other electronic communication, etc.)

4 = Field Experiences (i.e., outside the classroom)

5 = Connections with Business and Industry

6 = Science Literacy for Non-SMET Majors

7 = International Activities

Codes J-M

Give your best estimate of the numbers of persons in the indicated categories who will receive immediate benefit from the project (primary effect) and are likely to immediately benefit as a result of another person's participation (secondary effect) during the period the project is in operation (including intermediate periods for seasonal projects).

NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education

NSF FORM 1295: PROJECT DATA FORM

Refer to the accompanying instructions and codes to be used in completing this form.

1. **Program-track** to which the proposal is submitted: __________
2. Name of **Principal Investigator/Project Director** (as shown on the Cover Sheet):
   ____
3. Name of submitting **Institution** (as shown on Cover Sheet):
   ____
4. **Other Institutions** involved in the project's operation:
   ____

Project Data:

A. Major Discipline Code: __ __
B. Academic Focus Level of Project: __ __
C. Highest Degree Code: __ __
D. Category Code: __ __
E. Business/Industry Participation Code: __ __
F. Audience Code: __ __ __ __
G. Institution Control Code: __ __ __ __
H. Strategic Area Code: __ __ __
I. Project Features: __ __ __ __ __

Estimated number in each of the following categories to be directly affected by the activities of the project during its operation:

J. Undergraduate Students: ______
K. Pre-college Students: ______
L. College Faculty: ______
M. Pre-college Teachers: ______

NSF Form 1295 (10/98)

Appendix C Interviews

Interview Questionnaire for PDs

1) Could you state the objectives and goals of this project?

2) Could you explain what in the project was designed to target Women, Minorities, or Persons with Disabilities specifically?

3) Was the project helpful for All Students?

4) How was the project beneficial to Women, Minorities, or Persons with Disabilities specifically?

    - *If the project doesn't seem to target Women, Minorities, or Persons with Disabilities*: Why did you keep the audience code of WMD when it does not clearly target that group?

5) Do you think it would be easier for PIs if there was a Target Audience Code of All Students?

6) How do you think the techniques that were used in this project could be improved, was there an aspect of the project that seemed weaker than the rest?

7) Have you found the techniques that were implemented in this project to be widely used?

Interview Questionnaire for PIs

1) Could you restate the objective and goals of this project?

2) Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities?

3) Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students?

    - If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group?

    - If there had been a code for ALL Students would you have checked it?

4) Why did you decide to implement the following techniques?

        - Do they target Women, Minorities, or Persons with Disabilities?

5) Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?

Interview with Benjamin Pierce

Prop ID # 9455440
Current PO: Hal Richtol
Awarding PO: Hal Richtol
Baylor University

Development of an Integrated Multidisciplinary Course for Comprehensive Universities

Monday November 29, 1999 3:00 p.m. EST

1) *Could you restate the objective and goals of this project*?
   - The primary goal of this project was to develop a model for an integrated science course that was to be part of a multidisciplinary core curriculum.
   - The second goal was to create a series of modules that would take an interdisciplinary approach to science.
   - Third was to integrate the teaching curriculums by having professors teach a variety of the eight classes that were involved in the project.
   - The final goal was to develop teaching assistant material for TA's to use in the future.

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - Dr. Pierce used different teaching methods to target WM. He used non-traditional teaching methods such as collaborative learning and group work.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students*?
   - He felt that this project was helpful to all students, and after assessing the project he found that a majority of students liked the techniques that were implemented, not just women and minorities.

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group*?

     - *If there had been a code for ALL Students would you have checked it*?
   - He was not sure if he would have checked the ALL Students category because although it did not single out WM, the techniques that were used were designed for WM.

4) *Why did you decide to implement the following techniques*?
   - He used these techniques because during his research he found that WM may not do as well in SMET under the traditional learning styles (which is singular study, lecture only, looking through a textbook, etc.). He felt that incorporating group

work and collaborative learning methods would appeal to and help WM become interested and succeed in the sciences.

- *Do they target Women, Minorities, or Persons with Disabilities?*

– He found that all students liked these methods.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*
   – Since this is an ongoing project he has made many changes. Most of these changes have been at an administrative level.
     – They are still using an integrated approach
     – They are still using the 8 modules, however they changed their order
     – They hired a lab coordinator that oversees all lab sessions and participates in all of the lecture classes, this allows for a better consistency throughout all of the 8 modules
     – They added a writing course which allows the students to learn to write in a scientific manner
     – They removed a math course because the material that was being taught had been incorporated throughout the 8 modules so it was unnecessary to have a separate math class

Interview with Desmond Penny

Prop ID # 925227
Current PO: Duncan McBride
Awarding PO:
Southern Utah University
<u>Computerization of the Physics Laboratory</u>
Monday November 29, 1999 and 5:00 p.m. EST

1) *Could you restate the objective and goals of this project*?
   - The primary goal was to obtain data acquisitions equipment and to use this technology to improve the students understanding of physics.

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - This targeted WD and Native Americans. However, he felt that they couldn't target these groups without having a negative affect towards other students.
   - Computers help D because it allows them to participate in a laboratory with greater ease
   - He felt that a computer has become a very friendly medium for a lot of students, particularly women and the computer reduced the negative feeling that a lot of women had towards physics. He also mentioned that they had hired a female lab coordinator
   - There is a large number of Native Americans at this school, so the help for minorities was self explanatory
   - He emphasized that physics was a nonsexist and nonracist field
   - Their main objective was to promote physics to all students, and in a lab environment it is essential that the instructor take each student separately. For all students to succeed it is required to look at each on a person to person level.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students*?
   - Again he mentioned that he felt it would be impossible to single WMD out because it would act negatively on other students. He said that this project helped all students.

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group*?

     - *If there had been a code for ALL Students would you have checked it*?
   - An ALL Students code would be helpful if the project set out to target all students
   - He said that he would have marked an ALL Students code.

4) *Why did you decide to implement the following techniques*?

- A lab environment is a non intimidating, non lecture environment anyway, so they were already working in groups and using cooperative learning styles
- In these labs they designate a specific role to each student and rotate roles for each lab, this way each student is forced to gain the skills from every role.

  - *Do they target Women, Minorities, or Persons with Disabilities?*

-

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*
   - They had to totally rewrite the lab manuals to incorporate the computers and they had to change the traditional labs in order for them to be able to use the computers. This was necessary because the computer is capable of doing much more in-depth analysis of lab work.
   - This is a continuing process because of the advances in computer technology that are being made.

Interview with Duncan McBride

Prop ID# 9252277
PI: Desmond Penny
Southern Utah University
Computerization of the Physics Laboratory
Tuesday, November 30, 1999 4:00 p.m. EST

1) *Could you state the objectives and goals of this project?*
   - He was not the awarding PD, he did not have access to the jacket, and he knew very little about the project.
     - He did remember that a target was the adaptation of the physics workshop using techniques that were acquired from another school

2) *Could you explain what in the project was designed to target Women, Minorities, or Persons with Disabilities specifically?*
   - He did not remember anything that significant that was done for WM

3) *Was the project helpful for All Students?*
   - He felt that it was more helpful for ALL Students

4) *How was the project beneficial to Women, Minorities, or Persons with Disabilities specifically?*

   - *If the project doesn't seem to target Women, Minorities, or Persons with Disabilities*: Why did you keep the audience code of WMD when it does not clearly target that group?

5) *Do you think it would be easier for PIs if there was a Target Audience Code of All Students?*
   - He said that it would NOT be helpful to have a category labeled ALL Students
     - It is hard to define what ALL Students means
       - Is it the same for a senior class as it is for a freshman class?
     - Recently they have been telling PIs to leave the F code blank unless they actually do something significant to target one of the groups indicated
       - If the mark it and don't target a group it is a waste because the PD is supposed to take the code out
     - He would rather see more Blanks

6) *How do you think the techniques that were used in this project could be improved, was there an aspect of the project that seemed weaker than the rest?*
   - The techniques that were used in this project are used very well and Dr. Penny put a lot of time and effort into this project
     - Dr. Penny spent an entire summer with the originator of these techniques in an effort to increase his understanding of the techniques so that he could implement them better

7) *Have you found the techniques that were implemented in this project to be widely used?*
   - These techniques are becoming more and more widespread. They will soon not be considered non-traditional.
   - The interesting thing about this project is that Dr. Penny implemented these techniques before these techniques were becoming widely used

Interview with Louis Friedler

Prop ID # 9351926
Current PO: Marjorie Enneking
Awarding PO: Tina Straley
Beaver College

Elementary Statistics Computer Laboratory

Tuesday November 30, 1999 9:00 a.m. EST

1) *Could you restate the objective and goals of this project?*
   - His main goals were to change the Elementary Statistics course to a more lab based course and to give students role models in this field by having guest speakers talk to classes and introduce real world statistical topics to the students.

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities?*
   - The guest speaker idea was designed to target women because he felt that it would give them role models in the statistical field.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students?*
   - Although a main target was woman, he felt that this project was beneficial to all students. He felt that the laboratory experience and the guest speakers were beneficial to all students.

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group?*

     - *If there had been a code for ALL Students would you have checked it?*
   - Having a category for ALL Students would be a good idea
   - However, for this project he would have still checked W
     - Because Beaver College used to be all female and there is still nearly 70% female enrollment there.

4) *Why did you decide to implement the following techniques?*
   - He felt that a lab experience would be a good way to attract students to statistics by giving them a more hands on approach and he also felt that having guest speakers would allow students to see what happens in this field after college.

     - *Do they target Women, Minorities, or Persons with Disabilities?*
   - No these techniques do not target W only.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*

- Since the school has gotten bigger since the project was introduced it was required that they have more sections of the class, increasing from 4 to 6.
  - It was impossible for them to get enough guest speakers and they couldn't find a time at which all of the sections could meet to listen to the speaker.
    - They tried videotaping the speaker and showing the video to the sections but that didn't have the desired effect.
      - They were forced to stop using guest speakers
  - One professor supervises the entire course and all of the sections
    - They rotate the supervising professor
    - This professor meets with all of the instructors from each section
      - This allows for the entire course to be completely coordinated
  - The labs are still in use and are working very well
  - The number of student complaints about the course have dropped significantly

He wants a copy of the final project

Send to:

Department of Mathematics
Beaver College
Glenside, PA 19038

Interview with Melanie Cooper

Prop ID # 9455526
Current PO: Hal Richtol
Awarding PO: Susan Hixson
Clemson University

Cooperative Organic Laboratory

Tuesday November 30, 1999 9:30 a.m. EST

1) *Could you restate the objective and goals of this project*?
   - The main goal was to redesign the Organic Chemistry Laboratory for Science majors
     - She wanted to make it a more research based laboratory
       - With an emphasis on group based research

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - In a previous project they had done in a general chemistry lab
     - They had found that W that worked in cooperative labs did better than their peers that worked under more traditional learning styles
       - They also had a much lower drop out rate than their peers

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students*?
   - Based on here prior research she felt that these ideas would help W the most
     - However, after the project had been implemented she found that ALL Students had benefited greatly from this project

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group*?

