



Montana State University's pursuit of prestige: research activity and its effects on graduate education
by Christopher John Junghans

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education
in Education

Montana State University

© Copyright by Christopher John Junghans (2002)

Abstract:

This study was initiated and supported by the Dean of the College of Graduate Studies at Montana State University just before the Carnegie Foundation for the Advancement of Teaching published its revised, interim standards for its classification system of higher education institutions in October 1999. The dean was concerned that Montana State University may have been pursuing Grant and Contract Activity at the expense of the institution's teaching mission, which turned out to be one of the concerns at the Carnegie Foundation that led to its classification system's revisions. Literature reviewed for the study addressed questions of how university teaching and research missions can be treated in a way that strengthens both. There appeared to be anecdotal evidence and lore at Montana State University to suggest that the two missions are incompatible at some basic level. If that were true, the researcher would have expected to encounter a "please don't bother me about teaching, I'm a researcher" attitude from the Montana State University prominent researchers interviewed. In the qualitative component of this study, at least, quite the opposite view was found. This study found strong evidence to support the claim that prominent research faculty at Montana State University place a high priority on the institution's educational mission. The quantitative component of the study described a number of institutional trends, including flat doctoral production during a period (1989-1999) of booming Grant and Contract Activity. These results suggest that policy changes may be considered at Montana State University to better allow research activity to benefit graduate instruction and doctoral production, a goal that the Carnegie Foundation for the Advancement of Teaching appeared to consider relevant in revising its classification system of higher education institutions.

MONTANA STATE UNIVERSITY'S PURSUIT OF PRESTIGE:

RESEARCH ACTIVITY AND ITS EFFECTS

ON GRADUATE EDUCATION

by

Christopher John Junghans

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

Doctor of Education

in

Education

MONTANA STATE UNIVERSITY

Bozeman, Montana

April 2002

© COPYRIGHT

By

Christopher John Junghans

2002

All Rights Reserved

D378
J956

APPROVAL

Of a dissertation submitted by

Christopher John Junghans

This dissertation has been read by each member of the dissertation committee and has been found to be satisfactory regarding content, English Usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

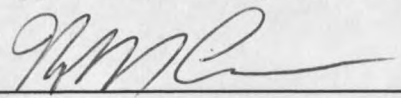
Robert N. Carson


(Signature)

4-22-02
Date

Approved for the Department of Education

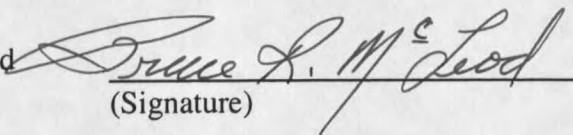
Robert N. Carson


(Signature)

4-22-02
Date

Approved for the College of Graduate Studies

Bruce McLeod


(Signature)

4-22-02
Date

STATEMENT OF PERMISSION TO USE

In presenting this dissertation in partial fulfillment of the requirements for a doctoral degree at Montana State University, I agree that the Library shall make it available to borrowers under rules of the library. I further agree that copying of this dissertation is allowable only for scholarly purposes, consistent with "fair use" as prescribed in the U.S. Copyright Law. Requests for extensive copying or reproduction of this dissertation should be referred to Bell & Howard Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106, to whom I have granted "the exclusive right to reproduce and distribute my dissertation in and from microform along with the non-exclusive right to reproduce and distribute my abstract in any format in whole or in part.

Signature



Date

4/19/02

For My Boys
Tony, Luca, and Erich

TABLE OF CONTENTS

1. INTRODUCTION TO STUDY	1
CHAPTER INTRODUCTION.....	1
PROBLEM.....	1
PURPOSE.....	3
THEORETICAL BASIS.....	4
QUESTION	6
IMPORTANCE OF STUDY	6
OPERATIONAL DEFINITIONS	8
ASSUMPTIONS AND LIMITATIONS	9
ORGANIZATION OF THE STUDY.....	10
2. LITERATURE REVIEW	12
CHAPTER INTRODUCTION.....	12
CRITERIA FOR SELECTING THE LITERATURE.....	12
MONTANA STATE UNIVERSITY AND THE LAND GRANT MISSION.....	15
CURRENT UNDERSTANDING OF THE PROBLEM	17
PREVIOUS RESEARCH OF THE PROBLEM.....	21
PREVIOUS METHODOLOGIES USED FOR PROBLEM	27
RELATED PROBLEMS	37
CONCLUDING ASSESSMENT OF THE LITERATURE OF THE PROBLEM	45
STRENGTHS IN THE LITERATURE OF THE PROBLEM.....	51
WEAKNESSES IN THE LITERATURE OF THE PROBLEM	56
AREAS FOR FURTHER INQUIRY	59
3. METHODOLOGY	65
POPULATION	65
QUALITATIVE COMPONENT.....	66
Selection of Subjects	66
Materials	67
Instrument	68
Data Analysis Strategy	69
Validity and Reliability.....	71

QUANTITATIVE COMPONENT.....	73
Rationale for Quantitative Component.....	73
Invalidity and Minimization	74
Procedure	75
Analysis Strategy.....	75
ASSUMPTIONS AND LIMITATIONS	77
TIMEFRAME	79
CHAPTER SUMMARY.....	79
 4. RESULTS	 80
CHAPTER INTRODUCTION.....	80
GENERAL RESULTS OF THE QUALITATIVE DATA ANALYSIS	81
RESEARCH AND TEACHING AS UNIFIED ACTIVITIES.....	82
POSTDOCTORAL, DOCTORAL AND OTHER STUDENTS IN RESEARCH.....	89
Montana State's Assessment of Faculty Teaching and Research.....	96
STATE SUPPORT FOR RESEARCH AT MSU	105
RESULTS OF THE QUANTITATIVE DATA ANALYSIS	112
Discussion of Unified Teaching and Research Theme.....	113
COLLEGE OF AGRICULTURE	122
COLLEGE OF EDUCATION, HEALTH AND HUMAN DEVELOPMENT	125
COLLEGE OF ENGINEERING	127
COLLEGE OF LETTERS AND SCIENCE.....	130
SUMMARY OF UNIFIED RESEARCH AND TEACHING THEME	133
DISCUSSION OF POSTDOCTORAL RESEARCHERS AND STUDENTS THEME.....	134
DISCUSSION OF MONTANA STATE'S ASSESSMENT OF FACULTY TEACHING AND RESEARCH THEME.....	135
DISCUSSION OF STATE SUPPORT FOR RESEARCH THEME.....	136
CHAPTER SUMMARY.....	136
 5. CONCLUSIONS.....	 138
CHAPTER INTRODUCTION.....	138
Summary of Problem, Methodology and Results	138
Interpretation of Results	140
Corresponding Conclusions Drawn from Interpreted Results	146
DISCUSSION OF BROADER IMPLICATIONS OF THE FINDINGS.....	148

Corresponding Conclusions Drawn from Interpreted Results	146
DISCUSSION OF BROADER IMPLICATIONS OF THE FINDINGS.....	148
Theoretical Implications	148
Practical Implications	150
Limitations of the study	153
SUMMARY OF CONCLUSIONS.....	153
Answer to Question	153
Implementation of Findings	154
REFERENCES CITED	155
REFERENCES	156
APPENDICES	164
APPENDIX A: Qualitative component Questions.....	165
APPENDIX B: Figures	171

LIST OF TABLES

Table	Page
1. Grants and Contracts at Montana State University	113
2. Montana State University Doctor's Degrees Awarded with and without College of Education, Health, and Human Development	115
3. Montana State University Grants and Contracts with and without College of Education, Health and Human Development	116
4. Montana State University Doctoral Candidates with and without College of Education, Health, and Human Development Candidates	118
5. Graduate Research and Teaching Assistants, and Postdoctoral Researchers at Montana State University	119
6. Cumulative Grade Point Average of Montana State University Doctoral Candidates	120
7. Montana State University Full-time Equivalent of Tenurable and Nontenurable Faculty	121
8. Montana State University Grants and Contracts and Indirect Cost Distribution in College of Agriculture	122
9. Montana State University Graduate Degree Production and Grants and Contracts in College of Agriculture	124
10. Montana State University Grants and Contracts and Indirect Cost Distribution in College of Education, Health, and Human Development	125
11. Montana State University Graduate Degree Production and Grants and Contracts in College of Education, Health, and Human Development...	126
12. Montana State University Grants and Contracts and Indirect Cost Distribution in the College of Engineering	128

13. Montana State University Graduate Degree Production and Grants and Contracts Activity in the College of Engineering.....	129
14. Montana State University Grants and Contracts and Indirect Cost Distribution in the College of Letters and Science.....	131
15. Montana State University Graduate Degree Production and Grants and Contracts in the College of Letters and Science	132

LIST OF FIGURES

Figure	Page
1. Grants and Contracts at Montana State University.....	172
2. Montana State University Doctor's Degrees Awarded with and without College of Education, Health, and Human Development	173
3. Montana State University Grants and Contracts with and without College of Education, Health, and Human Development	174
4. Montana State University Doctoral Candidates with and without College of Education, Health, and Human Development candidates	175
5. Montana State University Graduate Teaching Assistants	176
6. Montana State University Graduate Research Assistants	177
7. Montana State University Postdoctoral Researchers	178
8. Annual Cumulative Grade Point Average of Montana State University Doctoral Candidates	179
9. Montana State University Full Time Equivalent of Tenurable and Nontenurable Faculty	180
10. Montana State University Grants and Contracts in the College of Agriculture	181
11. Montana State University Doctoral Candidates at College of Agriculture .	182
12. Montana State University Grants and Contracts Per Doctor's Degree Awarded in College of Agriculture.....	183
13. Montana State University Grants and Contracts in College of Education, Health, and Human Development.....	184
14. Montana State University Doctoral Candidates in College of Education, Health, and Human Development.....	185

15. Montana State University Grants and Contracts Per Doctorate in College of Education, Health, and Human Development	186
16. Montana State University Grants and Contracts in College of Engineering	187
17. Montana State University Doctoral Candidates in College of Engineering	188
18. Montana State University Grants and Contracts Per Doctorate Awarded in College of Engineering	189
19. Montana State University Grants and Contracts in Letters & Science College	190
20. Montana State University Doctoral Candidates in College of Letters and Science	191
21. Montana State University Grants and Contracts Per Doctorate in College of Letters and Science	192
22. Montana State University Grants and Contracts Per Doctorate (Without College of Education, Health, and Human Development)	193
23. Montana State University Grants and Contracts Per Doctorate (With College of Education, Health, and Human Development)	194

Abstract

This study was initiated and supported by the Dean of the College of Graduate Studies at Montana State University just before the Carnegie Foundation for the Advancement of Teaching published its revised, interim standards for its classification system of higher education institutions in October 1999. The dean was concerned that Montana State University may have been pursuing Grant and Contract Activity at the expense of the institution's teaching mission, which turned out to be one of the concerns at the Carnegie Foundation that led to its classification system's revisions. Literature reviewed for the study addressed questions of how university teaching and research missions can be treated in a way that strengthens both. There appeared to be anecdotal evidence and lore at Montana State University to suggest that the two missions are incompatible at some basic level. If that were true, the researcher would have expected to encounter a "please don't bother me about teaching, I'm a researcher" attitude from the Montana State University prominent researchers interviewed. In the qualitative component of this study, at least, quite the opposite view was found. This study found strong evidence to support the claim that prominent research faculty at Montana State University place a high priority on the institution's educational mission. The quantitative component of the study described a number of institutional trends, including flat doctoral production during a period (1989-1999) of booming Grant and Contract Activity. These results suggest that policy changes may be considered at Montana State University to better allow research activity to benefit graduate instruction and doctoral production, a goal that the Carnegie Foundation for the Advancement of Teaching appeared to consider relevant in revising its classification system of higher education institutions.

CHAPTER 1

INTRODUCTION TO STUDY

Chapter Introduction

The problem, purpose and question of the study are presented in this chapter. The chapter addresses the theoretical basis for a case study of graduate instruction at Montana State University. The qualitative and quantitative components of the study are described. The characteristics of the study are introduced. These include a rationale for the importance of the study, operational definitions of the study, assumptions and limitations, and the organization of the study.

Problem

The number of doctoral degrees awarded at Montana State University from 1989 to 1999 remained relatively constant during a dramatic increase in grant and contract activity at the University, from \$15 million in 1989 to \$50 million in 1999. The apparent disconnect between booming funded research activity (i.e., grants and contracts) and flat production of doctoral degrees concerned the dean of the College of Graduate Studies at Montana State University. His original hypothesis was that the university might have

shifted its emphasis from teaching to research. In his view, one possible result of that shift may have been Montana State's recruitment and deference to high profile researchers, who then generally avoided doctoral students in favor of less demanding, more able postdoctoral researchers. The dean supported this study in order to gather data and analysis for possible future policy decisions. This study described how funded research activity affected the instructional mission of Montana State University at the doctoral level between 1989 and 1999.

While it may be evident to some on many campuses that an emphasis on research deprives the teaching mission of both resources and faculty devotion, it has not been shown that teaching and research at Montana State University are incompatible. One of the successes of American research universities in the 20th Century has been shown to be their respective abilities to deliver quality research according to marketplace demands (Graham & Diamond, 1997). By more than tripling its funded research activity between 1989 and 1999, Montana State University appeared to be capitalizing on federal and commercial demands for its research capacity. The negative institutional effects on universities competing for research funding, however, has led the Carnegie Foundation for the Advancement of Teaching to undertake substantial revisions of its widely recognized classification system of higher education institutions (McCormick, 1999). "The drive to 'move up' in the classification system can affect resource allocation and

hiring, possibly at the expense of other components of institutional mission that are less finely measured or absent from the classification's definitions," (McCormick, 1999). The problem this study addressed is whether Montana State has compromised its graduate instructional mission during a period of dramatic increase in its research activity.

Purpose

There were steady increases between 1989 and 1999 in the numbers of postdoctoral researchers and non-tenurable faculty at Montana State. Over the same period of time, doctoral degree production remained flat. These two trends suggested to the Dean of Montana State University's College of Graduate Studies that doctoral candidates might not have benefited from the increased research activity at the University. While faculty and administrators at Montana State might reasonably assume that the benefits of increased research activity at the University naturally trickle down to graduate students in the form of stipends and (dissertation) research topics, this assumption may or may not be the case. It was the purpose of this study to examine the available evidence for the assumption. The results of this study were intended to inform Montana State University administrators—in particular, the Dean of the College of Graduate Studies—regarding the effects of University policies on doctoral production and grant and contract activity. An analysis of those results in chapter 5 of this study was

intended to provide some additional basis for an evaluation of Montana State University policies governing grant and contract activity and doctoral production.

This study described how funded research activity affected the instructional mission of Montana State University at the doctoral level between 1989 and 1999. This study contains a qualitative component in which prominent faculty researchers at Montana State discuss the meaning of their work. This study contains a descriptive, quantitative component in which pertinent data from Montana State's institutional records are presented. Both components address the research question of this study. The purpose of an analysis and discussion of these components in chapters 4 and 5 of this study was intended to inform policy makers at Montana State University regarding effects its rising research activities are having on graduate education. The study was intended to provide information and analysis helpful to the development of successful policies governing Montana State University's teaching and research missions.

Theoretical Basis

The mission statement of Montana State University's College of Graduate Studies points out the fundamental importance of research in benefiting graduate instruction. The

availability of Montana State faculty and facilities “allows graduate students the opportunity to conduct high level, in-depth investigation of their subject of interest,” (Montana State University, 2000). Montana State University’s College of Graduate Studies mission statement reflects the historical influence on American higher education by the German model of a productive relationship between research-centered faculty and students (Veysey, 1965). The statement also reflects the research role assigned to Montana State University’s original predecessor, the Agricultural College of the State of Montana, established in 1893 as a land-grant institution under the Morrill Act (Rydell, Safford & Mullen, 1992).