     - *If there had been a code for ALL Students would you have checked it*?
   - She thinks that it is a good idea to have an ALL students category.
     - However she still would have checked W because she thought it would help W more
       - But if she had to redo her form now that the project had been running for a while she would check the ALL Students category

4) *Why did you decide to implement the following techniques*?
   - She felt that since the project that had been done in the general chem. lab had worked so well at helping W it would be a good idea to do the same type of thing in the organic lab
     - She was dissatisfied with the way that the organic lab was being taught and how it was running.

- *Do they target Women, Minorities, or Persons with Disabilities*?
  - She felt that they would target W
    - But it turned out that it actually targeted ALL Students.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it*?
   - One of the main goals of the project was the development of materials
     - Since technology is changing so fast these methods of development have had to change also
       - She thought that they were on their third or fourth type now
- At the beginning the experiments that they were conducting were to open ended
  - This would have been OK if a very experienced professor was overseeing the labs
    - But with a TA overseeing the labs the experiments were too complicated for the TA to handle
    - They are working on refining the experiments so that they are not as open ended and complicated
      - They are attempting to refine the experiments
- Since most of the students are not chem. majors it is required to refine the experiments
- However all of the experiments are still multi-week experiments

Additional: When you were in college did you find the labs to be a helpful and attractive tool?
- The introductory labs did not interest her that much
  - But once she started getting into her major and conducting research there she found them to be very helpful and fun.

Interview with Susan Hixson

Prop ID# 9455526

PI: Melanie Cooper

Clemson University

Cooperative Organic Laboratory

Wednesday, December 01, 1999 9:00 a.m. EST

1) *Could you state the objectives and goals of this project*?
   - In general these projects tend to use small classes
     - Dr. Cooper, in her first project focusing on gen. Chem. Focused on a larger scale and incorporated more students
     - She did the same thing in this Organic project
     - One of her main objectives was to restructure how the organic lab was conducted

2) *Could you explain what in the project was designed to target Women, Minorities, or Persons with Disabilities specifically*?
   - The techniques that she used were also used in her gen. Chem. Project. These techniques proved to work well for women
   - In a project at Wisconsin these techniques also proved to help W
     - However, word got out that W did better in this class
       - So more and more W were enrolling in the class
         - This lead to an overall idea that the entire class was improving every year, however since there were more and more W every year, the idea was somewhat incorrect

3) *Was the project helpful for All Students*?
   - It turned out to be just as helpful for ALL Students as it was for W

4) *How was the project beneficial to Women, Minorities, or Persons with Disabilities specifically*?

   - *If the project doesn't seem to target Women, Minorities, or Persons with Disabilities*: *Why did you keep the audience code of WMD when it does not clearly target that group?*

5) *Do you think it would be easier for PIs if there was a Target Audience Code of All Students*?
   –

6) *How do you think the techniques that were used in this project could be improved, was there an aspect of the project that seemed weaker than the rest*?
   - Group work, hands on experience

7) *Have you found the techniques that were implemented in this project to be widely used?*

- These techniques have not been widely used in organic chem.
  - The idea of using open-ended labs
  - And implementing it on a large scale

Additional: Have these techniques been copied by anyone that you know of?

- The techniques and ideas that she used in general chem. Have been used by other schools
  - However these other schools have not gone through NSF to do this
  - Dr. Cooper prepared multimedia for other schools to use
  - Dr. Cooper also ran workshops through NSF about faculty enhancement
    - This spread the word about her gen. chem. project
    - NSF does not support those workshops anymore so there is not that opportunity to spread the ideas about the organic labs
  - Dr. Hixson assumes that Dr. Cooper is doing the same multimedia preparation with her organic lab to spread the ideas that she used
    - People come to NSF to get the equipment necessary to run programs similar to this
      - Not the pedagogical ideas

Interview with Steven Strand

Prop ID # 9455447
Current PO: Terry Woodin
Awarding PO: Terry Woodin
University of California at Los Angeles (UCLA)
Computer-Integrated Introductory Biology Lab
Tuesday, November 30, 1999 10:30 a.m. EST

1) *Could you restate the objective and goals of this project?*
   - The goal was to create a hands-on/ non-threatening laboratory environment that would allow students to work at their own pace. He felt that it would be necessary to allow the students to make their own mistakes when conducting the experiments and for the students to find ways to solve their mistakes on their own.

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities?*
   - He felt that the laboratory experience would appeal to students outside of the typical white middle class area. It would allow underrepresented students to be successful and they would also work to increase the success of these students by giving them a non-threatening environment to work in.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students?*
   - His original idea was that it would be helpful for ALL Students. This was accomplished
     - However creating an all inclusive lab experience with rigid guidelines about participation it helped the underrepresented groups a little bit more.

   ▪ *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group?*

   ▪ *If there had been a code for ALL Students would you have checked it?*
   - It is a good idea to have a category for ALL Students
     - However when you check a box or put down a letter it gives the impression that you are excluding a group
     - He would only use the ALL Students category if there was a way for him to also state that he had a big emphasis on the underrepresented groups as well
     - It is very hard to create a program that is not in some way beneficial to ALL Students.

4) *Why did you decide to implement the following techniques?*
   - In a lab environment where men and women are working together, it is often found that the men dominate the groups and the women sit back and watch

- In his project it is required that all groups members participate evenly
- This eliminates any roles that some people would tend to take on a consistent basis and forces everyone to participate at each level.

- *Do they target Women, Minorities, or Persons with Disabilities*?
- They help women and minorities because they allow them to work in a group and not feel threatened or intimidated by their surroundings.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it*?
   - This project is under continual evaluation
     - They have added sound to the project
     - They have focused less on keyboard use and more on the use of the mouse

Additional: Have you found these techniques to be used elsewhere (because in the abstract it mentions that this was designed in part to be a blueprint for introductory courses across the nation)?
- A few schools have used some of the materials
  - But these are generally professors that have worked at UCLA and then moved on to different schools.
- They are just beginning to disseminate their materials to other schools

He would like a copy

Send to:

Biology Department
UCLA
Los Angeles, CA 90095-1606

Interview with Ann Rushing

Prop ID # 9650358
Current PO: Lee Zia
Awarding PO: Lee Zia
Baylor University

Laboratory Activities for an Integrated, Multidisciplinary Science Literacy Course

Tuesday, November 30, 1999 12.30 p.m. EST

1) *Could you restate the objective and goals of this project*?
   - The main goal was to increase science literacy and the comfort that students have with science in general.
   - They wanted to provide opportunities to actually see science in progress and see what can be done with science.

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - They felt that incorporating active learning (i.e. collaborative learning, group work, and hands on experiences) would benefit the students and make them more comfortable with science in general.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students*?
   - She felt that although they had placed an emphasis on WM that this project was beneficial to ALL Students.

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group*?

     - *If there had been a code for ALL Students would you have checked it*?
   - She would have checked ALL Students, however she would also like it to be known that they were placing an emphasis on WM because the techniques that they were implementing were beneficial to underrepresented groups.

4) *Why did you decide to implement the following techniques*?
   - They chose to use these techniques because they wanted this course to be as active as possible
     - They have students work in-groups and give group presentations that force all members of the group to participate.

     - *Do they target Women, Minorities, or Persons with Disabilities*?
   - They do target WM, however they are beneficial to ALL Students.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*
  - The lab activities have changed a lot since the proposal was written.
    - The students are doing more critical thinking.
- However she is not teaching the course right now so she could not go into a lot of detail about how the course is working now.

Additional: Did labs and hands on experience help interest you in these fields when you were in college?

- Yes they did
  - She had a lot of lab courses
    - However she did not get to design her own experiments
      - Which is one thing that she wishes she could have done and is having students do now.

Interview with Lee Zia

Prop ID# 9650358
PI: Ann Rushing
Baylor University

Laboratory Activities for an Integrated, Multidisciplinary Science Literacy Course

Thursday, December 02, 1999 9:00 a.m. EST

1) *Could you state the objectives and goals of this project*?
    - This was an ILI project
        - So there was not any funds directed towards curriculum development
    - Baylor had introduced an entirely new core curriculum
        - This project incorporated five different disciplines
            - Through one two semester class called 'The Natural World'
                - This class utilized modular components
                - And was linked to two humanities courses

2) *Could you explain what in the project was designed to target Women, Minorities, or Persons with Disabilities specifically*?
    - He did not know why
        - But he felt that there had to have been something that mentioned WM as a target
        - He thought that sine Baylor is a very large school with a diverse population
            - And since this was a general education course
                - The population that was enrolled in the course would be very diverse
    - He did not know if WM were specific targets because these techniques appeal to ALL Students
        - But they tend to help WM very well

3) *Was the project helpful for All Students*?
    - Since this was a general education course it helped ALL Students
        - Or at least the intent was there to help ALL Students

4) *How was the project beneficial to Women, Minorities, or Persons with Disabilities specifically*?
    - He did not know
        - *If the project doesn't seem to target Women, Minorities, or Persons with Disabilities*: *Why did you keep the audience code of WMD when it does not clearly target that group?*

5) *Do you think it would be easier for PIs if there was a Target Audience Code of All Students*?

- The reason for this code is because DUE wants to know something about the project and the if the project has a specific target
  - If there is not a target code it is assumed that there is not a specific target and therefore targets ALL Students
- If the course that is being reformed has a high percentage of WMD
  - Then PIs tend to check WMD
- So to answer the original question: no it would probably not be helpful to have an ALL Students Involved code
  - As his own conjecture:
    - Where you see a blank it is probably more often than not the result of a PD eliminating a code
    - The PIs are very sensitive about their projects
      - And they want to have their idea come across as well as possible to any looking at it
        - Therefore they have the tendency to put WMD down to improve the image
        - Often times it is found that if the college has a large percentage of WMD enrolled there the PI will check WMD under the assumption that since there are a lot of WMD at my school, a lot of WMD will take my class, therefore I am targeting WMD

6) *How do you think the techniques that were used in this project could be improved, was there an aspect of the project that seemed weaker than the rest*?

- He had no clue
  - On the surface the ideas were correct and well thought out
    - But he did not have any follow up information about the outcomes

7) *Have you found the techniques that were implemented in this project to be widely used*?