American higher education beginning in the late 19th Century was modeled after the German research institutions in which graduate study was largely research and laboratory based (Veysey, 1965). At these institutions, learning was as much a matter of professional apprenticeship as it was a matter of studying textbooks and listening to lectures. Having adopted this model for over a century, American universities have become the most productive in the world, both in terms of the recognized quality of education and the quality and quantity of scientific research (Graham & Diamond, 1997). Historically, it seems odd to argue that research and teaching are somehow incompatible, except to the extent that institutional policies set up conflicts over resources, or create a reward structure that fails to encourage the integration of both sets of duties. This case

study of Montana State University attempts to determine whether institutional policies may have created such a conflict between the University's fundamental missions of graduate instruction and research.

Question

If research activity at Montana State is meant to benefit doctoral students, why did the number of doctoral degrees awarded by Montana State University remain flat during a ten-year period in which research activity increased from \$15 million in 1989 to \$50 million in 1999?

Importance of Study

This study described a ten-year relationship (1989-1999) between research activity and graduate instruction at Montana State University. These data and their analysis may provide a basis for evaluating University policy governing graduate programs and grant and contract activity at Montana State University. This study was limited to Montana State University's Graduate College, and its results have direct applicability to Montana State only. However, as a case study of a land-grant institution with rising research activity and flat doctoral degree production, it may serve a cautious

reader some illumination for respective policy considerations at other institutions of higher education with similarly apparent trends.

Whatever the results, the policy considerations of this study to Montana State administrators and faculty should be significant. If prominent Montana State faculty researchers appear to successfully integrate their respective research and teaching duties (in the qualitative component of the study), how well is this integration at Montana State demonstrable by institutional data (in the quantitative component of the study)?

Depending upon these results, policies and processes at Montana State might be altered to allow the research and the teaching duties of Montana State faculty to better support and strengthen one another. For example, how can policies for promotion and tenure, institutional support and resource allocation best support MSU's faculty's integration of teaching and research duties?

The Carnegie Foundation for the Advancement of Teaching revised in 2000 its classification criteria for higher education institutions. The revision reduced the significance of funded research and increased the significance of the breadth and rate of doctoral production (McCormick, 1999). "Although the Carnegie Classification is not intended to confer status or influence institutions' access to resources, we recognize that it has both effects, and that they are most evident among doctorate-granting universities," (McCormick, 1999, p.1). This study provided data and analysis regarding the relationship

between Montana State's research and teaching missions between 1989 and 1999. If Montana State administrators and faculty are to ensure that neither of these historical missions is pursued at the expense of the other, then the results of this study should prove useful to them.

Operational Definitions

Montana State as an institution is defined as a Doctoral/Research-Intensive University. The Carnegie Foundation for the Advancement of Teaching's latest classification edition defines a Doctoral/Research-Intensive university as offering a wide range of baccalaureate programs. Such a university is "committed to graduate education through the doctorate," with at least 10 doctoral degrees awarded per year across three or more disciplines, or at least 20 doctoral degrees per year overall (Carnegie, 2000). The Carnegie Foundation defines a Doctoral/Research-Extensive University as producing at least 50 doctorates across at least 15 disciplines (Carnegie, 2000). Montana State's mission as a public, Land Grant University also defines the institution.

Research activity is defined as the amount of grants and contracts awarded to Montana State University researchers by external funding sources. These data were collected from Montana State University's Office of Grants and Contracts. Faculty at Montana State University are defined as either tenurable (i.e., tenured or on a tenure-

track) or non-tenurable (i.e., not on tenure track). These data were collected from Montana State University's Institutional Research Office. Graduate Teaching Assistants are graduate students with teaching assignments. Graduate Research Assistants are graduate students with research assignments. Data on these students were collected from the Office of the College of Graduate Studies at Montana State University. Postdoctoral researchers are defined as non-student researchers hired by Montana State University. Data on these researchers were collected from the Office of Institutional Research at Montana State University. The number of doctoral degrees awarded by Montana State University defines graduate instructional activity. These data were collected from the Office of Institutional Research at the University.

Assumptions and Limitations

This study was limited to describing the changing conditions of research activity at Montana State University and the possible effects those conditions have had on graduate instructional quality and doctoral degrees awarded from 1989-1999. The case study method allowed the researcher to closely examine local conditions and the quantifiable and qualitative results of those conditions. A multi-site study necessarily

broadens such an examination, but may be less helpful to consumers of the study who are primarily interested in the conditions and results at a single institution. The detailed knowledge created by the study of a particular case may lead to theoretical insights that are useful as a basis for generalization beyond the original case study (Merriam, 1998; Yin, 1994).

This study used quantitative, institutional data to define instructional quality: doctoral degree production. The researcher recognized that this operational definition of instructional quality reduces its richer, scholarly meaning. Boyer argued for an expansion of the notion of scholarship to include teaching (1990). He divided the concept of scholarship into four kinds: (1) the scholarship of discovery (basic research); (2) the scholarship of integration (literature reviews and other synthetic tasks); (3) the scholarship of application (professional service or outreach); and (4) the scholarship of teaching. While reducing an analysis of instruction at the graduate level to an examination of doctoral degree production, this study relied on Boyer's multifaceted concept of scholarship in its analysis of the qualitative and quantitative data collected (chapters 4 and 5).

Organization of the Study

The approach of this study in examining graduate education in relation to funded research activity drew broadly on the approach taken by the Carnegie Foundation for the Advancement of Teaching in its classification of institutions of higher education (Carnegie, 2000). The Foundation is developing more subtle ways of classifying higher education institutions, scheduled for release in 2005. The Foundation shifted its classification criteria in 2000 from amounts of funded research to the number and kind of doctoral degrees awarded (McCormick, 1999). McCormick indicated that The Carnegie Foundation's 2005 Classification will shift further in that direction by taking into account particular institutional missions for its classification purposes (1999).

As a case study of Montana State University, this study examined data collected in the light of the institution's historical and current mission—in particular its graduate education mission. After a review of the literature in chapter 2, and a description of the qualitative and quantitative methods used in the collection of data in chapter 3, the results of the qualitative and then quantitative data are presented and interpreted in chapter 4. Chapter 5 draws broader, theoretical conclusions regarding the results of the study, and addresses possible policy questions for Montana State University's College of Graduate Studies regarding doctoral production and grant and contract activity.

CHAPTER 2

LITERATURE REVIEW

Chapter Introduction

This chapter reviews the literature of the problem. The criteria for the selection of the literature are presented. Themes in the literature describe the current understanding of the problem, previous research of the problem and methodologies used to research the problem. Two problems related to the study, faculty workload and faculty unionization, are addressed. A concluding section summarizes the literature of the problem. Strengths and weaknesses in the literature of the problem, including gaps and saturation points, are described in the concluding section. Avenues for further inquiry, including student evaluations of graduate instruction at Montana State University, conclude this chapter.

Criteria for Selecting the Literature

The historical relationship between the federal government and the academic recipients of the currently \$15 billion awarded for annual scientific research was considered in this literature review (Goldman & Williams, 2000, p.67). This relationship was considered relevant to this study because it provides the context in which any

assessment of the impact of federal funding of research at Montana State University might be made. This historical relationship helps to establish the context in which policies on federally funded research and graduate education at Montana State University might properly be considered. The literature reviewed here attempts to anticipate possible, future questions posed by this study of Montana State University. Do federal regulations for funded research at Montana State University diminish or impede the University's mission to educate graduate students, for example? Or is the condition of a discipline or department at Montana State University itself hindering that mission? Such questions cannot be adequately addressed without an examination of the larger context of the relationship between government funding agencies and U.S. research universities, and Montana State University in particular.

Literature that addresses historical and current rationales for university research, particularly as it relates to doctoral-level instruction, is reviewed. The literature in this area was rich, as the question of measuring and balancing faculty research and teaching duties have occupied those who study and administer higher education for quite some time. This literature included work on the changing character of American higher education, declining state support for public universities, quality standards and assessments, causes and consequences of unfinished doctoral degrees, and the political accountability of higher education institutions.

In 1999, Montana State University completed its ten-year institutional self-study for the Northwest Association of Schools and Colleges, Commission on Colleges. This piece of literature, rich in institutional data gathered by Montana State University administrators, staff and faculty for accreditation purposes, is reviewed and relied upon in this study as a vital source for assessing Montana State University's stated purpose and progress. Other Montana State University policy documents, such as the Productivity, Quality and Outcomes Agreement with the Montana Governor's Office, the Montana Board of Regents and the Montana Commissioner of Higher Education, were reviewed for this study. Public statements by Montana State University officials and other interested parties that address funded research and the instructional mission of the University were also reviewed for this study.

This study posed a direct question about whether Montana State University fulfilled its instructional mission at the doctoral level during a time of unprecedented growth in its research activity. Therefore, as a case study of Montana State, sources that described the mission and operation of the university were reviewed to introduce the current understanding of the problem. The historical and current purpose of Montana State University, as a public, Land Grant University leads a broader consideration of the problem.

Montana State University and the Land Grant Mission

As a Land Grant institution, Montana shares much of its historical mission with the 72 institutions created by the Morrill Act of 1862 (Veysey, 1965). The Land Grant mission contains three parts: research, teaching and service. It is the relationship at Montana State between the first two parts of this mission that this study addressed, specifically for the period of time between 1989 and 1999, when research activity more than tripled. In addition to the Morrill Act, which was intended to expand access to American higher education, the Hatch Act of 1887 created agricultural experiment stations that boosted the concept of basic and applied research (Kerr, 1964). In 1893, only four years after Montana had become the forty-first state, Governor John E. Rickards signed the bill establishing the first state-supported college that would eventually become Montana State University (Rydell, Safford & Mullen, 1992). It was called the Agricultural College of the State of Montana, reflecting its status as a Land Grant institution.

Before World War II, research activity at Montana State University was largely in agriculture, with a focus on improving the state's dominant economic engine (Rydell, Safford & Mullen, 1992, p.253). The federal government's role in agricultural research in Montana was prominent from the beginning, with the U.S. Department of Agriculture's

joint administration of the first agricultural experiment station in Moccasin established in 1907 (1992, p.254). In 1991, Montana State University soil scientist Hayden Ferguson said that "in relation to the total state economy, research and development here at the College of Agriculture has contributed so much that it has probably had the greatest in-state impact of any such program in the nation," (1992, p.253). Agricultural research at Montana State University has included work on irrigation methods, the development of the beet sugar industry, new varieties of sustainable grains, and veterinary breakthroughs that increased the viability of Montana livestock (1992, p.255).

Research activity at Montana State University since World War II has been profoundly influenced by the federal government's support of basic research in science, as all American universities have (1992, p.243). From 1940 to 1960, federal grants for university research increased by a factor of 100, to \$1.5 billion per year in 1960; in 1991, total federal support for university research was about \$30 billion per year (Kerr, 1994). In 1950, the National Science Foundation (NSF) was created to distribute federal monies to American universities for basic scientific research (1992, p.244). In order to broaden the distribution of these monies beyond a handful of powerful research universities, the NSF created the Experimental Program to Stimulate Competitive Research (EPSCoR) in 1978, which targeted 17 "have not" states. In 1979, Montana State University plant pathologist Dr. Gary Strobel secured an EPSCoR grant and established Montanans on a

New Trac for Science (MONTs), allowing any researcher in the state to apply for NSF funding (1992, p.244). According to Strobel, Montana's success ratio under EPSCoR (33 percent) is well about the national average (1992, p.244).

EPSCoR has been criticized for promoting a "geographical redistribution" of federal funds for science over the traditional, peer-reviewed method of funding in place since World War II (Martino, 1992). Citing comparisons between the EPSCoR states and the averages of all states and of the "top ten" NSF-funded states (Mervin,1990), Martino argues that EPSCoR states "...are not supporting research with their own funds, their science faculties are on the average less research-oriented (fewer Ph.D.s), and their research output (publications) is well below the national average," (1992, p.53). Martino points out that where the EPSCoR states perform up to the national and "top ten" averages is in the production of B.S. degrees in science. He concludes that "geographic redistribution may well have the effect of destroying good science training colleges while turning them into second-rate research universities, at the expense of first-rate research universities," (1992, p.53).

Current Understanding of the Problem

The Kellogg Commission recently completed a six-part study conducted under the auspices of the National Association of State Universities and Land Grant Colleges on

the future of state and Land Grant universities in the United States (Kellogg Commission, 2000). This study recommends state and Land Grant universities build a "new covenant" with the American people to better serve their rapidly changing needs for education in the 21st Century. Similarly, the Carnegie Foundation for the Advancement of Teaching revised its classification system for higher education institutions in 2000 in an attempt to de-emphasize its use by prestige-driven universities to pursue research at the expense of other institutional missions, such as instruction (McCormick, 1999). For technical as well as philosophical reasons, the Carnegie Foundation for the Advancement of Teaching's 2000 Classification paid more attention to the number and breadth of doctoral degrees awarded at an institution and less attention to the funded research activity at an institution (McCormick, 1999).

The Carnegie Foundation's next revision of its classification system is expected in 2005. This revision is expected to take into account an institution's mission, as defined by the institution, for classifying purposes (McCormick, 1999). The Kellogg study and the Carnegie classification system of 2000 represent prominent attempts to describe the current state of American universities in the context of their respective missions. This study describes the relationship between the research and teaching missions at Montana State University, and in particular the relationship between funded research and doctoral education. Additional literature that addresses local, regional, national and international

efforts to assess institutional progress in higher education, particularly at the doctoral level, are reviewed below under methodologies used with the problem.

According to the College of Graduate Studies (2001), Montana State University offers 17 doctoral degree programs in 14 departments. Six of these doctoral degrees are offered in the College of Engineering, with degree options in particular areas of concentration, by the departments of Chemical Engineering, Civil Engineering, Computer Science, Electrical and Computer Engineering, and the Department of Mechanical and Industrial Engineering. The nine other departments awarding doctoral degrees—also with options for areas of concentration—are the departments of Chemistry and Biochemistry, Ecology, Education, Land Resources and Environmental Sciences, Mathematical Sciences, Microbiology, Physics, Plant Sciences, and Veterinary Molecular Biology.

According to Montana State University's Office of Institutional Research (2001), the total number of doctoral students was 219 in 1990-91 and 269 in 2000-01, with a peak of 334 in 1996-97. Total Montana State University student enrollment over this period of time, including masters, doctoral and undergraduate students, went from 10,392 in 1990-91 to 11,761 in 2000-01 (with no significant peak during the intervening years).

These enrollments, in particular that of doctoral students during this period of time, correspond to a period of time when annually funded research at Montana State University more than tripled, from \$15 million in 1989 to \$50 in 1999. During this same

period of time the number of graduate research and teaching assistantships, which includes doctoral and master's students, remained flat, while the number of postdoctoral researchers increased more than six-fold, from 10 in 1989 to 64 in 1999. A snapshot figure available on the number of postdoctoral researchers working at Montana State University was taken by the College of Graduate Studies on December 4, 2000, which showed 89 on Montana State University's payroll (McLeod, 2000).

The explanation of a flat doctoral production at Montana State University between 1989 and 1999 during a period of strong growth in funded research may be found in the absence of any increase in research and teaching assistantships awarded to graduate students during that period of time. Geiger has observed that flat national doctoral production between 1954 and 1958 can be traced to a dearth of financial support for graduate students. The explosive growth of national doctoral production in the 1960s can be traced to the dramatic rise of federal research and direct doctoral student funding (Geiger, 1990, p. 221). Federal research funds have historically "trickled down" to graduate students in the form of research and teaching assistantships. Lovitts' survey of 175 students who left doctoral programs without degrees indicated financial reasons are given 19 percent of the time (2001, p. 177). Beyond the direct financial support assistantships provide, indirect benefits include access to active research topics and better inclusion in departmental culture. Lovitts' students cited such "academic reasons" 49

percent of the time in explaining their departure from a doctoral program without a degree (the remaining 23 percent cite personal reasons). Lovitts and others have lamented the lack of national and even institutional data on graduate programs, including rates of attrition (Lovitts, 2001; Breneman, 1975; Damrosch, 1995; Bowen & Rudenstine, 1992). Lovitts compiled the work of three prominent researchers in the field of graduate attrition to develop some estimates of doctoral attrition. She determined that between about 1950-53 and 1972-76 the rate of attrition at top institutions (rated by recipients of prestigious fellowships) was 40 to 55 percent, and 50 to 60 percent at all other institutions (2001, p. 176). Unfortunately, like many institutions of higher education, Montana State University's College of Graduate Studies has not collected data on doctoral attrition rates.