- A lot of projects use these techniques (hands on, collaborative learning, group work)
  - A lot of people are beginning to understand that more participation by the student in a class
    - Leads to more success for the student in the class
  - Some projects want to use these techniques but do not fully understand how to implement them
    - And that comes across in the way that they write the proposals
  - The field is changing and more and more people are realizing that these techniques are the best way to teach now
  - The reviewers do a very good job sorting out the proposals
    - From ones with good ideas but without substance

        - And those that have very good ideas and they show how they are going to implement the techniques and how the techniques will be beneficial

Additional:

- Our project has helped him to understand better how the DUE and project funding and follow up work
    - Our project reveals the products of the system
    - He felt that there needed to be more communication between the PI and PD
        - The PDs had to be better in touch with the programs
        - One idea he had was to keep former PDs involved
            - This way it would not be required to switch the PD of a project half way through the project
        - He mentioned an idea that he had worked on
            - Which was to require the PIs to edit their abstracts every year because the projects change so much
                - The PI would then be allowed to include information about the success of the project
                - This also allows someone searching awards to have a better understanding about the award through the abstract
                    - The abstract is not actually put online until nearly one year after the proposal was submitted

Interview with Patricia Shuart

Prop ID # 9455638
Current PO: Elizabeth Teles
Awarding PO: Elizabeth Teles
State University of New York (SUNY) at Oswego

State University of New York (SUNY) Pre-Precalculus Program: Empowering Underprepared Two and Four Year College Mathematics Students

Tuesday, November 30, 1999 1:00 p.m. EST

1) *Could you restate the objective and goals of this project*?
   - Their main goal was to look at developmental mathematics and to design a sequence of courses to address these areas.
   - These courses were designed to be more student friendly
     - Incorporating technology (such as graphing calculators)
     - Incorporating cooperative learning

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - The incorporation of extra support systems and visual aids tend to increase the acceptance of WMD towards math.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students*?
   - The techniques that were used seem to benefit ALL Students, however when she was filling out the form she had the intentions that these techniques would target WMD more specifically.

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group*?

     - *If there had been a code for ALL Students would you have checked it*?
   - If she had to fill out the form again she would check WMD because she didn't know how the project would affect students and she felt that it would affect WMD more.
   - If she had to fill out the form now she would probably check ALL Students because she has seen how it has affected ALL Students.
     - But she would still like to have it note that a large target was WMD.

4) *Why did you decide to implement the following techniques*?
   - The techniques that they used were formed through the modules that they created for the series of classes.

- The graphing calculators and visual aids were integrated into the program through the problems that were introduced to students.

- *Do they target Women, Minorities, or Persons with Disabilities?*
- They do target WMD, but not only WMD
  - These techniques help ALL Students.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*
- The time frame and structure of the project was followed very closely.
  - They currently have a grant with a publisher
    - This program lead to the writing of two textbooks
      - In these textbooks she is used instead of he in an effort to make W feel more comfortable.
  - They are currently publishing the textbook

Additional: Has this project been imitated at other schools?
  - Yes it has
    - There are 13 colleges in the SUNY system that currently use this program
    - There are a significant number of schools outside of New York that are using this program
      - She did not know the exact number
    - A few high schools have purchased the textbooks and are currently using them in classes
    - 20 books were purchased by a foreign country
      - She was not sure what country or how they were using them

Interview with Liz Teles

Prop ID# 9455638
PI: Patricia Shuart
State University of New York (SUNY) at Oswego

State University of New York (SUNY) Pre-Precalculus Program: Empowering Underprepared Two and Four Year College Mathematics Students

Wednesday, December 01, 1999 11:00 a.m. EST

1) *Could you state the objectives and goals of this project*?
   - The main goals were to develop materials for a pre-precalculus class through a coalition of 2 and 4 year schools throughout New York
     - They did write a book
       - NSF asked them to get an editor to bring the book together into something that could be used
         - Because it was written for each module separately and NSF wanted it to be more congruent
   - Another goal was to bring the coalition together and get all of the schools working on the same page
     - This would allow students from the 2 years schools to transfer to the 4 year schools and not be behind in their preparation
   - They also had a parallel program running for faculty enhancement

2) *Could you explain what in the project was designed to target Women, Minorities, or Persons with Disabilities specifically*?
   - With regard to M
     - They have a math lab that provides services for ALL Students
       - However it provides special services for M students
   - With regards to W
     - There is a large population of W enrolled at the schools
   - She did not think that there was anything special done for D

3) *Was the project helpful for All Students*?
   - Yes it was

4) *How was the project beneficial to Women, Minorities, or Persons with Disabilities specifically*?

   - *If the project doesn't seem to target Women, Minorities, or Persons with Disabilities*: *Why did you keep the audience code of WMD when it does not clearly target that group?*

5) *Do you think it would be easier for PIs if there was a Target Audience Code of All Students?*
   - She did not think that it would be a good idea
     - Since all of these projects seem to help ALL Students most PIs would only check that off
     - It is understood that the default is ALL Students and if they check WMD they are stating that they do something special to target these groups

6) *How do you think the techniques that were used in this project could be improved, was there an aspect of the project that seemed weaker than the rest?*
   -

7) *Have you found the techniques that were implemented in this project to be widely used?*
   - Most research shows that these techniques (group work, collaborative learning, and visual aids) are very successful at increasing the success rate of students.
     - One thing is that they are building communities among the students through group activities
     - Another techniques that has proven to work is mentoring and tutoring
       - This makes students feel more comfortable

Additional:
   - Overall this project has done tremendous things
     - The coalition is working very well
       - With mutual contribution from all of the schools involved

Interview with Donald Wink

Prop ID # 9653080
Current PO: Susan Hixson
Awarding PO: Susan Hixson
University of Illinois at Chicago

CPLP: A Chemical Professional Laboratory Program for General Chemistry

Wednesday December 1, 1999 10:30 EST

1) *Could you restate the objective and goals of this project?*
   - The objective was to develop new laboratory experiments for General Chemistry.
   - The goal was to drawn from several different areas in industry that show the use of chemistry, as well as from several different departments on campus.

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities?*
   - Finds that certain groups suffer in standard chemistry courses. One reason is that it is assumed that they have more then a general knowledge of the material.
   - Use two elements to target women and minorities:
     - Though professional chemical experiences, which is when students are given actual problems that occur in industry, and it is referred to as connected learning.
     - Though skill building experiences, regardless of the students education background.
   - The techniques that are used try to be beneficial to everyone.

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students?*
   - It is definitely beneficial to all students. This program tries to be more inclusive of all students then specific to certain groups of students.

   - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group?*

   - *If there had been a code for ALL Students would you have checked it?*
   - . Not sure, the inclusiveness of the goals already includes all students. The project does try to target women and minorities, but in its very goals cannot only target those groups and exclude others.

4) *Why did you decide to implement the following techniques?*
   - The reason was two things needed to be implemented. One was to do a student design to make students do what they wanted to do. The other was to show that chemistry was important to students outside the chemistry department, since other majors that the general chemistry courses.

- *Do they target Women, Minorities, or Persons with Disabilities*?

– Thus far they have not looked solely at the different subgroups and how they are doing in the course. They have found that the students are definitely working well in groups thus far.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it*?
   – At this point they are about to have the program published, therefore they are in the process of locking the specifics down. In time hopefully the program can be expanded further to the point past NSF funding.

6) In addition, would like to have a copy of the final report:

   Professor Donald Wink
   Department of Chemistry (M/C 111)
   University of Illinois at Chicago
   845 West Taylor Street
   Chicago, IL 60607

Interview with Susan Hixson

Prop ID# 9653080
PI: Donald Wink
University of Illinois at Chicago

CPLP: A Chemical Professional Laboratory Program for General Chemistry

Wednesday, December 01, 1999 9:00 a.m. EST

1) *Could you state the objectives and goals of this project*?
   - The primary goal of this project was to gear lab experiments more towards the professional aspect of school
     - Week 1 of the program was a general chem. Overview
     - In week 2 of the program students conducted experiments that showed how chemistry was used at a professional level.

2) *Could you explain what in the project was designed to target Women, Minorities, or Persons with Disabilities specifically*?
   - The reason that the project claimed to target M was because there were a group of community colleges from around the Chicago area that were involved
     - The demographic chart on Pg. 9 of the jacket shows enrollment numbers from each school

3) *Was the project helpful for All Students*?
   - Yes
     - In an earlier project that he ran, called MATCH, he was not able to conduct it over the entire school, he was forced to confine it to a single class and that classes sections
       - This gave him valuable quantitative data
     - For this project he was unable to conduct the same quantitative data because he had a larger pool of students

4) *How was the project beneficial to Women, Minorities, or Persons with Disabilities specifically*?
   - The reason that it was beneficial to M was because they were already enrolled at the school. The methods that he used were effective in helping M students in chemistry, but the methods also helped ALL Students

     - *If the project doesn't seem to target Women, Minorities, or Persons with Disabilities*: *Why did you keep the audience code of WMD when it does not clearly target that group?*
   - She actually took out the W code for this one

5) *Do you think it would be easier for PIs if there was a Target Audience Code of All Students*?
   - If the target audience code is left blank it defaults to assume that it helps ALL Students.

- The problem with creating an ALL Students code is that this implies that you will help ALL Students, however in one of these projects you are not able to do that.
  - ALL Students implies all science majors and all non-science majors

6) *How do you think the techniques that were used in this project could be improved, was there an aspect of the project that seemed weaker than the rest*?
   - These techniques (group work, hands on experience) are widely used and are very effective

7) *Have you found the techniques that were implemented in this project to be widely used*?
   - The idea of students working in groups and using hands on experiences are widely used
     - However in this project an emphasis was placed on preparation for a professional environment
       - Which is not widely used

Interview with Wen Shieh
Prop ID # 9451210
Current PO: Chalmers Sechrist
Awarding PO: Daniel Hodge
University of Pennsylvania
Discovery-Oriented Multidisciplinary Engineering Laboratory
Wednesday, December 01, 1999 1:00 p.m. EST

1) *Could you restate the objective and goals of this project*?
   - The goal of this project was to change how lab courses are taught
     - Traditionally in a lab courses the instructor lectures about the principles and then the students go into the lab to see these principles at work
     - In this lab course the system was reversed.
       - The student does the lab first and discovers the principles on their own
       - Then the students and the professor discuss these principles that the students discovered
         - The discussion is based on how and why the item in the lab works and how the principles are related to the item

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - This project was initiated by a summer project that introduced High school science teachers to the labs and this discovery learning technique
   - High school students from the inner city also participated in this summer program
     - Most of these students were minorities
       - This introduced these students to science in a different light than the traditional classroom work

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students*?
   - This project was helpful for ALL incoming freshman
     - Freshman usually take general science courses in their first semester
       - This course, which is offered in the spring semester
         - Introduces freshman to engineering topics and principles
           - Which they would not have been introduced to until they began major specific classes

   - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group*?

   - *If there had been a code for ALL Students would you have checked it*?
   - This project was helpful for ALL Students

- However it was designed to encourage minority participation in engineering at the high school level, through the summer sessions.

4) *Why did you decide to implement the following techniques?*
   - A lot of students find traditional lab work to be 'boring'
     - Like they are following a recipe
- This technique allows the students to explore and imagine more about the principles behind engineering
  - Because they do not have to follow a set of directions to do the lab they actually design how they want to do it.

    ▪ *Do they target Women, Minorities, or Persons with Disabilities?*
  - These techniques are helpful for ALL Students
    - But the initial target was minority students at inner city high schools.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*
   - A new professor will take over the class next year
   - Every 2 or 3 years the professors involved with the class discuss the topics that are brought up in the class and change those topics.

Additional: *Do you still run the summer sessions for high school students?*
- They haven't run the summer session for two years now
  - There was a lack of funding so they were unable to run these sessions
- They hope to begin these sessions again this summer
  - And they plan to invite high school students from around the world to participate
    - They will emphasize students from under developed countries

Interview with Roger Persell

Prop ID # 9251014
Current PO: Duncan McBride
Awarding PO:
City University of New York (CUNY)-Hunter College
Upgrade of Introductory Biology Laboratories
Wednesday, December 01, 1999 3:00 p.m. EST

1) *Could you restate the objective and goals of this project?*
   - The goal was to provide a project oriented sequence of isolated steps and projects that were integrated into the biology theme
     - These projects would give students a better idea about how science is actually conducted

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities?*
   - Hunter College is predominately WM
     - It is nearly 70% W
     - The biology department has almost the exact same representation as the rest of the school
   - The idea of a computer based lab seemed to target WM because it provided a less intimidating opportunity in biology
   - Also the idea of working in groups with other students would increase the accessibility of biology to a lot of students

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students?*
   - The literature that he had showed that these techniques (computer based labs, group work) helped WM

     - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group?*

     - *If there had been a code for ALL Students would you have checked it?*
   - He would have checked WM still because of the large enrollment numbers of these underrepresented groups at Hunter College
     - An ALL Students Involved code could possibly be helpful, but he would still want to indicate that WM was a target.

4) *Why did you decide to implement the following techniques?*
   - These techniques seemed to be more preferential to the population that he was targeting

- The techniques allowed students to get away from isolated experiments and lectures
  - Also it allowed them to get away from solitary study habits

- *Do they target Women, Minorities, or Persons with Disabilities*?
- Collaborative learning and group work seemed to help WM participate more in biology and science as a whole.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it*?
   - They have not changed a lot about the labs specifically
     - However, they have added a discussion session where students talk to students and professors about the labs and what they have found.
     - They have a computer resource center dedicated entirely to this course
     - Senior biology majors help students taking this class with work and problems
     - They have formed study groups for students
       - These have been the most helpful aspect
     - They are planning on making technical upgrades to the labs because of the increase in technology that has been made since the project began
     - The use of computers has been extremely helpful
       - They have set up email lists for the class and they have websites where students can obtain information about the class

Interview with Robert Mignone

Prop ID # 9452621
Current PO: William Haver
Awarding PO: Tina Straley
College of Charleston

A Unified Approach Toward Success in Calculus
(Fostering Inclusiveness in the Mathematics Major)

Friday, December 03, 1999 12:30 p.m. EST

1) *Could you restate the objective and goals of this project*?
   - He had taken a sabbatical at the University of California at Berkeley working in the Math-Science Research Department
     - There he met Dr. Yuri Treisman
       - Who was trying to get M to be more successful in calculus by incorporating out of class help and study sessions
         - This technique is called Supplemental Instruction (SI)
           - And is considered to be very intensive for both the student and teacher
         - They also incorporated computer assistance labs for students
   - This project aimed at obtaining money to purchase the computer equipment needed for Dr. Mignone to mimic Dr. Treisman's techniques
     - The students benefit greatly from these methods
       - Professors provide problem sessions and tutorials for students to use
     - Dr. Mignone wanted to see if using unification techniques were particularly helpful to M students

2) *Could you explain what in the project was designed specifically to target Women, Minorities, or Persons with Disabilities*?
   - The College of Charleston is 60-65% W
     - The representation of W in the math classes is very similar to that of the entire school
     - Therefore anything that is done to benefit the entire population will also benefit W
     - Dr. Mignone was interested in finding out how these particular techniques benefited M

3) *Do you feel that the project implemented is specifically beneficial to Women, Minorities, or Persons with Disabilities or does it benefit All Students?*
   –

   - *If project doesn't seem to target Women, Minorities, or Persons with Disabilities: Why did you put the audience code of WMD when it does not clearly target that group?*

   - *If there had been a code for ALL Students would you have checked it?*
   - The ALL Students Involved code would be helpful
     - Mainly because anything that is done to help WMD will also be beneficial to ALL Students
   - This project was helpful for everyone
     - But it had a more dramatic effect on M students.

4) *Why did you decide to implement the following techniques?*
   - He wanted to incorporate the techniques that he had learned while at Berkeley into the curriculum in his classes and at his school.
   - However instead of implementing the techniques exactly how Dr. Treisman did
     - Dr. Mignone collaborated with the schools study skills office
       - The study skills office had gotten a federal grant to implement SI techniques
     - So he used that grant to implement the pedagogical techniques
       - Which he had to refine from Dr. Treisman's study in order to comply with the grant that the office of study skills had received.

   - *Do they target Women, Minorities, or Persons with Disabilities?*
   - They target ALL Students, however he was interested in seeing how they targeted M specifically.

5) *Now that you have seen the project in progress/completed, are there any changes that you would make to improve it?*
   - He no longer teaches the calculus course
     - He has taken an administrative job and no longer has time to teach the class
     - So the program is no longer in his hands
- However the computer lab and SI technique are now an integral part of the undergraduate curriculum at the College of Charleston

Additional:
He talked about the results that he had found

- For his analysis he broke the students into two groups and five categories
  - The groups were M students and Other students
    - For each group he separated students by their SAT scores in math
    - He looked at the number of times a student attended an SI session
      - He then separated students into two more categories
        - Those that had attended 10 or more SI sessions
        - And those that had attended fewer than 10 sessions
    - He found that for M students attending 10 or more sessions
      - Their final grades improved 2%
    - For M students attending fewer than 10 sessions
      - Their final grades improved 1%
    - For general students attending more than 10 sessions
      - Their final grade improved 1%
    - For general students attending fewer than 10 sessions
      - Their final grade did not improve
- He concluded that these sessions were more beneficial for M students because they tended to improve their final grades more when exposed to this pedagogical method

Follow Up Electronic Mail Inquiry to DUE PDs

Dear Sir or Madam:

As you all may know we are conducting research about the DUE and how effectively the DUE targets Women, Minorities, and Persons with Disabilities. One conclusion that we have made thus far is that the Target Audience Code (Code F on form 1295) is not specific enough and needs to be revised because over two-thirds of all CCD and ILI awards funded between FY1992 and FY1997 left the Target Audience Code blank.

One of the suggestions that we are thinking of making is to add a code entitled "ALL Students Involved." We feel that many PIs mark WMD based on the fact that their class has a lot of these underrepresented students enrolled in it. This code would prevent PIs from marking down WMD when they do not specifically target these underrepresented groups; instead they have a large number of these students participating in the class. The "ALL Students Involved" code would allow the PI to state that they are targeting ALL Students Involved with the class. However, as well as marking the "ALL Students Involved" they would be encouraged to also state that they are targeting WMD specifically if they have mechanisms and ideas in place that will benefit WMD. This would eliminate confusion with the Target Audience Code and would make searching DUE awards much easier for researchers like ourselves.

If you could please respond to this proposed recommendation by Monday, December 8, 1999 we would be very appreciative.

Thank you very much for your time and input.

Sincerely

The WPI interns:

Bryan

Nick

Shirine

Appendix D

D.1. Historically Black Colleges and Universities (HBCU)

Minority On-Line Information Service.
http://web.fie.com/web/mol/molis-hbcus.html

- Alabama A&M University
- Alabama State University
- Albany State University
- Alcorn State University
- Allen University
- Arkansas Baptist College
- Barber-Scotia College
- Benedict College
- Bennett College
- Bethune-Cookman College
- Bishop State Community College
- Bluefield State College
- Bowie State University
- Central State University
- Cheyney University of Pennsylvania
- Claflin College
- Clark Atlanta University
- Clinton Junior College
- Coahoma Community College
- Concordia College
- Coppin State College
- Delaware State University
- Denmark Technical College
- Dillard University
- Edward Waters College
- Elizabeth City State University
- Fayetteville State University
- Fisk University
- Florida A&M University
- Florida Memorial College
- Fort Valley State University
- Gadsden State Community College
- Grambling State University
- Hampton University
- Harris-Stowe State College
- Hinds Community College
- Howard University
- Hutson-Tillotson College
- Interdenominational Theological Center
- J.F. Drake State Technical College
- Jackson State University
- Jarvis Christian College
- Johnson C. Smith University
- Kentucky State University
- Knoxville College
- Lane College
- Langston University
- Lawson State Community College
- LeMoyne-Owen College
- Lewis College of Business
- Lincoln University-Missouri
- Lincoln University-Pennsylvania
- Livingstone College
- Mary Holmes College
- Meharry Medical College
- Miles College
- Mississippi Valley State University
- Morehouse College
- Morehouse School of Medicine
- Morgan State University
- Morris Brown College
- Morris College
- Norfolk State University

- North Carolina A&T State University
- North Carolina Central University
- Oakwood College
- Paine College
- Paul Quinn College
- Philander Smith College
- Prairie View A&M University
- Rust College
- Saint Augustine's College
- Saint Paul's College
- Savannah State University
- Selma University
- Shaw University
- Shelton State Community College
- Shorter College
- South Carolina State University
- Southern University and A&M College
- Southern University at New Orleans
- Southern University at Shreveport
- Southwestern Christian College
- Spelman College
- St. Philip's College
- Stillman College
- Talladega College
- Tennessee State University
- Texas College
- Texas Southern University
- Tougaloo College
- Trenholm State Technical College
- Tuskegee University
- University of Arkansas at Pine Bluff
- University of Maryland – Eastern Shore
- University of the District of Columbia
- University of the Virgin Islands
- Virginia State University
- Virginia Union University
- Voorhees College
- West Virginia State College
- Wilberforce University
- Wiley College
- Winston-Salem State University
- Xavier University of Louisiana

D.2. Women's Colleges

The Library Network.
http://tln.lib.mi.us/~lpotter/wc5.html

- Agnes Scott College
- Barnard College
- Bay Path CollegeBennett College
- Bennett College
- Blue Mountain College
- Brenau University
- Bryn Mawr College
- Carlow Colleg
- Cedar Crest College
- Chatham College
- Chestnut Hill College
- College of New Rochelle
- College of Notre Dame of Maryland
- College of Saint Catherine
- College of Saint Elizabeth
- College of Saint Mary
- Columbia College
- Converse College
- Cottey College
- Douglass College of Rutgers University
- Elms College
- Emmanuel College
- Hartford College for Women
- Hollins College
- Hood College
- Immaculata College
- Judson College
- Lasell College
- Lesley College
- Mary Baldwin College
- Marymount College
- Meredith College
- Midway College
- Mills College
- Mississippi University for Women
- Moore College of Art and Design
- Mount Holyoke College
- Mount Mary College
- Mount St. Mary's College
- Mount Vernon College
- Notre Dame College of Ohio
- Pine Manor College
- Randolph-Macon Woman's College
- Regis College
- Rosemont College
- Russell Sage College
- Saint Joseph College
- Saint Mary's College
- Saint Mary-of-the-Woods
- Salem College
- Scripps College
- Seton Hill College
- Simmons College
- Smith College
- Spelman College
- Stephens College
- Stern College
- Sweet Briar College
- Trinity College
- Ursuline College
- Wellesley College
- Wells College
- Wesleyan College
- William Woods University
- Wilson College
- The Women's College at the University of Denver