The significance of the dramatic increase in the employment of postdoctoral researchers with a concurrent flatness of doctoral production helped to raise the question of this study, given the exceptionally strong increases in federally funded research at Montana State University over the same time. Interestingly enough, potential disruption to Montana State University's instructional mission (including graduate education) by an administrative policy to aggressively pursue federal research funding in the early 1980s, was anticipated by one of its own graduate students (Western, 1984).

Previous Research of the Problem

Kenneth Henry Western received his master's degree in Public Administration from Montana State in 1984, after submitting a professional paper entitled "The Risks of Excellence: The Role of Research at Montana State University." He was employed at Montana State's Office of Publications and News Services, and served an internship required for the Master's in Public Administration (MPA) in the Office of the Vice President for Research. Western helped to prepare the 1980 annual report on research activities at Montana State, though he is careful to point out that his paper was written to meet the requirement for the MPA degree and should not be read as an official, internal planning or assessment document. Western's positions at the university, however, gave him access to institutional data and policy statements that allow him to examine the larger implications of Montana State's (then recent) administrative decision to capitalize on its research mission. Western asked in his introduction, "What kind of research program is consistent with the aims, responsibilities and potential capabilities of Montana State University?" (1984, p. 4). He concluded this first chapter with a warning that may be correctly viewed as the purpose of the current study to assess: "The institution [Montana State] is cautioned that to base an overall survival strategy on an expanded research program is risky," (1984, p. 6).

Western's paper was submitted during a time when funded research at Montana State University, although historically high, experienced a slight dip. He begins his recording of Montana State University's funded research activity in 1947, with an award of a \$13,000 grant from a private company and adds that it was not until 1965 that Montana State University generated \$1 million in grant and contract expenditures (1984, p. 13). Following the funded research trend at Montana State University, Western reports its growth from 1970, when it amounted to \$1.3 million and 1980, after it had increased to \$6.7 million and then to \$7.7 million in 1981 (1994, p. 13). "However, this dropped in 1982 to \$6.8 million and again in 1983 to \$6.75 million....Significantly, the decline accompanied a drop in federal support of program activity from 75 percent in 1980 to 65 percent in 1983. The drop in research and program funding after years of steady growth is an ominous sign for Montana State University, which has set its sights high..." (Western, 1984, p. 13). Dr. John W. Jutila, Vice President for Research, in whose office Western interned, specifically defined those "sights" in his supplement to Montana State University's 1980 self-study report. Planning for the period of 1980 to 1985, Jutila set a goal of \$18 million in grants and contracts income (1980). In hindsight, this turned out to be above Montana State's capacity at the time to attract; that amount was still not quite reached in 1989, when grant and contract activity was about \$15 million, the year that begins the current study's focus. The rate of growth in the following decade did easily

match that of Jutila's earlier expectations, with grants and contracts activity reaching \$50 million in 1999.

In addition to ambitious expectations for growth in grants and contracts, Jutila called for "increased research space totaling 200,000 square feet" and "at least 100 new research professionals added to staff," as well as a number of other specific, research-promoting goals for Montana State University by 1985 (Jutila, 1980). In concluding his reporting of Montana State University's research goals, as officially articulated by Jutila, Western noted that:

The institution may soon be faced with decisions about which disciplines to emphasize in terms of research and which to neglect for funding. The setting of the five-year goals directs the university toward the area of natural sciences and engineering, leaving perhaps only the question of which programs and curriculums in these areas will flourish (1984, p. 18).

Western cited Gross and Bramsch who reported that the decision to emphasize research carries certain costs:

There are definite and predictable sets of goals, which characterize universities of high and low productivity. High productivity means focusing on research and graduate study and placing less emphasis upon traditional goals such as producing well-rounded students, loyalty to the local institution, or satisfying the needs of persons in the local areas (Western, 1984, p. 19).

Balderson wrote of the "inevitable tension" at research universities between the education of undergraduates and graduate students, "for few universities have established a

graduate faculty separate from the faculty that teaches undergraduates,” (1995, p. 243).

Montana State University does not have separate faculties, though the number of faculty on 100 percent research appointments (i.e., without teaching or service duties) has reportedly increased dramatically between 1989-1999, from 10 to 50 (see qualitative results, ch.4). Further, the dramatic increase in the employment of postdoctoral researchers on campus during the same period may be seen as fulfilling the increase in “research professionals” on staff called for by Jutila back in 1980.

The costs that concerned Western at Montana State University have been expressed more recently on a national perspective. The President’s Council of Advisors on Science and Technology warned that “[It] is unreasonable to expect that the system of research-intensive universities will continue to grow” and that it is “ill-advised” for such universities “to aspire to excel in all or most areas of scholarship,” (Bromley, 1992). Western acknowledges the necessary and transforming changes that have occurred at Land Grant Universities since their creation by the Morrill Act of 1862, but “what remains unchanged are the concepts and values that comprise these institutions and continue to guide faculty and administrators,” (1984, p. 19).

Based on numerous interviews with former Montana State administrators, Montana State University historian Dr. Pierce Mullen reported that increased dependence on federal grant monies for scientific research distracts faculty from the university’s

instructional mission (1992, p.243). Mullen writes that "science departments have experienced increasing tension as faculty members have become more and more deeply involved in their own research and less and less concerned with both the undergraduate and graduate teaching missions of the university," (1992, p.243).

On the national level, Clark Kerr has cited the increase in federal research funding as contributing to the distraction of university faculty away from undergraduate instruction (1991). Sponsored to study the problem by the Carnegie Foundation for the Advancement of Teaching, Boyer argued for a multifaceted definition of scholarship that included an emphasis on the "scholarship of teaching," as well as the "scholarship of discovery," or, research (1990). The Boyer Commission on Educating Undergraduates in the Research University then reported its recommendations to invigorate undergraduate education in the face of increased university research activity in "Reinventing Undergraduate Education: A Blueprint for America's Research Universities." Both Boyer and Kerr presume to protect undergraduate education from the expansion of funded university research, which is otherwise assumed to benefit graduate education. This study examines that assumption in the particular case of Montana State University. Did funded research benefit Montana State University doctoral students during the strong 1989-1999 growth in funded research activity at the University?

Previous Methodologies Used for Problem

Studies of doctoral programs have been hampered by a dearth of data, both institutional and national. This has been explained by the wide variety of departmental approaches to doctoral programs, and by the administrative weakness of graduate deans (Geiger, 1993; Lovitts, 2001, pp. 8-10; Goldman & Williams, 2000, pp. 71-72; Damrosch, 1995, pp. 143-144; Grigg, 1965, pp. 105-109; Cartter, 1996, pp. 4-5; Breneman, 1975: pp. 73-75). "Doctoral education has been perhaps the most anarchic area of American higher education," (Geiger, 1993, p. 221). Researchers of doctoral programs have used quantitative measurements using "input" (i.e., admitted students) and "output" (i.e., doctorates awarded) models for assessing program quality and efficiency (Breneman, 1975; Bowen & Rundenstine, 1992; Krohn, 1992). Historical studies of American doctoral programs, which attempt to explain current conditions based upon the origins of those programs, are numerous (Whitehead, 1932; Hofstadter & Metzger, 1955; Barzun, 1968; Kennedy, 1997; Graham & Diamond, 1997; Pelikan, 1983; Damrosch, 1995; Grigg, 1965; Geiger, 1993; Williams, 1991; Western, 1984). Faculty surveys of graduate program quality, which include both quantified data from those surveys as well as qualitative interviews with faculty members, appeared in the literature (Cartter, 1966; Serow & Demery, 1999).

Lovitts' research focused on interviews and surveys of graduate students themselves, on the premise that 40 years of ignoring high attrition rates among doctoral candidates by university departments and administrations called for an examination of the candidates' self-reported reasons for their attrition (2001). Management models for analyzing the proper administration of higher education have also been employed to address challenges that have traditionally remained in the academic sphere (Balderston, 1995; Peterson, Dill, Mets, et. al., 1997). Financial data that attempt to reveal the relationship between federally funded university research and its impact upon other institutional missions have been collected and analyzed (Martino, 1992; Goldman & Williams, 2000). One rather unique study establishes the apparently close connection between Nobel Prize-winning researchers and the likelihood of their research apprentices (i.e., graduate students and postdoctoral researchers) going on to win the prestigious award themselves (Zuckerman, 1977). Although not strictly scholarly works, state commissions on higher education and institutional self-studies for accreditation purposes should not be ignored in the literature of assessing doctoral programs (Taylor, 1974; Mudd, 1990; Evaluation Committee Report, 1999).

Geiger's historical treatment of American research universities since World War II describes in great legislative and policy detail how universities were called upon to support the war effort and then encouraged by the federal government to continue to

serve national peacetime needs (1993). Wartime needs of the nation set focused objectives for federally selected universities and research teams (e.g., the development of the atomic bomb). A significant break in the tradition of assigning projects to individual universities came in the funding practices developed by the Office of Naval Research (ONR) (1993, pp. 23-25). ONR was not a significant participant among the U.S. military branches in the funding of wartime university research.

In 1945, seeking to increase the Navy's share of university-conducted research, ONR initiated two significant changes from the wartime funding of university research. These changes were intended to appeal to the existing culture of scientific researchers at American universities, in order to compete with other branches of the military already entrenched in the employment of university research. One change by ONR was to allow university researchers themselves to propose topics for funded investigation, rather than to allow the topics to be directed from a centralized Navy office. The other was to agree that the research funded by ONR would be unclassified and publishable. In shifting the control of research to university scientists, ONR did indeed attract the interests and work of scientists at leading U.S. research universities, showing that the ideals of Vannevar Bush had an eminent practicality.

In the early 1950s Cold War fears turned some American state and federal officeholders, most notably Senator McCarthy, into domestic "red" (i.e., Communist)

hunters (Geiger, 1993, pp. 37-40). As in other employment sectors of the U.S. economy during those times, university faculties were required to sign oaths of loyalty and appear before state and national committee hearings to swear that they were not Communists. In 1953, Congress subpoenaed over 100 university teachers, and at least 30 were fired from their positions after testifying (Geiger, 1993, p. 39). Such numbers themselves hardly warrant an interpretation of major disruption at American universities. Geiger, however, cited instances of serious academic harm (such as at the University of Illinois) and a more pervasive if less ostensible increase in the level of federal influence on the supposed autonomy of university faculty (1993, p. 40).

In his historical analysis of graduate education since World War II, when federally funded university research began to boom, Geiger notes that about 3,000 earned doctorates per year were awarded just before the war and climbed rapidly to almost 9,000 in the mid-1950s (1993, p. 217). By the mid-1970s, American research universities awarded over 33,000 doctorates, peaking in 1973 at 34,790 degrees. Geiger uses baby-boom demographics to partly explain this explosive expansion of the supply of doctorates to meet the teaching demands of growing university enrollments. He points out that while a few prominent scholars warned against seeing the apparent shortage of university teachers as a crisis, this is in fact how it was perceived by most analysts throughout the 1960s (1993, p. 218). Geiger describes the willingness of American universities to vastly

expand their doctoral cohorts as driven by an incentive "to do well for themselves by doing good for the country," since new or expanded doctoral programs increased the prestige of an institution (1993, p. 218).

In fact, Geiger notes doctoral programs had been expanding since World War II. "In 1949, just over 100 regular universities awarded doctoral degrees. By 1970, after doctorates had expanded over six-fold, the number of doctoral institutions had doubled. At least 35 universities conferred their first doctorates in the 1950s and 45 more in the 1960s," (Geiger, 1993, p. 219). Research-oriented universities meanwhile worried about the quality of doctoral education (Carter, 1966, pp. 119-121). Geiger reports that the top 15 universities in 1925 graduated 76 percent of the total number of doctorates awarded in the U.S., while in 1957 their share had been reduced to 43 percent (1993, p. 219). Based upon such data, federal and private foundations responded to the presumption of erosion of graduate education quality by awarding grants directly to the most qualified doctoral candidates rather than to the graduate school in which they were to be enrolled (Geiger, 1993, pp. 219-221). These foundations also supplied "cost of instruction" funds to the institutions chosen by the grant-supported doctoral candidates, which invariably ranked in the top tier of recognized research universities (Geiger, 1993, p. 221).

Geiger states that increases in federal research funding "should have brought about at least a doubling of research assistantships in the 1960s," though data available

for that period are "uncertain," (1993, p. 222). Geiger tempers his tacit assumption that the data would show research funding supported graduate research assistantships in the 1960s by pointing out that teaching assistantships rose more rapidly than enrollments from the late 1950s to the mid-1960s, at both public and private institutions (1993, p. 222). This he explains by the use of graduate students to teach lower level courses, noting that even the prestigious University of California at Berkeley and the University of Michigan employed graduate teaching assistants to teach more than 40 percent of their lower division courses (1993, p. 222).

While Geiger does not explicitly connect the rise in federal research funding at universities with the trend toward using graduate students to teach, the connection is implicit. As university faculty became busy with increased research work, federally funded, then graduate students, also in part federally funded, could be used to fill in for them in the classroom. Geiger states that in the midst of this era of increased financial support for graduate students (either by fellowships, state and/or federal support in the form of research and teaching assistantships, and tuition waivers), two major problems were recognized at the time: longer time to degree and doctoral attrition rates (1993, pp. 224-229).

Geiger attributes the lack of decrease in the time to degree for doctoral candidates, despite increased financial support for them in the 1960s, to the fact that support was

focused toward supporting the start of graduate study rather than toward its completion (1993, p. 224). A combination of the lack of support for ABDs (all but dissertation) and their attractiveness as instructors at universities with increased enrollment (where they concurrently and, often, over an increasing length of time, completed their dissertations), prolonged the time to degree (especially in the humanities and social sciences). Geiger stresses the “perverse and rational” behavior of academic departments that recruited a large cohort of doctoral candidates with a lengthened time to degree and high rate of attrition (1993, p. 225).

A larger population of graduate students yielded further benefits in advanced classes to teach and [serve as] graduate assistants...Departments consequently had strong incentives to expand their recruitment of graduate students as long as qualified applicants were available. The constraint they faced was on the output side. Only those Ph.D.s who where placed into other strong departments conferred prestige upon their mentors. Producing too many doctorates, and seeing them forced to accept employment in undistinguished, non-research institutions, would soon diminish the reputation of a department and its members, (Geiger, 1993, p. 225).

Geiger reports that the attrition rate for qualified doctoral students in the 1960s was 75 percent in the humanities, 70 percent in the social sciences and 40 percent in the natural sciences (1993, p. 226). Again, Geiger turns to prestige to explain institutional complacency toward these levels of attrition, which continue to the present (Lovitts, 2001, p. 23). “One reason [for complacency about attrition] was that enhancing prestige, whatever its undesirable incidental effects, was an inherent goal of research universities

as well as of their faculty members. This shared purpose was just one of the reasons why graduate education proved so recalcitrant to reforms," (Geiger, 1993, p. 227).

Alfred North Whitehead addressed many distinguished academic audiences about the purpose of the university, as schools of education and schools of research fruitfully combined. In these addresses and in his writing, Whitehead draws upon an intimate knowledge of the history of the development of academic curriculum and institutions, both in the U.S. and abroad. In the *Atlantic Monthly*, Whitehead wrote, "The justification for a university is that it preserves the connection between knowledge and the zest of life, by uniting the young and the old in the imaginative consideration of learning," (Whitehead, 1932, p. 139). He goes on to say that the uniting of education and research must be the purpose of any efficient faculty, adding:

Do you want your teachers to be imaginative? Then encourage them to do research. Do you want your researchers to be imaginative? Then bring them into intellectual sympathy with the young at the most eager, imaginative period of life, when intellects are just entering upon their mature discipline. Make your researchers explain themselves to active minds, plastic and with the world before them; make your young students crown their period of intellectual acquisition by some contact with minds gifted with experience of intellectual adventure, (Whitehead, 1932, pp. 146-147).

The American research university, particularly the land-grant university, has a focus on the commercial and social application of research that the German ideals of *Lehrfreiheit* (academic freedom of faculty) and *Lehrnfreiheit* (academic freedom of

students) does not entirely account for. The historical progress of *Wissenschaft* (Science) developed in the German system of higher education was almost entirely turned over to the freely pursued academic activities of university faculty and their students, without any significant pressure from administrative, social or commercial needs (Hofstadter & Metzger, 1955, pp. 382-387). Service as an academic duty is largely an American creation (Kennedy, 1997). It emerged from both a different appointment system for American faculty, where institutional loyalty is the expectation, and from U.S. industrial interests in training a workforce and applying university research to solve industrial problems (Hofstadter & Metzger, 1955, pp. 380-381). The focus on practical production rather than pure science (*Wissenschaft*) at American universities is alternatively told as either the greatest success story of academia or the cause of vast institutional problems (Graham & Diamond, 1997; Barzun, 1968, pp. 251-258).

Any interpretation of the condition of American universities, individually or collectively, ultimately resides in a value judgement. Allan Cartter was one of the first prominent researchers in the field of database assessment of quality in graduate education. In an early work, he wrote that "In an operational sense, quality *is* [emphasis in the original] someone's subjective assessment, for there is no way of objectively measuring what is in essence an attribute of value," (Cartter, 1966, p. 4). Whitehead

appears to have recognized the tendency toward measurable and applicable production at the American institutions he addressed. He writes:

It must not be supposed that the output of a university in the form of original ideas is solely to be measured by printed papers and books labeled with the names of their authors. Mankind is as individual in its mode of output as in the substance of its thoughts. For some of the most fertile minds composition in writing, or in a form reducible to writing, seems to be an impossibility. In every faculty you will find that some of the more brilliant teachers are not among those who publish. Their originality requires for its expression direct intercourse with their pupils in the form of lectures, or of personal discussion. Such men exercise an immense influence; and yet, after the generation of their pupils has passed away, they sleep among the innumerable unthanked benefactors of humanity. Fortunately, one of them is immortal—Socrates, (Whitehead, 1932, pp. 148-149).

While an assessment of graduate school quality may come down to a judgement about the purpose and value of higher education, many historical treatments of the development and operation of graduate programs rely upon analyses of institutional data. Using survey data from university administrators, faculty and students, Grigg noted that much criticism of graduate education has centered on the practice of training students for research rather than for teaching (Grigg, 1965). Among those criticisms has been the length of the doctoral program and the notion of the dissertation as an original piece of research (rather than as a training instrument). The diffuse nature of responsibility for graduate programs among individual departments has made it difficult for American graduate schools to address criticisms that focus on the nature of graduate education as a

whole. Given the responsibility of awarding graduate degrees without a faculty of its own, many graduate colleges form graduate councils made up of diverse faculty members, who formulate the rules and regulations for degree programs. Significantly, graduate councils appear rarely to initiate changes or innovations, but rather, mostly handle issues that originate in the academic departments of the university (Grigg, 1965).

Grigg discussed minimum standards for doctoral programs in the areas of administration, faculty, library, facilities and student body; however, he noted that most faculty members who teach graduate students and serve on graduate councils have other institutional concerns, largely relating to their own respective departments (Grigg, 1965). Graduate deans, advised by faculty councils, rarely possess the administrative power to affect departmental behavior regarding graduate education, largely because they control no significant portion of the university budget (Breneman, 1975). "Because of this limited budget authority, it is unrealistic to expect the dean's office to be a powerful force for change in graduate education," (Breneman, 1975, p. 73).

Related Problems

Former Montana State University President Michael Malone created the Quality and Outcomes Task Force in the fall of 1994. At the urging of the Montana Commissioner of Higher Education in the spring of 1995, "Productivity" was added to

the goals of the task force, leading to the Productivity, Quality and Outcomes (PQ&O) Agreement. The Governor of Montana, the Chairman of the Board of Regents, the Commissioner of Higher Education and the President of Montana State University signed this agreement on September 29, 1995. Its implementation was placed under the direction of Montana State's Provost and Vice President for Academic Affairs, who directed committees and appointed task forces to address specific issues in the agreement (Malone, 1997). After rejecting in the summer of 1995 a draft Agreement approved by Montana State's Faculty Council, then-Commissioner Jeffrey Baker added two goals that were considered part of the Agreement by the September 29 cosigners: a 15 percent increase in undergraduate instruction, and an annual 15 percent increase in research. Instruction would be measured by class credits per instructional FTE (full-time equivalent, for tenured and tenure-track faculty). Research would be measured by annual funded research (grant and contract activity). The baseline for both these measurements would be fiscal year 1993. The other goals of the Agreement were to:

1. Increase Access to Undergraduate Education
2. Increase the Quality and Availability of Advising
3. Increase the Quality of Undergraduate Education Through Smaller Classes and Through Active and Alternative Modes of Learning
4. Increase the Quality of Undergraduate Education Through Expanded Involvement of Undergraduates in Research and Creative Work
5. Increase the Quality of Education Through Greater Access to Information Technologies Reward and Further Develop Teaching Excellence

6. Continue Growth in External Funding Support for Student Learning and Education
7. Expand Off-Campus Access to Classes and Educational Resources Throughout Montana
8. Enhance Access to the Intellectual and Physical Resources of the University to Support the Economic Development of Montana

In his October 13 cover memorandum to the submission of the 1997 PQ&O Interim Report, then-President Michael Malone wrote the Commissioner of Higher Education that "I am especially concerned that the record seems to indicate that we are failing to enhance the Instructional portion of our budget," (Malone, 1997). Malone went on to explain at some length the University's significant use of its "discretionary" expenditures as opposed to its "fixed costs" and "fee waivers." Malone wrote:

When adjustments are made for these factors [i.e., fixed costs and fee waivers], the percentage of discretionary investments in the Instructional sector has remained virtually unchanged from 62.74 percent in FY 1993 to 62.73 percent in FY 1997. We are finding it very frustrating that investments in improved Instruction, such as wiring of academic buildings, classroom improvements, and library investments, are actually undercutting this measurement standard. While this explanation still does not enlarge the percentage of Instructional funding, we are hopeful that this can occur in the future..." (1997).

The PQ&O Agreement is related to this study because it attempts to analyze instructional quality at Montana State University, albeit largely at the undergraduate level. In negotiating the standards and measurements in the Agreement with Commissioner of Higher Education Baker, Montana State University President Malone

proposed in a September 1, 1995, memorandum to reduce the 1993 baseline for class credits per faculty FTE from 14.3. "Because the focus of the Montana State University document is upon undergraduate instruction, we recommend that, using the FY 1994 teaching load study, we break out the undergraduate proportion of the teaching load total, which is 12.17 class credits per FTE," (Malone, 1995). Based upon Malone's reference to the 14.3 class credits per FTE baseline in the submission of the 1997 PQ&O Interim Report, it appears that Malone's 1995 proposal of 12.17 class credits per FTE was not adopted in the final PQ&O Agreement. The negotiation between Malone and Baker regarding a baseline for the measurement of faculty productivity at Montana State University for the PQ&O Agreement is significant to this study because an operational, institutional consideration of faculty workload emerges.

When faculty workload is formally addressed later in the September 1, 1995, draft of the PQ&O Agreement, the three components of teaching, research and service of a public, land-grant institution are invoked. "This document concentrates on the undergraduate teaching component, and the creation of new knowledge (research), but the other components must be kept in mind, for they are integral parts of the faculty workload at Montana State University-Bozeman and not always separable from one another," (Malone, 1995, p. 6). This note of philosophical caution in an administrative document attempting to practically define faculty workload resonates with the literature

reviewed here on the history of combining teaching and research in institutions of higher education. The drafters of the PQ&O Agreement at Montana State University appear to have understood that the political impetus outside the university behind the formulation of the Agreement may cost the institution more than will be measured by the Agreement's standards. They write:

We emphasize that the faculty at MSU-Bozeman already has a full (100 percent) workload as measured by any reasonable standards. Therefore, the workload implications of this document reflect a reallocation of resources and reaffirmation of commitment to quality and access in the undergraduate programs. The result is a shifting of effort toward undergraduate teaching...while not reducing efforts to meet the scholarly or service missions of the institution (1995, p. 6).

If the premise of this statement is accepted, namely, that faculty are at a full workload, then any shifting of resources to undergraduate teaching, while holding commitments to scholarly (research) and service missions constant, must necessarily remove resources from some part of the university. Graduate education at Montana State University goes notably unmentioned in this excerpt from the Agreement. The PQ&O Agreement, with its explicit emphasis on faculty workload in relation to undergraduate education at MSU, on the whole has little to say regarding graduate education. This is significant because the Agreement, in its statement of intent, attempts to "match what the collective-bargaining campuses have produced, in a non-unionized context," (Malone, 1995).

Whether in a unionized or non-unionized context, it may be relevant to this study to ask who represented Montana State's College of Graduate Studies at the PQ&O bargaining table? According to his September 1, 1995 memorandum to Commissioner Baker, President Malone offered to separate graduate courses from the definition of faculty workload in order to begin the Agreement with a lower baseline measurement of course credits per faculty FTE. Since there is no separate graduate faculty at Montana State University, it would appear that Malone's proposal for the PQ&O Agreement would have altogether removed graduate instruction from the definition of faculty workload at Montana State University. While the baseline figure adopted in the final PQ&O Agreement of September 29, 1995 appears to include graduate instruction, the implications for failing to leave any significant place for graduate education in the PQ&O Agreement is related to the focus of this study.

Faculties at several Montana university campuses are unionized, including the University of Montana-Missoula, though Montana State University's faculty (Bozeman) is not. The state affiliates of two national organizers of university faculty in Montana, the National Education Association and the American Federation of Teachers (affiliated with the AFL-CIO) merged in September 2000. This organization, MEA-MFT, also affiliated with the AFL-CIO, now represents most unionized higher education faculty in Montana, as well as most unionized Montana K-12 teachers. The significance of this development

to this study pertains to two issues. The first is that the new organization, even before it formally merged, has taken the quality of Montana higher education as its rallying cry.

"The quality of education at the university system is in serious trouble, and negotiations are the key to reversing the decline in quality," (Minow, 1999, p. 1). Whether or not this organizing strategy reaches sympathetic faculty ears at Montana State University, negotiated bargaining agreements are applied to Montana State University's faculty because they are reached with the Montana University System.

The Montana Board of Regents recognizes the University Teachers' Union (UTU) of the University of Montana as the exclusive bargaining representative "for all persons on academic appointment to the rank of instructor, assistant professor, associate professor, professor, and all others on any academic appointment..." (University Teachers Union Bargaining Agreement, 1999, p. 4). Specifically, negotiated agreements on workload definitions for Montana university faculty are recognized by the Montana University System. In the current agreement with the UTU, "instructional workload will also be measured through a workload protocol to be developed by the parties, which better reflects the full range of instructional activities," (UTU Bargaining Agreement, 1999, p. 99). Whether or not Montana State faculty themselves organize into a collective bargaining unit, the Montana University System through the Board of Regents will be legally bound to apply its negotiated definitions of faculty workload in administrative

policies to Montana State University. As with the PQ&O Agreement of 1995, the implications of any negotiated agreement with UTU on faculty workload definitions may be related to the focus of this study.

Montana State University, or Montana State College as it was then known, had a small but vocal chapter of members who organized in the late 1940s (Rydell, Safford & Mullen, 1992, p. 76). A collective bargaining initiative under the American Association of University Professors (AAUP) platform was voted down on May 18, 1978 at Montana State University (Rydell, Safford & Mullen, 1992). In 1989, MSU faculty again voted down an initiative to unionize (Rydell, Safford & Mullen, 1992). In other parts of the United States, increased graduate student organization by unions has been reported (Bronfenbrenner & Juravich, 2001). While no evidence of this is apparent at Montana State University, the 1999 accreditation report states that graduate "stipends are lean at MSU and should be increased to at least a level that keeps pace with the cost of living," (Commission on Colleges, 1999). Because of the implications of negotiated bargaining agreements on university policies treating faculty or graduate student workload, potential unionization of either faculty or graduate students at Montana State may be related to the focus of this study.

Concluding Assessment of the Literature of the Problem

Based upon the German model of the student as an apprentice researcher in a scholar's laboratory, the first doctoral program in America was established at The Johns Hopkins University under Daniel Coit Gilman in 1876 (Veysey, 1965, p. 159). Yale Historian Jaroslav Pelikan has cited Yale's graduate courses in philosophy and the arts in 1846 and its awards of the Ph.D. beginning in 1861 as evidence that graduate education in the U.S. had actually begun before the establishment of Johns Hopkins (Pelikan, 1983, p. 5). John Henry Newman's *The Idea of a University* was published in 1873, and begins with a definition of the university as "a place of *teaching universal knowledge*," (Newman's italics). Newman goes on to say, "If its object were scientific and philosophical discovery, I do not see why a University should have students," (Newman, 1976, p. 5). Nevertheless, as Pelikan notes, graduate education in the U.S., and the Ph.D. in particular, is based on the German model, which emphasizes original research as the proper way to train new scholars (Pelikan, 1983, pp. 8-9).

Conceived solely as a graduate university in the German mold, Johns Hopkins immediately established undergraduate departments under pressure from the public (Grigg, 1965, p.2). Clark University, founded in 1889 under G. Stanley Hall, lasted just 13 years as a graduate school before adding an undergraduate college (Veysey, 1965,

p.166). Grigg notes that the German model of graduate education was modified in the U.S. by being superimposed on an existing (undergraduate) college system based on the English model (Grigg, 1965, p. 2). Further, the land-grant movement and graduate education began about the same time in the U.S., with the Morrill Act of 1862 establishing land-grant colleges to better serve the public (Grigg, 1965, p. 3). Teaching, research and service to the state, the “unified” missions of U.S. state and land grant universities—including Montana State University—have distinct historical origins.

Using imported and not obviously compatible components for their working model for over a century, American higher education institutions are recognized as the most productive in the world, for both educating students and conducting research (Graham & Diamond, 1997). The increase in the number of successful doctoral candidates in 20th Century America—particularly since 1920—reveals startling growth. By 1900, fewer than 400 doctorates were awarded annually; in 1920, fewer than 600 doctorates were awarded by only 14 American universities (Bowen & Rudenstine, 1992, p. 19). In 1988, the year before the ten-year period of this study’s focus on doctoral education at Montana State, 33,456 doctorates were awarded by over 350 American institutions (1992, p. 20). For every 1,000 Baccalaureate degrees conferred in 1920, 12.6 doctorates were awarded; in 1980, 35.1 doctorates were awarded by American universities for every 1,000 Baccalaureate degrees conferred. The decade of the 1960s

showed the most growth in doctoral degree production in the U.S. During that decade (1960-1970), the number of doctorates awarded tripled, from under 10,000 to nearly 30,000 (Bowen & Rudenstine, 1992, p.21).

Bowen and Rudenstine caution against making too much of growth or prospective growth in the U.S. academic marketplace. They correlate the large increases in doctoral production to the larger pool of Baccalaureate students from which to draw, particularly in the period of increased production of doctorates between 1954 to 1964 (1992, p.53). Periods of relative contraction in the production of doctorates are explained by their data as the end of the draft deferments for Vietnam (1964-1970) and a flight from the arts and sciences and a poor job market for academics (1970-1976) (1992, p.54). Also noted by Bowen and Rudenstine as evidence for the preeminence of American research universities has been their respective abilities to draw non-U.S. residents into their doctoral programs. In 1958, only 772 non-U.S. residents received doctorates from American universities; in 1988, the number had risen to 8,589 (Bowen & Rudenstine, 1992, p.28).