D.3. Tribal Colleges

American Indian Higher Education Consortium. http://www.aihec.org

- Bay Mills Community College
- Blackfeet Community College
- Cankdeska Cikana Community College
- Cheyenne River Community College
- College of the Menominee Nation
- Crownpoint Institute of Technology
- Diné College
- D-Q University
- Dull Knife Memorial College
- Fond du Lac Tribal & Community College
- Fort Belknap College
- Fort Berthold Community College
- Fort Peck Community College
- Haskell Indian Nations University
- Institute of American Indian Arts
- Lac Courte Oreilles Ojibwa Community College
- Leech Lake Tribal College
- Little Big Horn College
- Little Priest Tribal College
- Nebraska Indian Community College
- Northwest Indian College
- Oglala Lakota College
- Red Crow Community College
- Salish Kootenai College
- Sinte Gleska University
- Sisseton Wahpeton Community College
- Sitting Bull College
- Southwestern Indian Polytechnic Institute
- Stone Child College
- Turtle Mountain Community College
- United Tribes Technical College
- White Earth Tribal and Community College

D.4. Hispanic Alliance of Colleges and Universities (HACU)

Hispanic Alliance of Colleges and Universities
http://www.hacu.net/members/members.htm

Hispanic Serving Institutions (HSI)

- Adams State College
- Alamo Community College District
- Albuquerque Technical and Vocational Institute
- Allan Hancock College
- Arizona Western College
- Barry University
- Bayamon Central University
- Boricua College
- Borough of Manhattan Community College, City
- Bronx Community College, City University of New
- California State Polytechnic University, Pomona
- California State University, Bakersfield
- California State University, Dominguez Hills
- California State University, Fresno
- California State University, Los Angeles
- California State University, Monterey Bay
- California State University, San Bernardino
- Caribbean Center for Advanced Studies, Miami
- Cerritos College
- Coastal Bend College
- Colegio Universitario del Este
- College of Aeronautics
- College of Santa Fe
- College of the Sequoias
- Community College of Denver
- Compton Community College
- Del Mar College
- Dona Ana Branch Community College
- East Los Angeles College
- Eastern New Mexico University, Roswell
- El Paso Community College
- Eugenia Maria de Hostos Community College, City
- Evergreen Valley College
- Florida International University
- Fresno City College
- Fullerton College
- Gavilan College
- Glendale Community College
- Hartnell College
- Herbert H. Lehman College, City University of New
- Heritage College
- Houston Community College System
- Hudson County Community College
- Imperial Valley College
- Inter American University of Puerto Rico, Arecibo
- Inter American University of Puerto Rico, Central
- Inter American University of Puerto Rico, Guayama
- Inter American University of Puerto Rico, Ponce
- Inter American University of Puerto Rico, San
- John Jay College of Criminal Justice, City University

- LaGuardia Community College, City University of
- Laredo Community College
- Long Beach City College
- Los Angeles City College
- Luna Vocational Technical Institute, A Community
- Malcolm X College, City Colleges of Chicago
- Merced College
- Miami-Dade Community College, District
- Miami-Dade Community College, Homestead
- Miami-Dade Community College, InterAmerican
- Miami-Dade Community College, Kendall Campus
- Miami-Dade Community College, Medical Center
- Miami-Dade Community College, North Campus
- Miami-Dade Community College, Wolfson Campus
- Modesto Junior College
- Mt. San Antonio College
- New Jersey City University
- New Mexico Highlands University
- New Mexico State University
- New Mexico State University at Carlsbad
- New York City Technical College
- Northern New Mexico Community College
- Our Lady of the Lake University
- Oxnard College
- Palo Alto College
- Passaic County Community College
- Pima Community College
- Pueblo Community College
- Rancho Santiago Community College District
- Reedley College
- Richard J. Daley College City Colleges of Chicago
- Rio Hondo College
- Riverside Community College District
- Robert Morris College
- San Antonio College
- San Bernardino Community College District
- San Bernardino Valley College
- San Diego State University, Imperial Valley Campus
- San Jacinto College, North Campus
- Santa Fe Community College
- Santa Monica College
- South Mountain Community College
- South Texas Community College
- Southwest Texas Junior College
- Southwestern College
- St. Augustine College
- St. Edward's University
- St. Mary's University
- St. Philip's College
- St. Thomas University
- Sul Ross State University
- Texas A&M International University
- Texas A&M University, Corpus Christi
- Texas A&M University, Kingsville
- Texas State Technical College, Harlingen
- The National Hispanic University
- The Technological College of the Municipality of San
- Trinidad State Junior College
- Universidad Metropolitana

- Universidad Politecnica de Puerto Rico
- University of Houston, Downtown
- University of New Mexico
- University of New Mexico, Valencia
- University of Puerto Rico, Cayey University College
- University of Puerto Rico, Central Administration
- University of Puerto Rico, Humacao University
- University of Puerto Rico, Mayaguez Campus
- University of Puerto Rico, Rio Piedras Campus
- University of Southern Colorado
- University of Texas at Brownsville & Texas
- University of Texas at El Paso
- University of Texas at San Antonio
- University of Texas, Pan American
- University of the Incarnate Word
- University of the Sacred Heart
- Valencia Community College, Osceola Campus
- Victoria College
- West Hills Community College
- Western New Mexico University
- Wilbur Wright College City Colleges of Chicago
- Woodbury University

Associate Members

- Aims Community College
- Arizona State University
- Austin Community College
- Bloomfield College
- Brooklyn College
- Broward Community College
- California Polytechnic State University
- California State University, Chico
- California State University, Fullerton
- California State University, Hayward
- California State University, Northridge
- California State University, Sacramento
- California State University, San Marcos
- California State University, System Office
- Charles R. Drew University of Medicine and Science
- College of Biblical Studies, Houston
- College of Lake County
- Colorado State University
- Columbia College
- Community College of Philadelphia
- Crafton Hills College
- Dallas County Community College District
- Eastern New Mexico University
- Grossmont College
- Hillsborough Community College
- Hunter College, City University of New York
- Loyola Marymount University
- Maricopa County Community College District
- Michigan State University
- Milwaukee Area Technical College
- National University
- New Mexico Institute of Mining and Technology

- North Lake College
- Northeastern Illinois University
- Northern Arizona University
- Northern Essex Community College
- Pace University
- Palomar College
- Purdue University Calumet
- Queens College, City University of New York
- Queensborough Community College, City University
- Quinsigamond Community College
- Richland College
- San Diego State University
- San Francisco State University
- San Jose State University
- South Suburban College of Cook County
- Southwest Texas State University
- St. John's University
- State University of New York at Stony Brook
- Tarrant County Junior College District
- Texas A&M University
- Texas Lutheran University
- Texas Tech University
- The Metropolitan State College of Denver
- The Pennsylvania State University
- Trinity University
- University of Arizona
- University of California, Berkeley
- University of California, Los Angeles
- University of California, San Diego
- University of California, Santa Barbara
- University of California, Santa Cruz
- University of Central Florida
- University of Florida
- University of Houston
- University of Houston, Victoria
- University of Illinois at Chicago
- University of LaVerne
- University of Michigan
- University of North Texas
- University of San Diego
- University of South Florida
- University of St. Thomas
- University of Texas at Arlington
- University of Texas at Austin
- University of Texas at Dallas
- University of Texas Health Science Center at San
- University of Texas of the Permian Basin
- Valencia Community College District

Appendix E Statistical Data

E.1. All CCD/ILI Awards

Figure E.1
Target Audience Distribution of CCD and ILI Awards 1992-1997

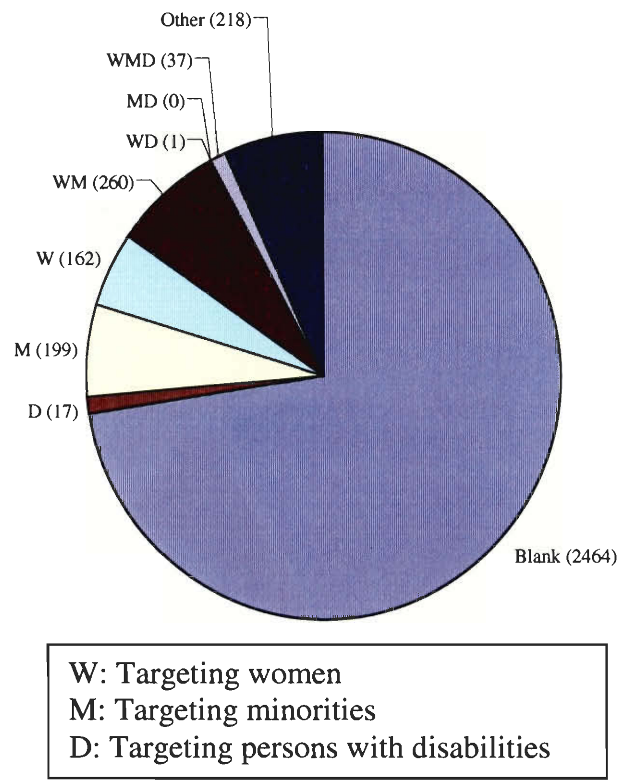
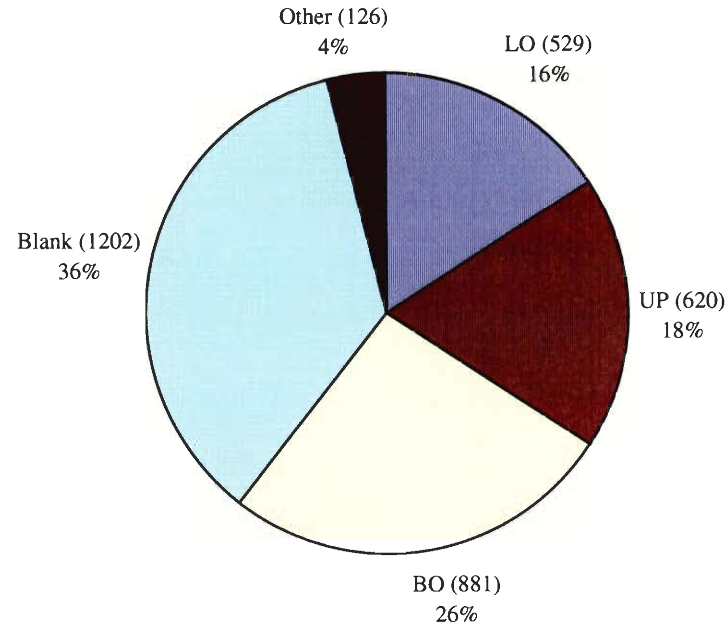
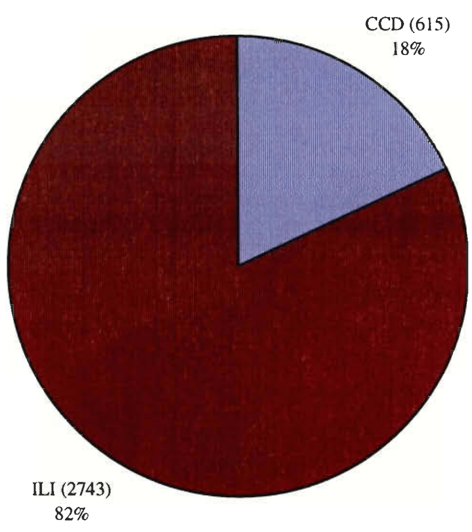