The historical tension between federal versus scientific control of the direction of basic research at universities receiving federal funding appears to persist today (Brainard, 2001). *The Chronicle of Higher Education's* annual survey of federal research awards to universities has reported a trend toward increased congressional "earmarking" of awards

that were previously distributed according to the decisions of scientific "peer review" committees (Brainard, 2001). According to the *Chronicle's* analysis, in fiscal year 2001 Congress directed \$1.668 billion to specific universities. This amount represents an increase of 60 percent from the previous fiscal year. It is the largest annual increase in "academic pork barrel," for the largest group of both universities and projects since the *Chronicle* began reporting on it in 1989 (August 10, 2001). Brainard reported:

Some university officials and scholars fear that the directed grants, called earmarks, are out of control and are eating into funds for peer-reviewed science. Agencies award the earmarked money without the merit-based competition typically used to distribute government funds for research, facilities, and other university projects, (2001, p. 1).

Clearly current trends toward congressional control of federal research awards was not part of Vannevar Bush's vision for the relationship between the federal government and its funded academic researchers. Nor could Bush have anticipated the growth in federal spending for science by the federal government. From 1940 to 1960, U.S. government support for higher education, largely in the form of research grants, increased by 100 times, to \$1.5 billion annually (Damrosch, 1995). By 1991, the federal government gave American higher education about \$30 billion per year, with about half of that amount going for basic research (Damrosch, 1995). Defenders of congressional earmarks point out that it enhances a more fair, geographical distribution of federal research monies. This may ring true in the ears of university researchers in Montana

(with its one, lone representative in the U.S. House of Representatives). Universities in the state of Montana were reported to have received \$25.4 million in politically “earmarked” federal research funds in 2001, ranking it 19th in the nation for the amount received that year (Brainard, 2001). The 2001 amount was about half of what Montana had received since 1997, which was a total of \$52.3 million, placing it 33rd in the list of U.S. states over the same period of time (Brainard, 2001). The economic fact remains that whether federal research is funded on a political or peer-reviewed basis, the demand for it continues to grow. As Clark Kerr wrote in his preface to *The Uses of the University*:

The basic reality, for the university, is the widespread recognition that new knowledge is the most important factor in economic and social growth. We are just now perceiving that the university’s invisible product, knowledge, may be the most powerful single element in our culture, affecting the rise and fall of professions and even of social classes, of regions and even of nations. Because of this fundamental reality, the university is being called upon to produce knowledge as never before, (1963, vii-viii).

In a September 27, 2001 press release on its grant and contract activity for the fiscal year ending June 30, Montana State University’s Vice President for Research Tom McCoy seemed to echo Kerr’s much earlier economic assessment of university research:

The total for fiscal year 2001 was \$61,023,165, within a few thousand dollars of the previous year’s record high of \$61,031,150. Tom McCoy, MSU’s vice president for research, said this year’s total shows that MSU continues to be a significant player as a research university and a major component of the local economy. For an institution of this size without a medical school, MSU is one of the top research universities, McCoy said.

I'm proud of the research and creative activities conducted by our productive and highly talented faculty (2001).

McCoy's September 2001 press release, which reflects some institutional analysis of the impact of grant and contract activity at Montana State University, went on to state:

MSU grant expenditures have been on a steep upward climb for more than a decade. In 1987, expenditures totaled \$13 million. That figure had doubled by 1993 and doubled again, to \$52 million, by 1998. The majority of the dollars--typically about 66 percent--come from federal agencies such as the National Science Foundation, the U.S. Department of Agriculture and the Department of Health and Human Services. The rest come from state agencies and private sources. Traditionally nearly two-thirds of the total grant expenditures pay the salaries of faculty, staff, students and others who work on the grant-funded projects, making university research one of Bozeman's major employers. About 10 percent of research expenditures pay for student fellowships and scholarships. Grants also provide funds for campus infrastructure, including the purchase of state-of-the-art equipment and the development of modern research and teaching facilities. McCoy said expenditures are just one measure of research activity on the Bozeman campus. Some projects lead to new products or processes that can be commercialized by Montana companies. Many other research projects lead to books, musical recordings, artwork and other contributions to the nation's cultural heritage (2001).

One of the concerns raised by the Northwest Association of School and Colleges 1999 accreditation committee is Montana State University's operating expenditures (Standard 7.B). "While a number of departments and research groups have increased their operating expenditures in recent years, largely from the distribution of the Indirect Cost Return, there remains a problem for some of those departments as well as those.

departments without contract and grant activity or other support,” (Commission on Colleges, 1999, p. 59). “Many departments and units not associated with research initiative play important roles in other aspects of the university mission and goals.” The committee went on to recommend that:

MSU-Bozeman engage in a full and inclusive process, involving all elements of the campus community, focusing on the nature of its mission and the changes that increased research emphasis is creating...Analysis should focus in part on the roles of undergraduate and graduate education in MSU-Bozeman’s changing environment, (1999, p. 61).

The committee commends Montana State for successfully increasing its grant and contract activity during a time of declining state revenues, and states that “faculty translated this success into improved instruction, and enhanced facilities, equipment and educational experiences,” (Commission on Colleges, 1999, p. 62). This study considered the evidence at the graduate level for this commendation, which came on the heels of the committee’s recommendation for an institution-wide analysis of how the emphasis on research is affecting Montana State University’s instructional mission.

Strengths in the Literature of the Problem

From its origins to its current condition, the history of federal funding of research at American universities is well documented (Williams, 1991). The beginning of the federal government’s emphasis on the production of knowledge (i.e., research) at

American universities has been tied to America's response to the launching of the Soviet Sputnik in 1957 (Bowen & Rudenstine, 1992). But as early as 1945, in *Science-The Endless Frontier*, Vannevar Bush was appointed by President Roosevelt to develop a strategic plan to increase federal funding for basic scientific research at U.S. higher education institutions, which was then submitted as a report to President Truman (Bush, 1945). Bush set up four committees to address the questions posed to him by Roosevelt in 1944 about how to build upon American wartime research efforts (such as the development of the atomic bomb) to create peacetime benefits (Geiger, 1993). Bush used the reports of the four committees to support the broader, fundamental recommendation in *Science-The Endless Frontier*: a federal program to fund basic research at American colleges and universities would increase national security and the U.S. standard of living. Bush's plan placed much of the control and administration of university research in the hands of the researchers, by its reliance on scientific "peer review" rather than federal administration to direct the flow of federal funds for research (Geiger, 1993, pp. 14-16).

Bush's vision for comprehensive federal approach to basic research was eventually adopted in 1950 with the creation of the National Science Foundation. However, in the intervening five years of public policy debate, Congress had already passed into law how federal funding would be apportioned for the largest portions of defense- and health-related research (Geiger, 1993). Nonetheless, Bush's plan continues

to influence national research policies (Bromley, 1992). This influence is affected—some would say diluted—by pressures that can be traced to the original political resistance to Bush's vision of a coordinated, federal research funding policy created for and largely directed by American university scientists (Geiger, 1993).

The pressures to alter Bush's plan introduced as congressional legislation in 1945 came from both the legislative and executive branches of government. U.S. Senator Kilgore and President Truman's budget director, Harold Smith, articulated similar concerns about the necessary federal control and "ownership" (in the form of patents) of federally funded research at the universities (Geiger, 1993, pp. 17-19). Smith's testimony to Congress on the original legislative version of Bush's plan, which was backed by Truman, included the argument that "an agency which is to control the spending of public funds in a great national program must be part of the regular machinery of government," (Geiger, 1993, p. 17). This was in opposition to Bush's idea of a "peer reviewed" basis for scientific funding by the federal agency that was to be created by the debated legislation. Geiger quoted from part of Bush's response to Senator Kilgore's proposal to increase federal control of any national science agency by placing it under the direct authority of a presidential appointee:

There is only one sound criterion for estimating the standing and capability of a man of science, and that is the evaluation of the way in which he is regarded by his colleagues in his profession...[These

evaluations] should be utilized in the procedure of selecting representative scientists for governmental purpose...It can safely be assumed that men selected for eminence in science by scientists themselves will also generally be disinterested, (Geiger, p. 17).

While the history of federal support for basic research at American universities is clear, its ongoing rationale, especially in relation to the instructional mission of these institutions, is increasingly troubling to some (Winston, et. al., 1998; Magner, 2000; Greenberg, 2001). At Montana State University, one critic on the faculty noted that:

Grants and contracts has gone from an inflation-adjusted \$37.6 million [1976] to approximately \$48 million [1998]. We have built and are subsidizing a local museum. Stadium sky boxes, fieldhouse renovation, prime research space for various projects all make the 'economic development' accomplishments list...The problem, as I see it, is that they have been paid for by undergraduate tuition, (Mooney, 1998).

A national study of academic research and undergraduate tuition costs by the National Science Foundation states that "some subsidy by undergraduate tuition for research over the period [1980-1994] is consistent with the data presented here," (Lehming, 1997). Montana State University officials announced on November 9, 2001, that "a decade-long accounting oversight in reconciling money students owe Montana State University resulted in a \$2.3 million internal shortage," (Roloff, 2001). Montana State University officials "do not believe that there was fraud involved, however many of the files that contained student receivable information prior to 1997 no longer exist." In order to balance the \$2,323,441 spent but not collected from students, Montana State University

will be "distributing reductions to the accounts that have received uncollected funds," (2001). It appears that Mooney's 1998 call to reduce student tuition and fees because they were unfairly subsidizing "economic development" projects at the university relied upon a 10-year fiscal understatement of what Montana State University student service funds will be charged.

The area in which undergraduate and graduate education quality measurements may overlap by definition is where graduate students teach undergraduates as a means to support their own graduate study. In her 1999, "welcome letter to graduate students," General Secretary Mary Burgan of the American Association of University Professors states that "since 1975 the number of faculty members who are also graduate students has risen by 35 percent and part-time faculty appointments by 103 percent. Tenured appointments grew only 25 percent while probationary tenure track appointments actually fell by 12 percent. Today, only 25 percent of all those who teach and do research in higher education have tenure," (Burgan, 1999).

Other data from the National Science Foundation suggest recipients other than adjuncts and graduate teaching assistants for teaching and research positions historically were held by tenured faculty. The NSF study states that "about 42 percent of all U.S. science and engineering Ph.D.s who ever had a postdoc position has risen for at least three decades, from 25 percent for the 1965-66 graduation cohorts to 42 percent for the

1993-94 cohort,” (Regets, 1998). The job market for new Math, Physics and Chemistry Ph.D.s has been shown to be “a complex set of possibilities, ranging from full-time positions to limited-term teaching or research appointments to part-time employment,” (Syverson, 1997, p. 3). Given the economic complexities of the Ph.D. market, it would be overly simplistic to attribute the flatness of doctoral production at Montana State University’s from 1989-1999 to the concurrent rise in nontenurable faculty and postdoctoral scholars at the university. Still, the literature on the origins and history of university research suggests that the quality and quantity of doctoral production should rise during a period of rising research activity. Taken nationally, this appears to be the case at U.S. research universities, whose international reputation for the quality and quantity of its production of both research and researchers is unparalleled (Graham & Diamond, 1997). Montana State University appears rather exceptional based on the literature reviewed here on the intended effects of a robust research program on doctoral education at the same university. Why, then, has doctoral production at Montana State University remained flat from 1989-1999, which represented a period of significant growth in the university’s research activity?

Weaknesses in the Literature of the Problem

While the history of deliberate and fortuitous policies leading to the current strength of federal funding for research at American universities appears clear, quantitative data on the levels, distribution and larger institutional effects of this relationship are hard to come by (Goldman & Williams, 2000). Forty years of data showing consistently high attrition rates and increasingly longer time-to-degree periods among doctoral candidates at American universities have not yielded much analysis by university administrators or by scholars of higher education. A recent, national examination of doctoral candidates' self-reported reasons for their attrition suggests such analysis is overdue for American graduate program policy makers (Lovitts, 2001).

The 20th century marketplace successes of American research universities in a knowledge-based world economy may have obscured academic and administrative interest in otherwise ominous indicators of institutional problems, such as the perceived decline in instructional quality by a variety of interested observers. While remedies that would address a possible decline of instructional quality at research universities have been both authoritative and articulate, they have not come from within the institutions themselves, and therefore have lacked the imperative for implementation. The Carnegie Foundation for the Advancement of Teaching revised its Classification System for Higher Education and sponsored a series of policy papers in order to raise the

institutional significance of the "scholarship of teaching" at American research universities (Boyer, 1990; McCormick, 1999).

One possible reason for a general institutional avoidance of grappling with the difficulties associated with examining the quality of graduate programs in higher education may be the fact that overall, since 1985, doctoral production in America has risen for 13 consecutive years (Sanderson, et. al., 1999). At Montana State University, however, from 1989 to 1999, doctoral production has remained essentially flat, despite a concurrent rise in research funding. As the Evaluation Committee of the Northwest Association of Schools and Colleges, Commission on Colleges, reported of Montana State University, "the data available for analyzing graduate affairs is scant," (Commission on Colleges, 1999, p. 37). The report stated that the (then newly hired) graduate dean of Montana State University "is aware of the need to develop longitudinal studies for understanding admissions and retention activities, developing data bases, as well as creating alumni satisfaction surveys to aid in the assessment activities and program review area," (Commission on Colleges, 1999, p. 38). While this literature review has found a general dearth of data and methods for analyzing graduate affairs, this particular study, as an examination of the apparent disconnect between research activity and doctoral production at Montana State University, has been hindered by an absence of

institutional data collection in the College of Graduate Studies of Montana State University.

The College of Graduate Studies should not be singled out in this regard, however. In its conclusions to its 1999 accreditation study of Montana State University, the committee from the Northwest Association of School and Colleges' first two concerns addressed that of Planning and Effectiveness (Standard 1.B) and Educational Program Planning and Assessment (Standard 2.B). With regard to Standard 1.B, "there is no clear perception about how the two planning groups, the Strategic Planning Budget Committee and the Long Range Planning Committee, interface as well as to how the recommendations of those two groups are used by the President's Executive Committee," (Commission on Colleges, 1999, p. 58). With regard to Standard 2.B, the committee noted that while there "are examples in some colleges that assessment has influenced decision-making...there was no evidence that assessment has influenced decision-making and resource allocation on a systematic basis throughout the organization structure" of Montana State (1999, p. 58).

Areas for Further Inquiry

Student evaluations of graduate instruction at Montana State University would have been included in the quantitative component of this study, if these data were usable

by the researcher. Trends in aggregate Montana State University student evaluation scores on graduate courses by college or department might have revealed, from a student perspective, some effect on graduate instruction within departments with rising research activity. One Montana State University English professor recently published an opinion column in the Washington Post in which he argued that student evaluations of instructors are used to determine "whether instructors deserve pay raises, retention, tenure and promotion," (Trout, 2000). One point not raised in the newspaper piece was that if Montana State administrators are using student evaluation data, they are drawing upon widely divergent methods for evaluating instruction (Boom, 2002). At least 10 Montana State University departments used individual, internal methods for gathering student evaluation data, while another 10 or so used one standard set of questions with which to collection evaluation data: A third form is used by nearly 20 other Montana State University departments. The use of these different methods for gathering student evaluation data did not break down in any disciplinary way. Departments within a single college, such as Engineering, used either their own survey, or one of the two more standardized student evaluation forms. Such disparities and lack of disciplinary cohesion in the collection of student evaluation data made it beyond the scope of this study to attempt a descriptive analysis of aggregate student evaluations during the period of robust growth in research activity at Montana State University. If Montana State University

administrators use these data across the university for the evaluation of instructors, it would add significance to the task of reconciling and studying these data beyond that of providing only a description of those trends in relation to research activity. The further significance would be that, as a policy, whether the use of student evaluation data from widely divergent methods to assess instructor performance at Montana State University helped or hindered the integration of its research and teaching missions.

This study was limited to an examination of the effects of rising research activity on graduate education at Montana State University. The study was further limited by its focus on the doctoral degree, which was found in the literature to be historically tied to university research and graduate education. Doctoral degree production was found to be an increasingly significant measure for a university's Carnegie Classification (McCormick, 1999). An area not treated in this study was how expanding research activity affects undergraduate education at Montana State University. While the literature on this subject as a national phenomenon is generally rich, a study focusing on Montana State University in particular might be useful to administrators for policy planning purposes in much the same way this study hopes to be for graduate-level education. Like most American universities, Montana State University does not have a graduate faculty apart from a faculty that teaches its undergraduate students. Extending this study's examination of the effects of research activity on graduate education at Montana State

University to an examination of the effects on undergraduate education would be natural and perhaps fruitful to Montana State University policy makers. It was, however, beyond the scope of this study.

Technological change affecting assessments of instruction in higher education may be a fruitful area for further inquiry to this study. One traditional measure of the health of graduate study, for example, is a university's library holdings. Montana State University's 1999 accreditation evaluation committee reported that "graduate students complained about the lack of current scientific publications in the library and noted that this is a severe impediment to their research activities," (Commission on Colleges, 1999, p. 22). According to a representative of Montana State University's library administration office, the library has apparently increased its subscriptions to online scientific journals (no hard data were available for this study). Given trends of increasing scholarly electronic publication, Montana State University's investment appears well reasoned, though measures for the effectiveness of this approach to building scholarly library holdings have not yet been established (Wittenberg, 2000).

Another area for further inquiry to this study would be in the literature of higher education management, which increasingly takes an "industrial" or "consumer" approach to analyzing academic policies and university issues (Brewer, Gates & Goldman, 2001). One particularly intriguing approach defined university management strategies as either

“prestige” or “reputation” based. “There is no single model of excellence in the higher education industry. Both reputation and prestige are positive assets for providers of higher education,” (Brewer, Gates & Goldman, 2001: 133). Prestige “generators” have been defined by Brewer, Gates and Goldman as student quality, research funding and sports, who note the risks of pursuing prestige as opposed to reputation (e.g., focusing on better serving their local student consumers instead of competing with other institutions for prestige generators). The authors stated that:

The industry as a whole does not appropriately balance the benefits and costs of prestige seeking because all stakeholders are not accorded equal voice in resource allocation decisions. Traditional institutions are governed largely by administrators or tenure-track faculty members, who reap the benefits of prestige if the institution is successful, but bear few of the costs. The costs, instead, are imposed on current students, adjunct or part-time faculty members, private donors, and state taxpayers. The costs of prestige seeking can place tremendous strain on an institution’s financial health, leading to financial ‘crisis.’ This sort of crisis is a product of the institutions’ ambitions for prestige, rather than external circumstances, (Brewer, Gates & Goldman, 2001, p. 134).

Has Montana State undertaken a “prestige seeking” strategy by developing more than a decade-long growth in outside research funding? The authors pointed out that this strategy is often taken to protect the institution from “environmental or policy changes such as demographic downturns or cuts in state funding,” (Brewer, Gates & Goldman, 2001, p. 135). Was the political impetus behind the PQ&O Agreement an effort to bring Montana State University to better serve its students, representing a “reputation seeking”

or "customer service" strategy? A definitive analysis of the larger economic conditions that drive universities, and Montana State University in particular, toward either a prestige or reputation strategy was beyond the scope of this study.

Further examination of the literature describing the relationships between academic mentors and their apprentices within prominent and productive American science programs might have helped to reveal how certain faculty are apparently able to blend their teaching and research duties to the benefit of their students and their respective fields (Colbeck, 1998). Raising these personal relationships to the context of their institutions, policies that encouraged the productive blend of teaching and research might reveal specific incentives and policies used to maintain the health of the mentor-apprentice relationships (Krohn, 1992). Any institution that wishes to see its graduate students benefit by professional collaboration with mature, university faculty researchers would benefit from a further examination of this literature.

CHAPTER 3

METHODOLOGY

This chapter describes the participants, instrument and research design of the study. In order to assess how increased levels of faculty-directed research may affect graduate production at Montana State University, this study included both a qualitative and quantitative approach to gathering and analyzing data. Assumptions and limitations of the study, as well as its timeframe, are also described in this chapter.

Population

According to Montana State's Office of Institutional Research, Montana State University employs 886 faculty, which in the fall of 1999 included 522 full-time and 163 part-time instructional faculty and department heads, and an additional 201 faculty in research and service positions (Montana State University, 1999). For the fiscal year 1998-99 there were 570 tenurable faculty working at Montana State University and 350 nontenurable. During the same period, Montana State University recorded \$49,741,404 in grants and contracts: 66 percent from federal agencies, 22 percent from private corporations and foundations, and 11 percent from state sources. Enrollment at Montana

State in fall of 1999 was 11,753 students, which includes 10,542 undergraduates and 1,211 graduate students (Montana State University, 1999).

Qualitative Component

Selection of Subjects

This study began in the summer of 1999 with a meeting of the Dean of Montana State University's College of Graduate Studies and the researcher's doctoral committee chair in the Department of Education. The researcher conducted a supervised independent study that summer, producing a paper on the then proposed changes to the Carnegie Classification of Universities in the United States. After reviewing that work, the dean accepted a proposal by the researcher to conduct a qualitative study in the fall of 1999 that would investigate the relationship between faculty research and graduate study on campus. Under the direction of the dean and his doctoral committee chair, the researcher developed structured interview questions to be used with 11 distinguished Montana State University researchers selected by the dean's office.

The central and topical questions developed followed a phenomenological approach (Moustakas, 1994). In order to gain the cooperation and candor of the Montana State University faculty researchers, the data collected in the interviews are not attributed to individual researchers. The names of the researchers interviewed are not disclosed in

this study. Researchers were asked to describe the meaning of their work (central question) in relation to those they supervised in their laboratories (topical questions). These questions, and the explanation for their purpose, were sent in advance to the researchers to be interviewed (Appendix A). All of the researchers chosen for the interviews had generated large grants and contracts at Montana State University and all were in the natural sciences or engineering. The dean sent a letter of introduction and request for participation to the selected participants, both by electronic mail and by interoffice mail (Appendix A).

Materials

The 11 selected participants were asked to contact the researcher in order to schedule an interview or to send electronic or regular mail responses to the interview questions. Eight participants responded by setting up interviews with the researcher, who took extensive notes using a laptop computer. The interviews, lasting between 45 minutes and 2 hours, were recorded and professionally transcribed. Three of the selected participants did not respond either to set up an interview or to submit written answers to the questions sent to them.

Instrument

A phenomenological approach was applied in the development of the interview questions (Creswell, 1998). The first four, main questions were open-ended and asked the individual participant to describe the meaning of his or her research on campus (Appendix A). The Dean of the College of Graduate Studies and the researcher's doctoral committee chair reviewed and helped to develop these questions. Participants were also asked about their work in relation to three levels of students: 1) postdoctoral; 2) doctoral; and 3) masters and undergraduate. In addition, there were two questions that asked the participant to estimate the hours per week spent in contact with these levels of students and in different kinds of academic activity (i.e. research, teaching, administration and a self-defined 'Other' category). The seventh question asked for any additional comment that the participant might like to make. Participants who responded revealed a ready willingness to describe and interpret their work as researchers and teachers in response to the first four questions. These four main questions were:

1. *What does your current research mean to your career?* Please be expansive about the origins of your research in relation to your academic training and your current faculty position at MSU. Include some consideration as to where the research may take you, career-wise, on or off the MSU campus. (If you are responding in writing, please think in terms of 5-7 sentences for an answer to this and the following three questions).
2. *What does your current research with postdoctoral researchers mean to you (if applicable)?* Without naming anyone, please describe your general

working relationship with these researchers. How do you expect their current research with you to affect their respective academic or non-academic career goals, as you understand them?

3. *What does your current research with MSU doctoral candidates mean to you (if applicable)?* Without naming anyone, please describe your general working relationship with these students. Specify whether you serve on any doctoral committees for them and how you expect their current research with you to serve their intended career goals, as you understand them.
4. *What does your current research with all nondoctoral MSU students (i.e., non-degree, master's and undergraduate) mean to you (if applicable)?* Without naming anyone, please describe your general working relationship with these students. How do you expect their work with you to serve their intended career goals, as you understand them?

Data Analysis Strategy

Interview data were analyzed using the "constant comparative method" of Guba and Lincoln (1985). Individual faculty responses to the interview questions (Appendix A) varied widely, reflecting the open nature of the four main questions. Instead, themes emerged from an analysis of the statements made by the faculty researchers. The researcher isolated statements from all of the interviews into the smallest possible categories, without any predetermined limitation on the scope of the emerging themes. Since faculty responses included statements not directly related to the structured interview questions, as is desired in the phenomenological approach taken in gathering the data, emerging themes were not limited either to the scope of the interview questions

or the literature review. Faculty statements were sorted from the smallest possible categories into emerging themes (see below). The following procedures were used to sort statements within the categories into themes:

1. Comparing incidents applicable to each category. The researcher systematically scrutinized the interview data to find patterns and relationships. Using notes taken on a laptop computer during the interviews, taped recordings of the interviews and transcripts of the interviews, the researcher kept separate, word-processed files on each of the interviews and for each of the themes emerging from the sorting of faculty statements into categories. Interview data was constantly compared during the analysis and arrangement of statements into categories and then themes. Ambiguous or unrelated remarks from the interviews were noted separately from the emerging themes.

2. Integrating categories into themes. The sorting of faculty statements into the smallest possible categories allowed themes to become apparent to the researcher. Several smaller categories could be collapsed into an emergent theme. At this point, the structured nature of the interview questions, as well as the literature review, enabled the researcher to place faculty statements into larger, thematic context.

3. Delimiting the theory. By consolidating the number of categories of faculty statements, the emergent themes were strengthened with supporting data.

During the interview data analysis, the researcher checked faculty references to university documents and institutional history by either locating specific documents, reviewing additional literature of the problem or by calling a university official to confirm the references made by the faculty. The researcher also relied upon regular meetings and correspondence with the Dean of the College of Graduate Studies and the

researcher's doctoral committee chair for ongoing outside verification of the interpretation of the interview data.

Validity and Reliability

Validity in phenomenological research depends largely on whether the theme or themes developed from the data are well grounded and well supported (Creswell, 1998).

"Does the general structural description provide an accurate portrait of the common features and structural connections that are manifest in the examples collected?"

(Moustakas, 1994, p. 58). Moustakas identifies five questions used in this study to validate the researcher's interpretation of interview data:

1. Did the interviewer influence the contents of the subjects' descriptions in such a way that the descriptions do not truly reflect the subjects' actual experience?
2. Is the transcription accurate, and does it convey the meaning of the oral presentation in the interview?
3. In the analysis of the transcriptions, were there conclusions other than those offered by the researcher that could have been derived? Has the researcher identified these alternatives?
4. Is it possible to go from the general structural description to the transcriptions and to account for the specific contents and connections in the original examples of the experience?
5. Is the structural description situation specific, or does it hold in general for the experience in other situations? (Moustakas, 1994, p. 57).

Verification procedures of phenomenological research rests largely on the work of the researcher (Creswell, 1998). This researcher systematically coded the comments

made by eight prominent Montana State University faculty researchers and looked for patterns of emphasis in the whole body of responses they had provided in the interviews. The researchers spoke for themselves on the subjects of broadly worded questions about the meaning of their work. Outside reviewers serve to confirm patterns in the researcher's organization of the interview data (Dukes, 1984). This study relied upon Montana State University's Dean of the College of Graduate Studies and the researcher's doctoral committee chair, who met weekly to review the data collected and analyzed by the researcher. The researcher's field notes were read and analyzed before these meetings. Areas of possible personal prejudices or personal judgments by the researcher were bracketed off in the notes. Tapes of the interviews were submitted to a professional word processing service, which produced verbatim transcripts. The researcher analyzed each of the tapes and transcripts for all possible meanings. The researcher used this analysis and the analysis of outside reviewers to identify four themes from the interview data:

1. Research and teaching duties are viewed by participants as unified: either inseparable or not worth separating.
2. Postdoctoral, doctoral and nondoctoral researchers are treated individually by the principal investigators (i.e., faculty researchers) according to their respective abilities to function in the laboratory.
3. MSU's administrative assessment of faculty teaching and research appears to be viewed by the participants as mostly harmless and necessary. Faculty with 100 percent research appointments, however, are seeking to formally represent themselves to the Montana Board of Regents for the purpose of being included in departmental calculations of instructional productivity.

4. Participants found state financial support for research lacking at MSU, though opinions regarding the actual effect on the institution of this lack of support ranged from negligible to serious.

The themes were ranked according to the frequency and focus of their appearance in the statements of the participants. The theme that emerged most significantly in the analysis of the participants' statements was that they performed research and teaching duties as a single, unified activity. Participants viewed research and teaching as deeply and intrinsically integral, not as incompatible. The strength of the qualitative results of this phenomenological approach, to be presented in chapter 4, "depends, in part, on whether the researcher can subsume them under other data," (Creswell, 1998, p. 207). A phenomenological approach employs the use of a very open, central question, followed by somewhat more topical interview questions (Creswell, 1998). The second component of this study will attempt to subsume the results of the phenomenological approach under descriptive institutional data from Montana State University.

Quantitative Component

Rationale for Quantitative Component

The results of the qualitative component of this study revealed that the Montana State University faculty researchers interviewed see themselves as employing an integrated approach to fulfilling their teaching and research duties. In addition, faculty

articulated a common belief in that integration for the success of both teaching and research duties. The qualitative study was limited to the Dean of the College of Graduate Studies selection of Montana State University faculty researchers who may not be representative of the approach to research and teaching taken by their colleagues. Moreover, while the theme of an integrated approach to research and teaching at Montana State University emerged from the respondents in the qualitative component, evaluations of instruction by Montana State University graduate students were not usable for this study (see Further Research, ch. 2).

Invalidity and Minimization

The quantitative component of this study proceeded from an assumption that faculty at Montana State University, as the qualitative component of the study suggested, might well integrate research and teaching. The qualitative study's results are not generalizable to the whole of Montana State University's campus, and the respondents' approach to research and teaching may not be widespread among the majority of Montana State University faculty. The quantitative component of this study sought to compare the faculty-centered results of the qualitative study with campus-wide data on graduate degree production. Other data that would indicate a robust graduate program in a particular department are described in the following section.

Procedure

In order to collect graduate degree production data during the increased faculty research activity at Montana State University from 1989 to 1999, the quantitative component of this study described trends in Montana State University's graduate student enrollment and doctoral production. The quantitative component also described a number of variables pertaining to Montana State University's graduate students by college, and compared those variables to the grant and contract levels at Montana State University by college. These variables included:

1. Doctoral Degree Production Figures by College
2. Doctoral Degree Candidates by College
3. Grant and Contract Activity by College
4. Grant and Contract Dollars per Doctorate awarded by College
5. Number of Postdoctoral Researchers
6. Number of Graduate Teaching Assistants
7. Number of Graduate Research Assistants
8. Number of tenured or tenurable Instructional Staff
9. Number of non-tenurable Instructional Staff

Analysis Strategy

If research was benefiting graduate students at Montana State University, then, based on the literature, one would expect to find an increase in the doctorates awarded with the increase grant and contract activity at Montana State University. Other factors

remaining constant, such as graduate candidate recruitment efforts and an offering of graduate stipends proportional to increased departmental expenditures, one would expect increased research budgets to bring a concurrent rise in the number of doctorates awarded by Montana State University. If more graduate students were engaged in the topics and work generated by the research activity, then the numbers of postdoctoral researchers would be expected to increase at roughly the same rate as the number of doctoral researchers. Research activity was found in the literature to provide doctoral candidates with topics for their scholarly training, and to provide financial support for that training in the form of teaching and research assistantships. One would then expect to find the numbers of graduate assistantships on the rise in those colleges with increased research activity.

According to the results of the qualitative component of this study, faculty researchers interviewed see research and teaching as a unified activity at Montana State University. Since the results of the qualitative component resonate with the literature on the rationale for the historical development of university research and teaching, one would expect to find Montana State University faculty awarding increasing numbers of doctoral degrees as research activity expands. Similarly, if there were the connection between faculty research and graduate instruction at Montana State University found in the literature and the qualitative component of this study, then expanded research should

permit increased opportunities for faculty to work with graduate students. Instructional contact between tenurable, faculty researchers and Montana State University graduate students should be measurably rising with increased research activity.