Figure E.2
Focus Level Distribution of CCD and ILI Awards 1992-1997



LO : Lower division undergraduate courses
UP : Upper division undergraduate courses
BO : Both divisions of undergraduate courses

Figure E.3
CCD and ILI Award Distribution 1992-1997



E.2. 677 Awards Specifying Target Audience

Figure E.4
Distribution of 677 CCD and ILI DUE Awards
1992-1997

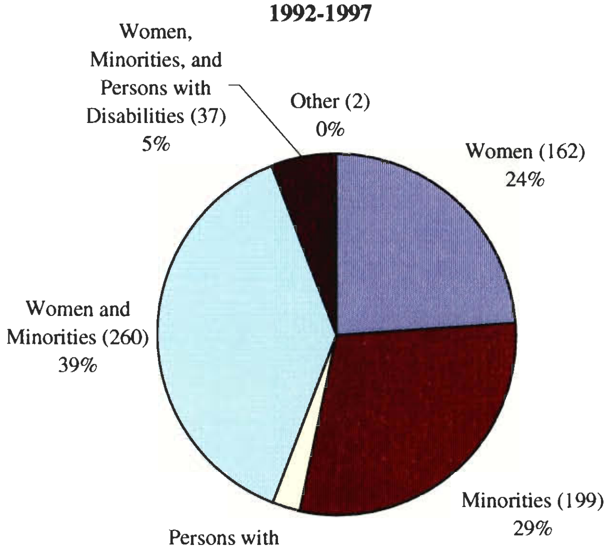


Figure E.5
Distribution of 536 ILI Awards
1992-1997

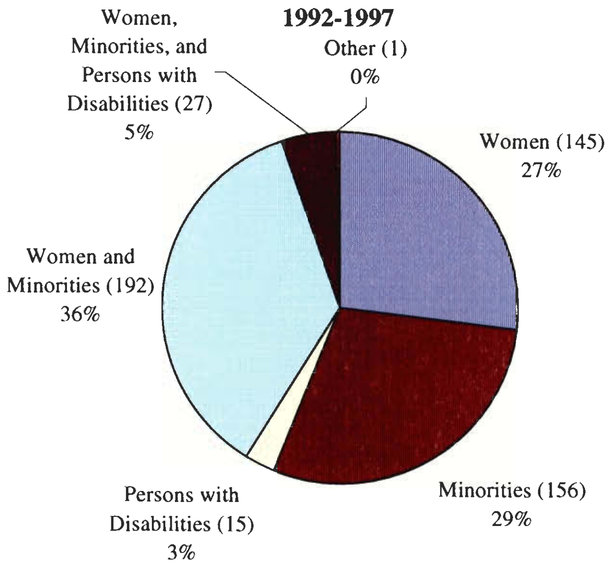


Figure E.6
Distribution of 141 CCD Awards
1992-1997

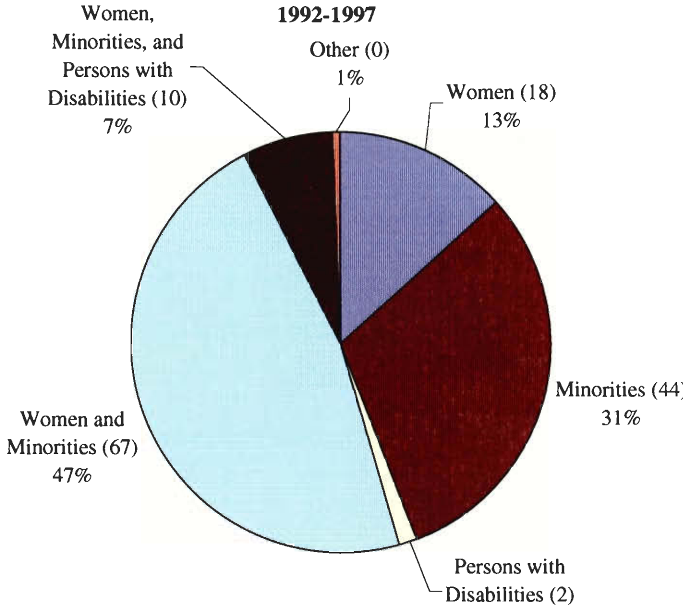


Figure E.7
Distribution of 144 Lower Level
1992-1997, CCD and ILI

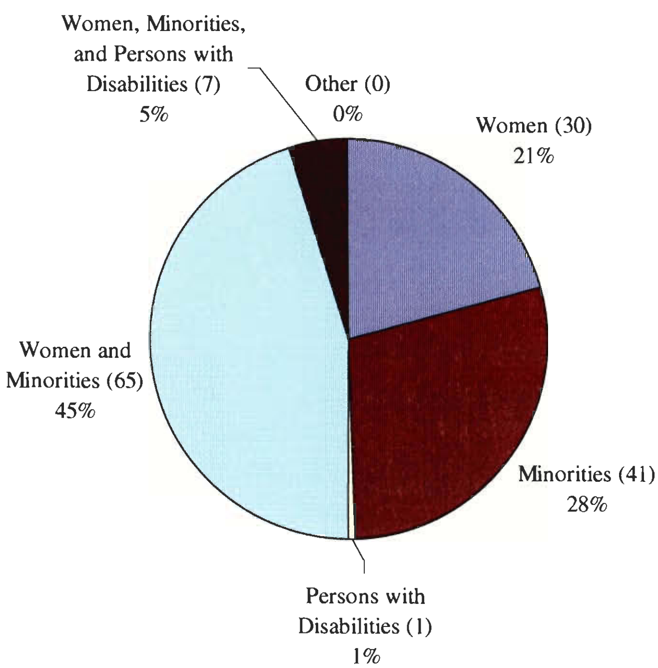


Figure E.8
Distribution of 105 Upper Level
1992-1997, CCD and ILI

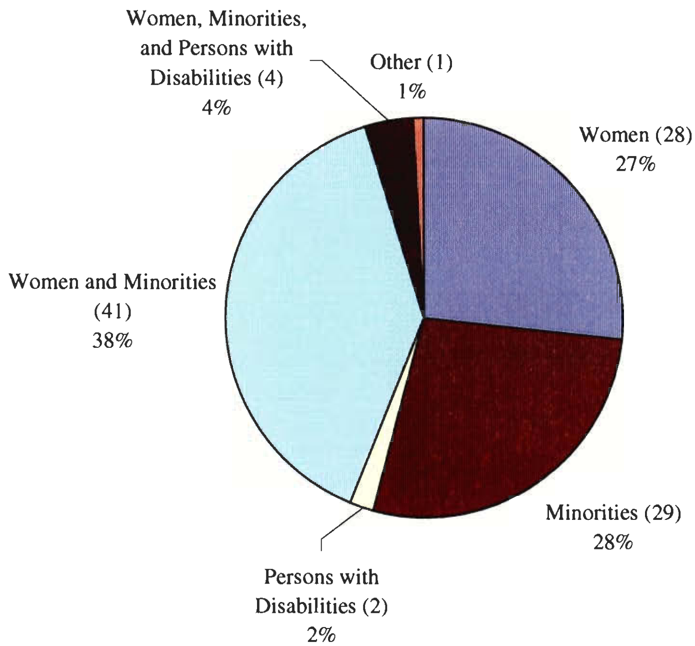


Figure E.9
Distribution of 195 Both Levels
1992-1997, CCD and ILI

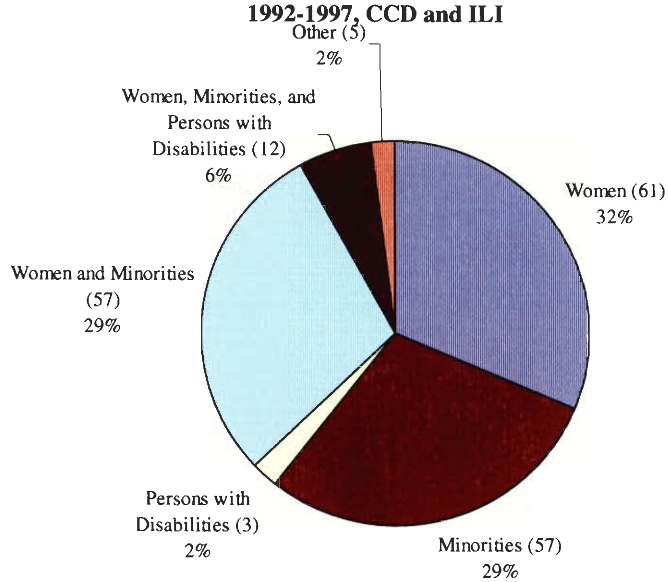


Figure E.10
Total Monetary Distribution of 677 ILI and CCD Awards
1992-1997