Both research and graduate instruction are fundamental tenets of Montana State University's land-grant mission. While there is no proportional relationship set up for measuring the progress of the institution between these goals, most faculty are appointed to support both of these goals (as well as the third major tenet of service). No unwavering and direct correspondence between incoming research and a rise in doctorates awarded by Montana State University ought to be expected. Institutional data from Montana State University did not appear to show the expected correlation between research activity and graduate education that has been found in the literature (see Results, ch. 4). According to the institutional mission and the results of the qualitative component of this study, faculty research should benefit graduate instruction at Montana State University in ways measurable in the quantitative component of this study.

Assumptions and Limitations

The literature on the rationale for the structuring of American graduate programs, based originally on the German model of the 19th Century, strongly suggested that research is critical for graduate programs designed to produce new scholars. But has

current university research as sponsored by federal, state and private interests grown demanding to the point of excluding untrained researchers (i.e., graduate students) from the laboratory? The longest economic boom in the history of the United States may have contributed to the decline in applications for graduate programs in the physical sciences and engineering (Sanderson, et.al., 1999). This boom, coupled with tight market conditions for tenure track positions in these same fields at American universities, may have displaced graduate student teaching and research opportunities in those departments by the hiring of more efficient and otherwise unemployed postdoctoral researchers.

This case study is limited to Montana State University and should not be applied without due caution to any other university, even to peer universities as defined by like size, mission and enrollments. Montana historian K. Ross Toole has called Montana a "land of extremes" This epithet seems also to apply to Montana's political treatment of higher education funding. Montana charges its students the second highest tuition among peer institutions in Washington, New Mexico, the Dakotas, Idaho, Arizona and (first) Oregon, while providing the lowest margin of per student state funding compared to those same states (Great Falls Tribune, 2000). For these reasons, any connection made between this study of Montana State University and another institution should be made with caution.

Timeframe

The researcher's doctoral committee approved a pre-proposal for this study on July 6, 2000. The formal proposal for the topic was accepted on December 14, 2001. Data were collected between spring 1999 and fall 2001. This study was completed to meet the dissertation requirement of Montana State University's Department of Education doctoral program for an Ed.D. in Curriculum & Instruction (secondary emphasis) with a Minor in Administration.

Chapter Summary

This chapter described the participants, instrument and research design of the study. In order to assess how increased levels of faculty-directed research may affect graduate degree production at MSU, this study included both a qualitative and quantitative approach to gathering and analyzing data. Assumptions and limitations of the study, as well as its timeframe, were also described in this chapter.

CHAPTER 4

RESULTS

Chapter Introduction

This chapter presents the qualitative and quantitative findings of the study, beginning with analysis of the qualitative data. The qualitative data were gathered in structured interviews with Montana State University faculty researchers in Engineering and the Natural Sciences, who were selected by the Dean of the College of Graduate Studies.

A phenomenological approach was used in the collection of the qualitative data, in which these researchers were asked to describe the meaning of their own work (Creswell, 1998). The names and departments of the faculty researchers are not provided here, as agreed before the interviews in order to maximize the candor and cooperation of the participants. All participants are referred to with a pseudonym and the pronoun "he," although two of the eight participants were female. Disciplinary-distinctive details of the interviews have been avoided in the presentation of the results in order to protect the confidentiality of the participants, though in some cases this meant a regrettable loss of depth and richness from their original statements. The quantitative data, gathered from

institutional sources with permission, are presented in tables in this chapter and in figures in Appendix B. As per instructions of the primary consumer of this study, the quantitative data are not analyzed using statistical methods. The discussion section of this chapter addresses the significance of both the qualitative and quantitative data.

General Results of the Qualitative Data Analysis

The analysis of phenomenological research rests largely on the work of the researcher (Creswell, 1998). This researcher systematically coded the comments made by eight prominent MSU faculty researchers and looked for patterns of emphasis in the whole body of responses they had provided in the interviews. The researchers spoke for themselves on the subjects of broadly worded questions about the meaning of their work. Outside reviewers serve to confirm patterns in the researcher's analysis of the data (Dukes, 1984). Outside reviewers relied upon were Montana State University's Dean of the College of Graduate Studies and the researcher's doctoral committee chair, who met or corresponded weekly during the data collection period in the Fall Semester of 1999.

As Guba and Lincoln describe, these individuals served as outside verification for the analysis of the interview data (1985). The researcher followed the data analysis procedure described in chapter 3 before verification meetings took place. Areas of possible personal prejudices or personal judgments by the researcher were bracketed off

in his notes. Tapes of the interviews were submitted to a professional word processing service, which produced verbatim transcripts. The researcher analyzed the data from each of the interview tapes and transcripts for all possible categories of meaning. The researcher used this analysis along with the verification of the interpretation by outside reviewers to identify four themes from the interview data:

1. Research and teaching duties are viewed by participants as unified: either inseparable or not worth separating.
2. Post-doctoral, doctoral and non-doctoral researchers are treated individually by the principal investigators (i.e., faculty researchers) according to their respective abilities to function in the laboratory.
3. MSU's administrative assessment of faculty teaching and research appears to be viewed by the participants as mostly harmless and necessary. Faculty with 100 percent research appointments, however, are seeking to formally represent themselves to the Montana Board of Regents for the purpose of being included in departmental calculations of instructional productivity.
4. Participants found state financial support for research lacking at MSU, though opinions regarding the actual effect on the institution of this lack of support ranged from negligible to serious.

Research and Teaching as Unified Activities

The themes were ranked according to the frequency and focus of their appearance in the statements of the participants. The theme that emerged most significantly in the analysis of the participants' statements was that they performed research and teaching duties as a single, unified activity. Participants viewed research and teaching as deeply and intrinsically integral, not as incompatible.

In addition to frequency of mention of the dominant theme, participants' voices were often passionately raised when discussing the unity of their teaching and research. Nearly the first words from Dr. Monday were about the "BS" that there is some tension between research and teaching. "It is a misperception perpetuated by people that haven't involved themselves all that much in research to realize how integral it is," Dr. Monday said, "Teaching is so ingrained, so much a part of the research, that they're really inseparable."

Dr. Monday went on to discuss his reasons for coming from a nationally recognized research university to his current position on the campus of a much smaller, land-grant university. Referring to a former campus administrator on his current campus, Dr. Monday said:

The vice president of research at the time realized that some of the great advances [in scientific research] were going to be made by interaction with people across disciplines, having different expertise, different but complimentary areas of expertise. So he was encouraging those kinds of interactions, whereas we were being discouraged, actively, at [the previous campus].

Dr. Monday later said there were many ways in which the administration on his current campus supported the entrepreneurial, multi-disciplinary, and collaborative nature of his research. And he included in his description of this research all of his work in the lab with post-doctoral, doctoral and non-doctoral (i.e., master's and undergraduate students) researchers.

Dr. Tuesday explained that as a distinguished researcher he was able to draw highly qualified students to campus and to gradually improve the overall quality of his department. "At this point we're bringing in junior people and mentoring them to become outstanding researchers and teachers," he said. "That'll catch on and it just mushrooms. And the students will come. Already in the short time I've been here I've seen an improvement in the students, certainly in the ones that have worked for me." Dr. Tuesday was somewhat frustrated by the lack of support for infrastructure for his department from the campus. "It's my feeling that with me here, we should be able to attract really outstanding young people and develop an outstanding program in [participant's disciplinary area]. Then when I retire this thing can move forward and [the university] will be that much better."

Dr. Wednesday said "there is a natural element in this profession that's something that comes together in the teaching. We cannot separate [research and teaching] in my opinion. While you can, the result wouldn't be something desirable." Dr. Wednesday did not formally account for the level of the students in his organization of the laboratory. "I'd rather stand on the line and see how people perform and then look at them assuming certain positions I'm happy with rather than trying to impose my vision on them." Dr. Wednesday said leadership in the laboratory emerges according to the performance and personality of the individual student rather than according to the level of training of the

student. He corrected himself slightly and said, "I've never seen it in the case of undergraduate students." Wednesday said students seem to establish their own identities as researchers while working in his laboratory.

Dr. Thursday also placed more significance on the individual student rather than on the level at which that student entered his laboratory. "Any student that comes into the lab, I spend anywhere from one to three weeks with them in a classroom setting. I've had undergraduate students that have been beyond some of our Ph.D. students and I haven't had to spend a lot of time just going over concepts. Whereas others, I've had to spend a lot of time." Dr. Thursday went on to describe a new undergraduate degree offered by his department, in which there is:

An incredible integration of the research and instructional programs. We've been successful in acquiring a very large amount of money for purchasing equipment for our research efforts. We tied that hand in hand with developing some new teaching labs, in which we're getting students into the research lab, not on an individual basis, like has been done historically, but with large numbers of students. We have created some state of the art teaching labs, which are essentially an extension of our research labs. This whole thing was made possible by the research. So integration [between teaching and research] is increasing and is more extensive now than it probably ever has been [on this campus].

Thursday added that, "there's now been increased efforts in taking the research program in which instruction is inherent and integrating it more with classical teaching programs."

He went on to say:

It's kind of semantics in what terms you're looking at, but if you look at it in that fashion, instruction has always been done with research and vice versa. Now the research programs are integrating more directly with the actual teaching programs. That's just increasing in virtually every university across the country. It's not unique to MSU, but it certainly is taking place here.

Dr. Friday said the number of faculty members on campus who have 100 percent research appointments has doubled from about 25 to 50 in the last four years. "It reflects the growth of research on campus and the fact that the research labs are now getting to the point that they are active enough that they need more people at that level. I think we've just been barely recognized for the first time in getting our own faculty council."

Dr. Friday, who said he values students of every level in his lab, added that "you couldn't teach a reasonably high level class in any of the scientific disciplines if you didn't do research. There's no way of keeping up. You'd be short-changing the students." Dr. Friday went on to say that, without a university research program, "you have a glorified high school. And I don't think that would be good for the high schools or the universities. They fulfill a different job."

Dr. Saturday said when he first came to campus, the university did not distinguish between research faculty and tenured faculty as far as teaching went, as far as productivity of the university was concerned. "This was imposed later," he said. "I was blind-sided by that." Dr. Saturday said that new rules imposed upon the campus by the workload definitions of an agreement negotiated at another campus in the state calculated

departmental teaching requirements without consideration for faculty with 100 percent research appointments who also teach. These researchers would then be seen as unproductive. "I'm certain that the [state governing board] did not anticipate the pressure to exclude research faculty when they imposed that rule." Dr. Saturday said that adjunct teaching faculty are also not counted in the new required state calculations of departmental workload. He added that the reason he came to the campus was to teach. "They offered me a chance to teach in addition to doing the research, so I moved, picked up my roots and moved, to get here and be able to teach. And a few years later that went away."

Dr. Sunday described his research and teaching duties as balanced.

When I teach in the classroom, I use my experience in research and my background in certain areas to teach the various courses I do. The other thing that I do in my teaching is to talk about areas of science or areas of investigation that are outside of my own research area. So, I actually use my teaching to help me put my research in perspective. Teaching in some ways motivates me to stay current in a lot of other fields that aren't directly related to my own specific research area. The other kind of teaching I do is teaching on an individual level, undergraduates, graduates or postdoctoral fellows. There the teaching is much more on a personal level. It's a one-on-one teaching situation, in which we design experiments and do problem solving together

Dr. Sunday said he chose his current university position "because of the requirement and interest that the faculty be actively engaged in research." Dr. Sunday went on to say:

If I didn't do research, I don't think that I would be able to understand and present material that I think is very current to the students. I wouldn't have the motivation

that I get from doing my research to stay on top of the field. I would probably teach what's in the textbook and nothing more, which I feel is a real disservice to students who want to get real information.

Dr. January said he treated his students according to their ability to perform in the laboratory, rather than according to the level of education they had attained.

With doctoral candidates there is a lot more mentoring [than with post doctoral researchers], but it ranges. That's very dependent on the quality of the student and what they bring in. I have one student, who is actually very early in her career, but the interaction is more like with my postdocs than with some of my graduate students.

Dr. January went on to say that "as a faculty member, there's of course a learning experience there, both on the instructional and the research side. You learn an awful lot through teaching and learn where the holes in your knowledge are. And you learn that you need to do good preparation in order to do your job."

Dr. January said he wanted to come to an institution:

That valued teaching as well as research. I have heard of people in very research oriented institutions. If their student evaluations are too strong, other faculty will come and say maybe they're spending too much time on that teaching. I did not want to be in that situation. I wanted to be in a situation where I felt I could pursue doing quality work in both areas.

He added:

I have trouble seeing how you can stay stimulated and remain being a stimulated instructor if you weren't somehow involved in some sort of creative activity. That creative activity doesn't necessarily have to be cutting edge research in your discipline. It could have to do with novel educational methods, or keeping current

with journals in your area. But it seems to me there has to be some sort of currency and creative activity to keep you fresh.

Postdoctoral, Doctoral and Other Students in Research

Dr. January described his shift from an otherwise successful research area to a more applied area as benefiting interest among graduate students. "The applied bent seems to generate more interest among graduate students, so it's easier to recruit graduate students into the group than it has been in the past," he said. "So the career implications are larger funding, the potential for getting involved in patent, or royalty returning situations which didn't exist in my other area." Dr. January went on to say that the administrative component of his job "probably opens up clear opportunities on this campus and other campuses that, to be truthful, I probably won't pursue. I want to keep a research component rather than go strongly administrative."

Postdoctoral researchers are given more laboratory responsibility due to Dr. January's administrative duties. "I'm trying to give some of the postdoctoral fellows more responsibility for day to day operations in the labs, so the students have access to somebody who can answer questions in a shorter time," he said. "I still do have almost daily contact with all of my students and postdoctoral fellows..." Dr. January went on to say that "with doctoral candidates there is a lot more mentoring, but it ranges." He added

that, with doctoral candidates, it is:

Very dependent on the quality of the student and what they bring in. I have one student, who's actually very early in her career, but the interaction is more like with my postdocs than with some of my graduate students. But with graduate students, I find more mentoring, more training, and then hopefully later in their career it develops to this point where we have discussions and debates over what's going on in our work.

Dr. January said that he serves on the committees of every graduate student in his laboratory working within his own area of research. "I think that's the convention university wide and probably nationwide," he said. "I have three doctoral candidates at the moment, 2 masters, 2 postdocs, and as of right now, no undergraduates. And that's a little unusual. I usually have one or two undergraduates as well." January pointed out that as a terminal degree a bachelor's degree in his field is not really that good, "you're basically a technician if you work in your field." He reflected upon his own scientific training. "One of the things that happens in graduate school with the good students that end up with strong careers in science is that at some point they run into a problem that they only solve by virtually total immersion in that project. I've talked to a number of people in related fields and they express a similar experience..."

Dr. Sunday said, "having a postdoctoral fellow in your research group or your laboratory is like having another, basically, fully fledged scientist." He said, "a postdoc is really a research peer. In many cases, they are as skilled as I am in certain research

techniques, in many cases they're skilled in other research techniques that I am not skilled in. I'm very interested in multi-disciplinary education, so I've had the opportunity of working with postdoctoral fellows who are [in a related field]."

Sunday said a Ph.D. student usually spends five to six years in laboratories.

"That's a very long-term relationship between the thesis advisor, the mentor and the doctoral candidate," he said.

It's almost like—they're almost like a member of your family, in some ways. What graduate students have to learn is they have to make the transition from learning material from textbooks in a classroom setting. They have to be able to transition from that to being real independent thinkers from reading primary literature, which is reading research results of other researchers around the country. They have to learn to design experiments and they have to learn all the experimental techniques. So, unlike a postdoc who has a lot of experience, graduate students have to learn everything.

Dr. Saturday said that research work depends more on the student than the researcher. "It's more determined by what the student brings to and expects from the activity, rather than what the researcher does." He added, "The researcher can afford the opportunity to the student and help guide them through the activity, but you can't make someone learn or feel excited about something. It's something that comes from them, not from you." Saturday went on to say, "If the student is interested in the work and stimulated by it, great! It'll be a healthy experience for the student and valuable to the research project. If the student takes the job because they want to earn a little money and

they're really bored and don't care, they are not going to be of any value, even if they do an excellent mechanical function."