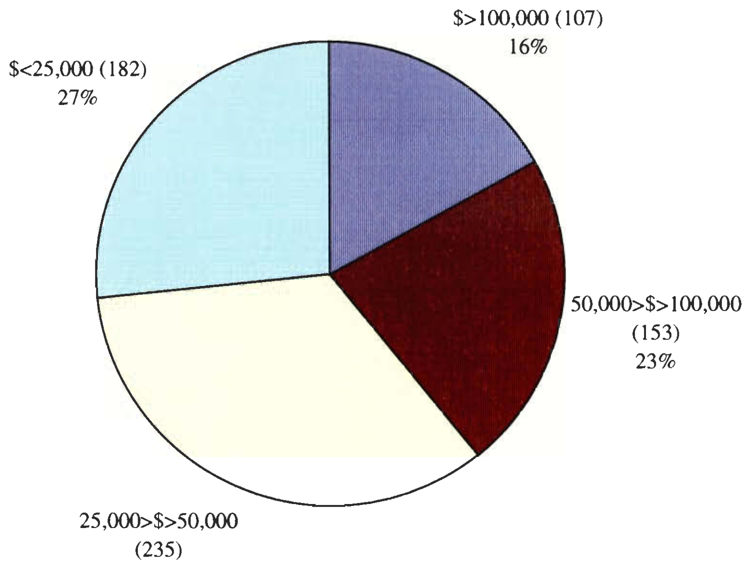


Figure E.11
Monetary Distribution of 536 ILI Awards
1992-1997

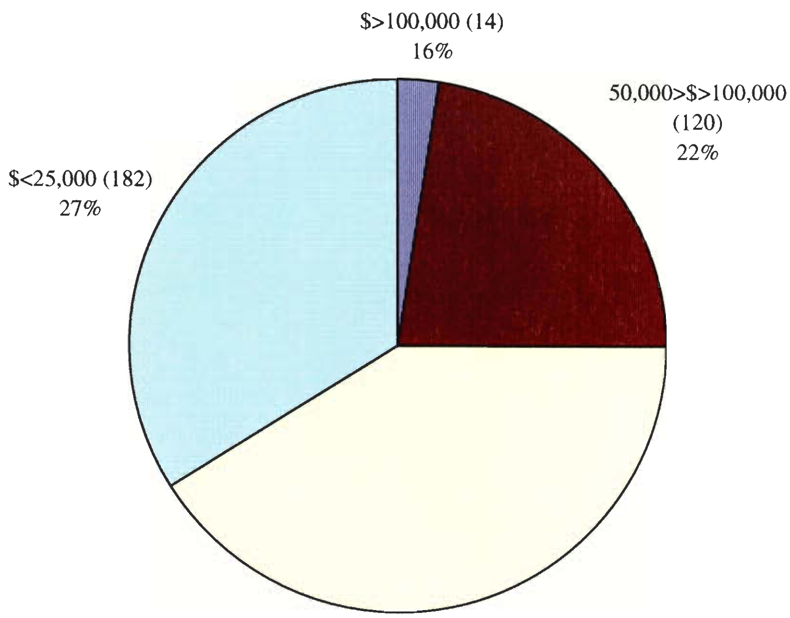


Figure E.12
Monetary Distribution of 141 CCD Awards
1992-1997

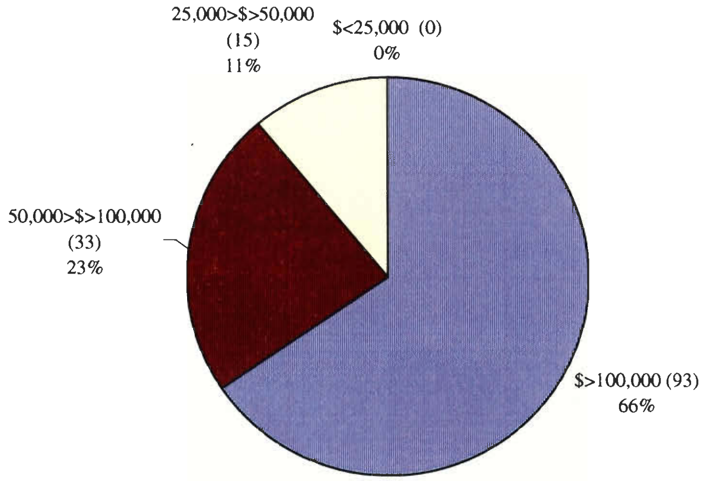


Figure E.13
Monetary Distribution of 144 Lower Level Awards
1992-1997, CCD and ILI

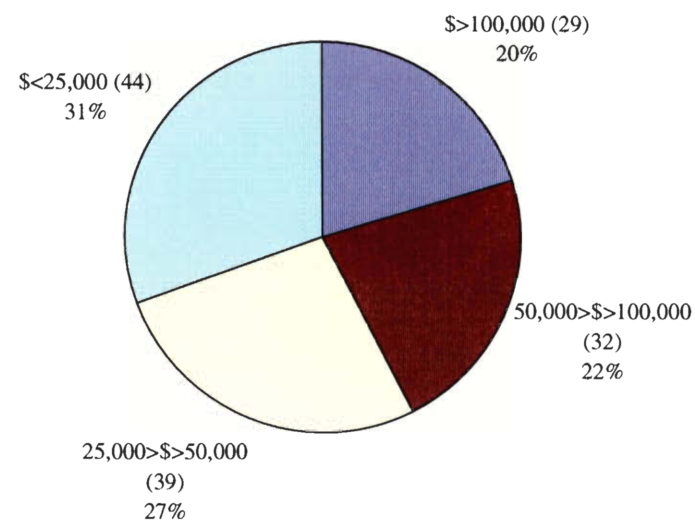


Figure E.14
Monetary Distribution of 105 Upper Level Awards
1992-1997, CCD and ILI

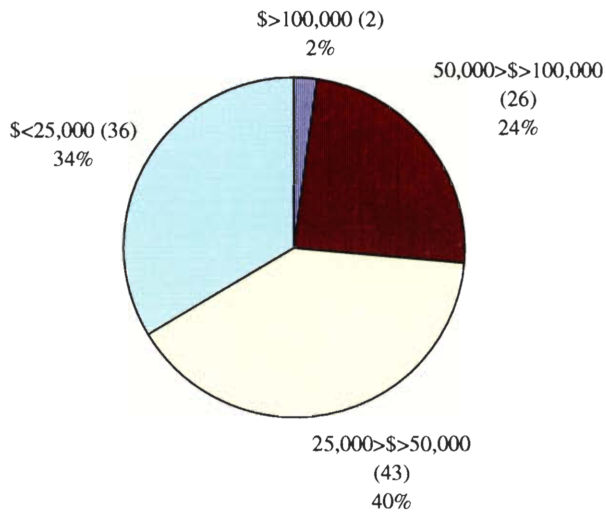


Figure E.15
Monetary Distribution of 195 Both Levels Awards
1992-1997, CCD and ILI

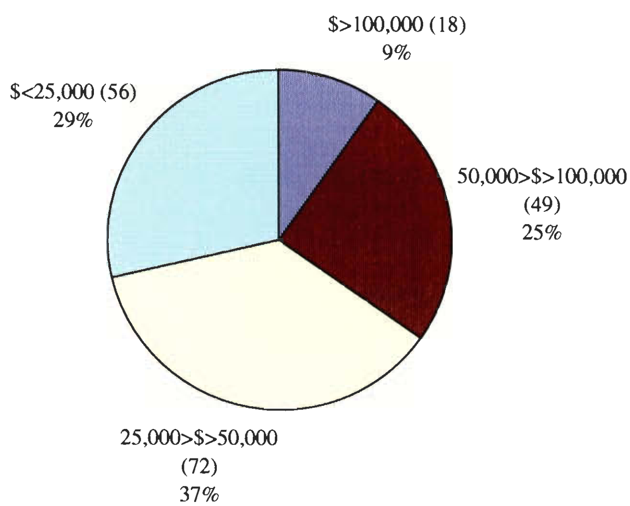
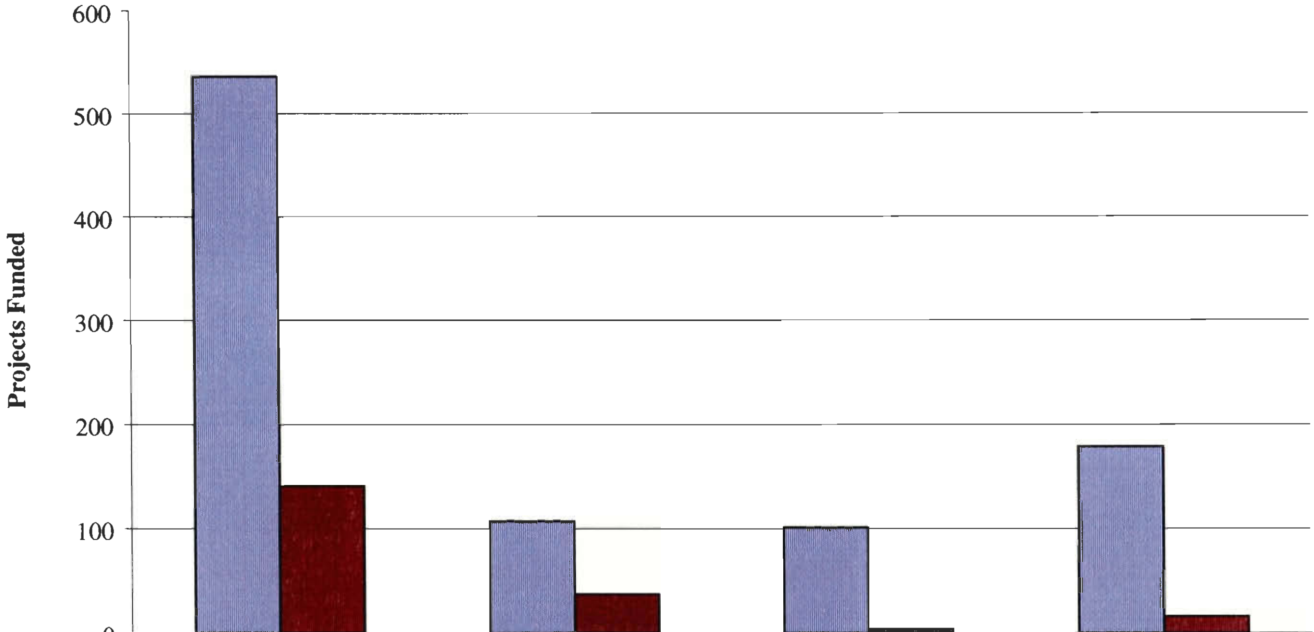


Figure E.16
ILI and CCD Focus Level Distribution
1992-1997

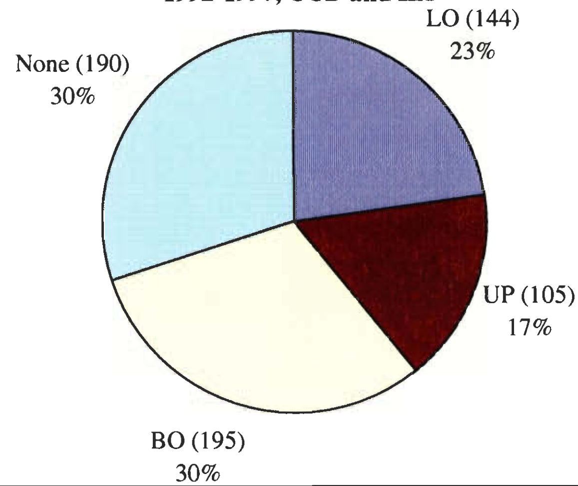


	All	LO	UP	BO
ILI	536	107	101	179
CCD	141	37	4	16

Focus Level

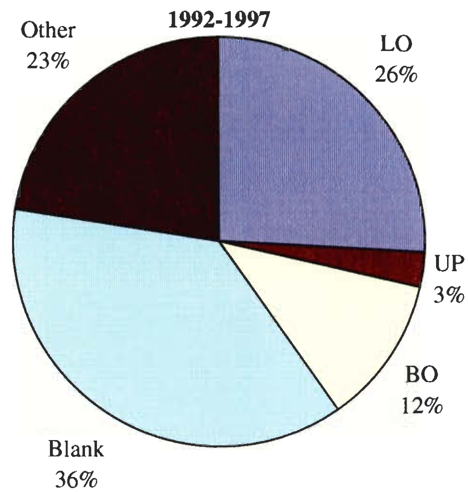
LO : Lower division undergraduate courses
UP : Upper division undergraduate courses
BO : Both divisions of undergraduate courses

Figure E.17
Focus Level Distribution of 677 Awards
1992-1997, CCD and ILI



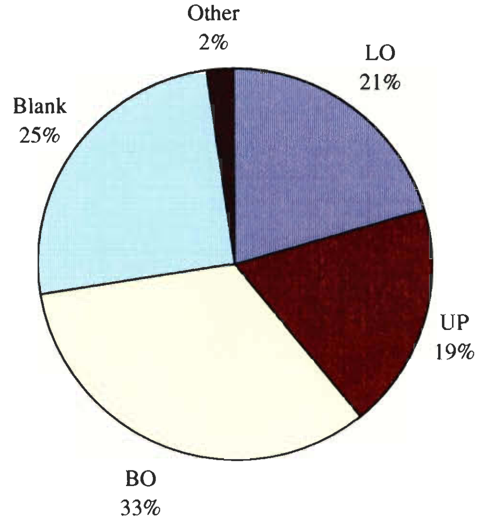
LO : Lower division undergraduate courses
UP : Upper division undergraduate courses
BO : Both divisions of undergraduate courses

Figure E.18
Focus Level Distribution of 141 CCD Awards
1992-1997



LO : Lower division undergraduate courses
UP : Upper division undergraduate courses
BO : Both divisions of undergraduate courses

Figure E.19
Focus Level Distribution of 536 ILI Awards
1992-1997



LO : Lower division undergraduate courses UP : Upper division undergraduate courses BO : Both divisions of undergraduate courses

E.3. 51 Awards

Figure E.20
Target Audience Distribution of 51 ILI and CCD Awards

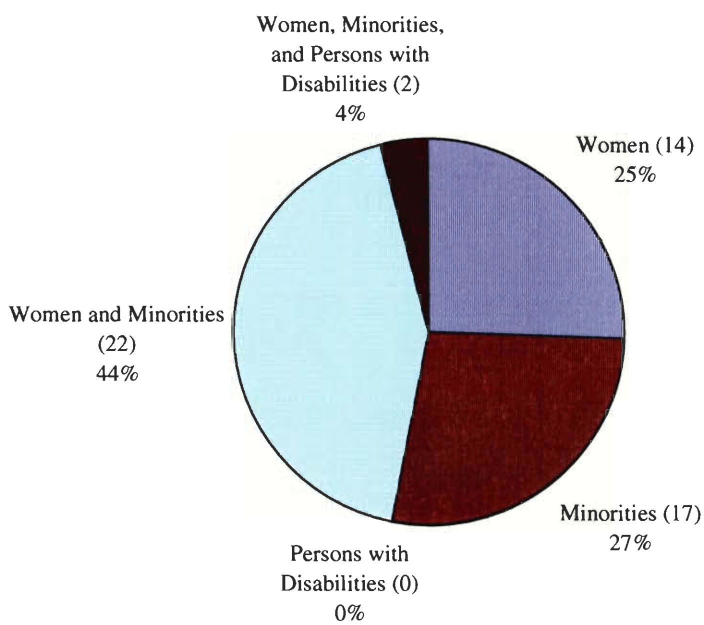


Figure E.21
Target Audience Distribution of 25 ILI Awards

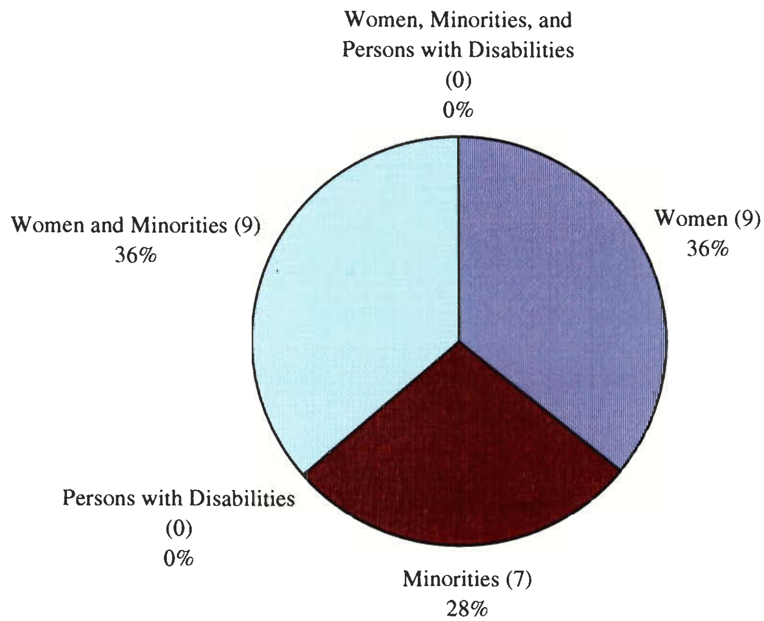


Figure E.22
Target Audience Distribution of 26 CCD Awards

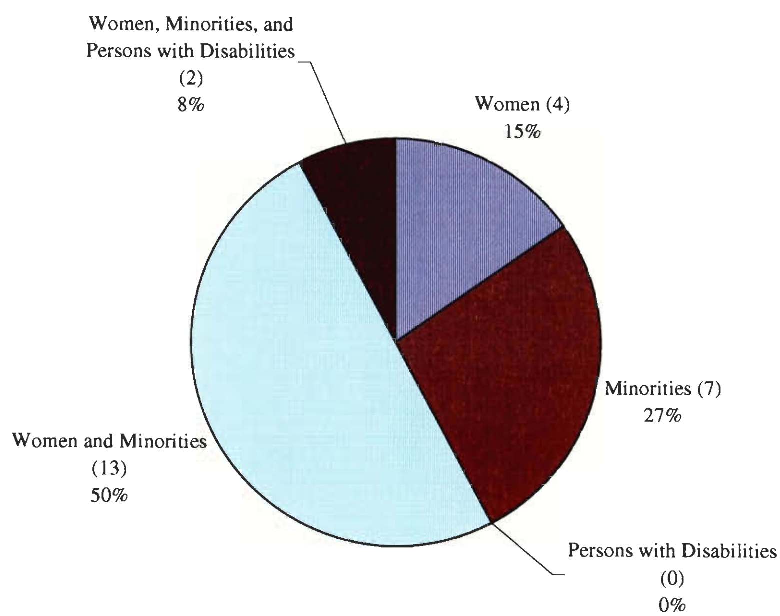


Figure 5.23
CCD and ILI Distribution of the 51 Awards

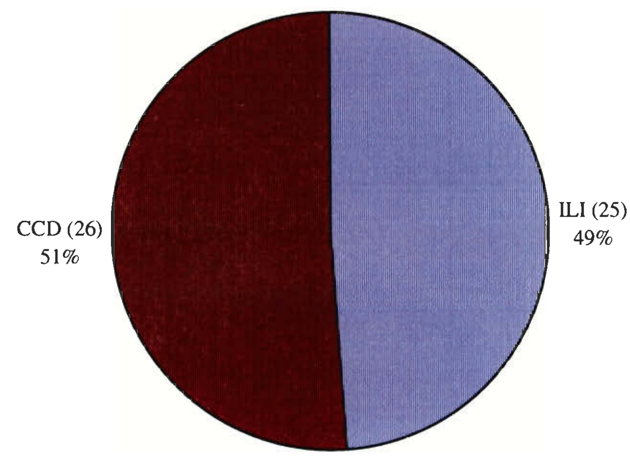
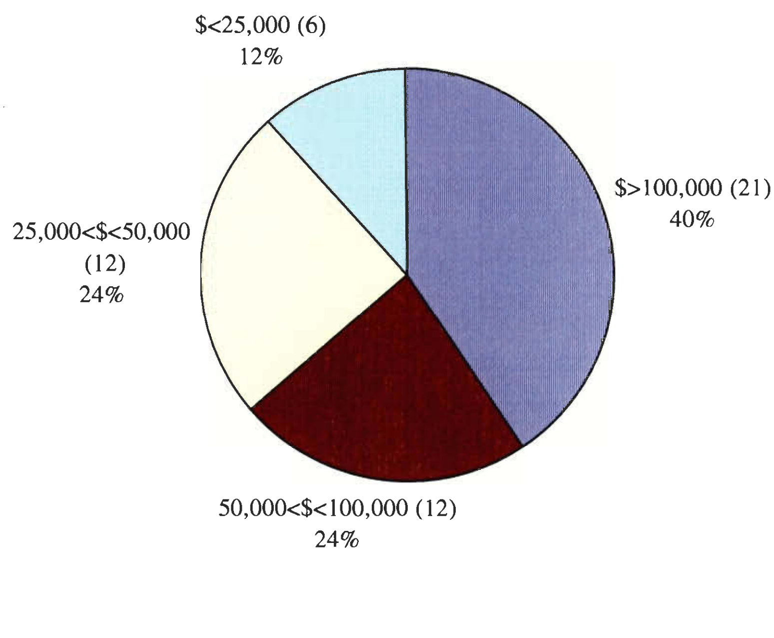


Figure 5.24
Monetary Distribution of 51 Awards



E.4. Abstract's Analysis

Table E.1 Abstract Distribution

Total Abstracts	51
Target Audience Stated	22
Persons with Disabilities Stated	1
Evaluation Method Given	6
Retention Mentioned	8
Laboratory and Hands-on	37
Group work-Collaborative Learning	22
Visual Aids and Development of Materials	20
Tutors, Mentors, or Role Models	10

Appendix F Acronyms

ATE	Advanced Technological Education
CCD	Course and Curriculum Development
D	Persons with Disabilities
DUE	Division of Undergraduate Education
DGE	Division of Graduate Education
EHR	Directorate of Education and Human Resources
EPSCoR	Experimental Program to Stimulate Competitive Research
ESIE	Division of Elementary, Secondary, and Informal Education
ESR	Division of Educational System Reform
HACU	Hispanic Alliance of Colleges and Universities
HBCU	Historically Black Colleges and Universities
HRD	Division of Human Resource Development
ILI	Instrumentation and Laboratory Improvement
M	Minorities
NSF	National Science Foundation
REC	Research, Evaluation, and Communication
PwD	Persons with Disabilities
SMET	Science, Mathematics, Engineering, and Technology
UFE	Undergraduate Faculty Enhancement
W	Women