Dr. Friday said he would not like to work for a high technology company or a commercial firm in his field. "I wouldn't like not to be around students," he said. "Never underrate the value of having a whole bunch of young minds." Friday went on to say, "I don't think it's fair for research labs to function without giving undergraduates the opportunity to come in...getting them interested in research labs and getting them more equipped for getting a good job when they get out with their degree." He said of doctoral students that, "they've chosen to come work under you." He added:

How they relate to you is more like now you're the wonderful person at everything and can teach them everything to begin with...By the time they're getting close to finishing they should know more about their area than you do. So you have this transition...Once they've graduated they come back to visit and we still work with a number of them. That's been one thing that I've been very happy about. But, it's a strange relationship.

On postdoctoral researchers, Friday said "at one time postdocs used to be a situation where somebody was coming to work in the lab, providing the lab with their expertise." He added, "It's sort of evolved from that into being sort of a super training situation...My research spans areas in which I have absolutely no expertise, but we still need the work done, so I have to hire someone to do that."

Dr. Thursday's view of postdoctoral researchers was close to that of Friday's.

"With a postdoc, you're looking at somebody who's already developed expertise in a given area." He went on to say, "In my interactions with a postdoc, it's much like my interactions with a faculty member, discussing science and interesting questions. I do not look at a postdoc as someone that I have to go in and tell them exactly what to do. I expect independence from the postdocs." Thursday contrasted this with doctoral candidates. "With a graduate student, it's kind of a step-wise progression. The initial interaction is really a very detailed training interaction where I spend in a classroom-type setting from one to two to three weeks, just going over the concepts and the terminology and the working model..." Thursday said that, "what I'm looking for in that Ph.D. candidate is somebody who is creative and can generate their own ideas. So, as early as I can--and this varies from student to student--I try to get them on a very independent line of work, where they are pushing themselves, not necessarily me behind them pushing."

Thursday said he meets with postdoctoral researchers and Ph.D. candidates together on a regular basis. "Then I interact with them on an individual basis going over some of their data in detail, or going over their writing if they're writing a thesis or paper." He added, "That's done on an unscheduled basis, but virtually every single day there's a significant amount of time devoted to that." Thursday said there has been an "incredible integration of research and instructional programs" in his department.

We've been successful in acquiring a very large amount of money for purchasing

of equipment and so forth for our research efforts. We tied that hand in hand with developing some new teaching labs, in which we're getting students into the research lab, not on an individual student basis, like has been done historically. We're trying to do it with large numbers of students. We have created some state of the art teaching labs, which are essentially an extension of our research labs. This whole thing was made possible by the research. So that integration, in my view, is increasing and is more extensive now than it probably ever has been at MSU.

Dr. Wednesday said that because students move through ongoing research programs in his department, postdoctoral researchers help maintain a continuity in the laboratory. "The students are developing the expertise and the students disappear and there is no bridge between the first student and the other. So this is one role that postdocs fulfill. They bridge the gap." Wednesday said that "by definition" postdoctoral researchers are more mature researchers compared to doctoral candidates.

Doctoral candidates need more supervision, occasional supervision, more consulting time and more coaching perhaps. So they do chunks of independent work, while the postdoctoral research associates can actually take care of larger pieces of research by themselves. But it varies from person to person... Sometimes doctoral candidates are so exceptional that they can take care of larger blocks of research by themselves.

Wednesday said undergraduate students in his laboratory are usually paired with a mentor. "It's either one of those more mature graduate students or perhaps doctoral students. I'm not sure supervise is the right word, but somehow coaching them in what they do, so they have someone that they can immediately talk to without making an appointment and waiting a day or two."

Dr. Tuesday said that career opportunities for postdoctoral fellows and doctoral candidates are the same in his laboratory.

If a young man or woman comes to me as a postdoc fellow, and they work in my lab and allow me to continue to mold them and develop them into a top-notch scientist—if during their tenure with me they're hardworking, productive—then in terms of their careers, they have unlimited possibilities. This is true with my Ph.D. students. In fact, my Ph.D. students are probably better than the postdoc associates I have with me, because I trained them.

Tuesday went on to say,:

The doctoral candidates tend to be your pride and joy. They're the ones you spend the longest time with. They're the ones that you mold into...my own Ph.D. students probably mean more to me because they really represent a product produced under my guidance. Whereas, opposed to a postdoc, who really gets his training elsewhere and he comes in, basically as an unknown.

Tuesday said that only about 50 percent of the students that work with him finish their Ph.D. He added, "There's been over the years a number of postdocs who just didn't cut it and I had to say that it's really best that we part. I don't like to do that, but if you have too many of these people and there's no productivity, what happens three years down the road and your grants don't get renewed and you're in serious trouble."

Dr. Monday said finding graduate students is a challenge at Montana State. "We find it hard to get the number of graduate students we'd like to have," he said, adding that his laboratory had recently developed a successful grant for a graduate research-training program to increase the numbers. "The postdocs and graduate students are the people that

do the bulk of the work that gets published in research papers that come out of my lab," he said. "The postdocs are more independent and can work with pretty much very little supervision. The grad students need more supervision and spend...half of their time learning how to do stuff and then half doing it." Monday said he treated all student and postdoctoral researchers the same. "I treat them all on kind of the same level of respect," he said. "You have to treat people as peers. Everybody is able to contribute something. It's just a matter of how much help you have to offer them to get them to the point where they can really do something creative that they feel really good about." Monday went on to say, "I probably have to spend four times as much time with a grad student than I do with a postdoc. There, it's three-fourths of the time helping them and a quarter of the time we're kind of helping each other, maybe struggling through a difficult paper."

Montana State's Assessment of Faculty Teaching and Research

"The deans here were really supporting interaction with people across disciplines, different expertise, different but complimentary areas of expertise," said Dr. Monday. "In fact, they realize that places like MSU could actually get a jump on some of the big universities, like Berkeley, MIT, Harvard, Stanford, places like that." Monday said larger universities want to restrict faculty interactions "to within a single P.I.'s [principal investigator] lab or to within the university, both for accreditation, but also for another

important reason." Monday went on to describe this reason. "It used to be just 'publish or perish.' Now it's 'patent or perish.' A lot of the sciences and what used to be considered strict academic sciences are now involving themselves in some kind of enterprise."

Monday said larger universities limit faculty interactions for institutional accreditation and individual tenure evaluations, and to keep patent profits "all in the family." Montana State, he said, has not limited his interdisciplinary collaboration with faculty on and off campus. "MSU is great in both those respects and we figured we'd have more freedom to really come and set up and build a little enterprise here than we could if we remained at [his previous university]. In other words, we really felt the quality and quantity of our research programs could increase here."

Monday said two Montana State faculty members have publicly argued that research negatively impacts instruction on campus.

They've decided that, in fact, that they are going to show—it seems to me—that the increase in research dollars coming in to the university has a causal relationship with the decrease in whatever they define as good about the university. They'll plot these things against the other and show a trend and insist that there's a causal relationship.

Monday said he was surprised the argument had garnered so much publicity.

"Essentially," he said, "it's an embarrassment for the university."

Dr. Tuesday said he had spent the day of the interview working on administrative tasks. "From 9 a.m. up until 4 p.m.," he said, adding that he had no teaching

responsibilities for the semester. "I view teaching graduate students one-on-one as another kind of teaching," Tuesday said, "although there's no formal credit for that. But really that's probably the best kind of teaching one can do is one-on-one."

Dr. Wednesday said Montana State department heads and deans have statistical data describing faculty research and teaching workloads. "They are very close to this situation...so they have to have certain ways of keeping score of what is happening. At the level of the individual researchers, things are mixed together. There are sometimes annoying situations, but you don't really separate it clearly in your mind." Wednesday went on to say that faculty workload can be reduced to statistics, "how many papers per year people publish...how much homework students have a week, how many contact hours faculty members have with the students...It gives you an image. What the image means is beyond me to really say, because I don't know how to compare statistics from two different places. But it can be done, and it is done."

Dr. Thursday said, "it is almost impossible to separate out hours associated with research, teaching, administration, because in fact you are almost doing all three or four of them simultaneously." Thursday said he works with doctoral students individually. "That's done on an unscheduled basis, but virtually every single day there's a significant amount of time devoted to that. Then on top of that you've got to spend all your time making sure the research program is going, teaching duties are being done, and in my

case, my administrative duties are being done as well." Thursday said that during the semester in which the interview took place, his workload did not include teaching. "I don't have much of a teaching appointment," he said, "though I teach quite a bit."

Thursday described Montana State's instructional workload definition.

There was a target, which the university had to hit. Essentially it's the number of hours standing in front of a group of students at the undergraduate level and teaching. That certainly has impacted us. We have predominately research appointments. So when they calculate our effort it's based upon a fraction of the appointment. For example, I have a 10 percent instructional appointment. You simply take the number of credit hours that you're teaching and divide by your appointment. If you had 100 percent instructional appointment, you're dividing by one. In my case, you're dividing by 0.1, so if I teach 10 credits then I get 100. It comes out to the value of 100 on their workload scale.

Thursday said of the workload measurement, "There are lots of reasons why it's not good; there's a lot of reasons why it's probably better than other approaches." Thursday said that a faculty member must have some type of instructional appointment in order for teaching to count in Montana State's measurement of workload. "If you have 100 percent research [appointment]," he said, "you're going to divide by zero. So even though someone could be teaching 10 credits, their number will come out to zero if they're 100 research."

Dr. Friday identified himself as "research-track faculty." He said his appointment is at the associate professor level. "The only difference is that, essentially, I pay myself," Friday said. "I have to get enough grant funding to cover paying all the people that work

in the lab. That's the bad side. The good side is that I can work on whatever I want and I don't have any teaching commitment." Friday said that if his department is short of instructors in his area, he does teach, "but mostly it's just the people who learn from being students in the lab." Friday said that he was one of about 50 research-track faculty at Montana State, up from about 25 four years ago (1995). "It reflects the growth of research on campus and the fact that the research labs are now getting to the point that they are active enough that they need more people at that level. I think we've just been barely recognized for the first time in getting our own faculty council." Friday said that he did not think the state of Montana, in developing the measurement of faculty workload, intended for teaching by research-track faculty not to count. "What they were trying to do is put pressure on the research-track people to teach more," he said. "I think in our case, probably, our teaching will be counted in the future once we make our case to the Regents properly." Friday later added that his workload on Montana State faculty committees "is the same as tenure-track would be at my level."

Dr. Saturday said he also has a 100 percent research appointment at Montana State. "It's not the research that keeps me away from teaching," he said. "It's the fact that I didn't apply for a tenured faculty position. It's a purely administrative classification, nothing to do with qualifications or duties or desires or what have you. It's just the pigeon hole that my job title is in." Saturday explained his decision years earlier not to

apply for a tenure-track faculty position at Montana State. "It's an enormous hurdle of paperwork and form filling to go for that kind of position," he said. "It's a lot of wasted time, as far as I'm concerned. It doesn't make you a better teacher, or make you any brighter. It just takes up your time. And it wasn't required at that time." Saturday said that because no tenure-track position was open in his field, the semester during which his interview took place would be his last at Montana State University. "At that time [when hired at MSU], there wasn't any distinction between research faculty and tenured faculty as far as teaching goes, as far as the productivity of the university was concerned," he said.

Like Dr. Friday, Saturday said the exclusion of research faculty's teaching from Montana State's calculation of workload and productivity was not intended. "I, personally, think some of the measures--metrics--that they're using to establish the quantity of work, as it were, are arbitrary to a certain degree, and have had some unintended consequences," he said. "I'm certain that the Board of Regents did not anticipate the pressure to exclude research faculty from teaching when they imposed that rule." Saturday said that, in his view, a negotiated contract reached between University of Montana faculty and the Montana Board of Regents determined the workload definitions that excluded research faculty from being counted in measurements of university instructional productivity. "It seems the University [of Montana] and the Regents had

reached this agreement," he said, "and then, MSU was told, 'O.K., here's your agreement; you agree to this.'" Saturday later said that, while he would not question the motivation of the negotiators, he did not have a chance to vote on the implementation of the agreement at Montana State. "I got to read it [the negotiated contract]," he said, "but I didn't get to vote on it. And I don't think anybody else here got to vote on it." Saturday said the policy of not crediting faculty researchers for instruction is "inconsistent." He said, "If you believe that you need to do research to give vitality to your teaching, and if the function [of MSU] is to do teaching, then it follows that you should support research. But, if you won't let research faculty teach, then what's the point?" Saturday added, "It's somebody else's idea of the proper policy—not mine, but it's not my job to decide that."

Dr. Sunday said Montana State faculty "get very little credit for teaching laboratory sections." He said, "I spend an enormous amount of time teaching in the lab because I have to set the lab up, write the lab exercise, grade the lab exercises, be in the lab and answer all the students' questions who don't know what's going on." He added, "The time that they're saying we put into laboratories is vastly under—it's a low estimate." Sunday said Montana State's assessment of faculty instructional productivity does not take into account out-of-class teaching. "Because it's not classroom teaching," he said, "somehow it doesn't get counted under teaching. But in fact, even though I impact fewer students, I think it's equally valuable if not more so." Sunday went on to

say that "there's no recognition or value placed on the other type of teaching [outside the classroom] that we do, which is the one-on-one instruction with either undergraduates or graduates or postdocs." Sunday said that, in his field, with only an undergraduate degree, "there's not much you can do." He added,

You almost always need either a Master's degree or some kind of technical training that goes beyond what we offer here in order to get a job that's worth it. I really feel it's part of our mission to offer additional training to students who really want a good job. I think we can do that because we are a university and our faculty does research.

Sunday stated that, as a university, Montana State has three roles: teaching, research and service.

Every faculty member should be actively engaged in all three of those activities. However, if you turn the tables and say the only thing that counts is classroom teaching, then suddenly the scales get tipped and research--there is no measure--it doesn't even enter into the equation at all, neither does advising or mentoring or any of the other things that we can do.

Sunday cited a measurement of faculty workload from his field at the University of Oregon. "Every faculty member has a teaching load of five whole courses per year," he said.

They get one course reduction if they have a funded research program, which means a peer-reviewed, nationally competitive research program. They get another course reduction if they have graduate students and postdocs in their lab. They get another course reduction if they're training undergraduates in their lab. This comes out to be about one course each semester, which for a nationally competitive active research scientist is, I think, a reasonable teaching load.

Sunday said that Montana State does not have a measure that includes out-of-classroom teaching. "We have these departmental averages that we're supposed to meet and there's all kinds of other teaching that isn't counted," he said. "I think they need to incorporate into the counting measure—if they are going to use some kind of counting measure—the number of students in the course." He added, "Even though it's the same number of hours in the classroom, in terms of the numbers of students impacted and the amount of extra work there is to do, it's not equitable at all. That's not in the formula."

Sunday said Montana State's cap on the number of credits for undergraduates, along with the requirement for undergraduates to sign up for research credits if faculty are to be credited for teaching, is also a problem. "Many students will simply run out of research credits and will be unable to continue on in doing their research," he said, "if their mentor really needs those credits to reflect the work that they're doing in terms of mentoring."

Sunday said faculty workload measurements at MSU "have been used as ammunition as either trying to increase teaching loads in some colleges, decrease teaching loads in other colleges, or to impact how dollars should move between different colleges." Sunday added, "I just see it as, frankly, a ridiculous measure because it measures so little of what we really do, and also what we're required to do, as faculty."

Dr. January, like Dr. Sunday, said that in his field, "a bachelor's degree is not that good as a terminal degree." He added that, with a bachelor's degree, "you're basically a

technician if you work in your field. That's opposed to [another MSU department]. Their bachelor's degree is very much a terminal degree. They get hired at a salary comparable to what I'm getting now." January said that Montana State does a good job of exposing students to current science. "We have state of the art technology available," he said:

But we still have undergraduates that can access it. That's something that this type of institution does better than the liberal arts college, which gives great individual attention but doesn't typically have the cutting-edge research available. If you go to the Research I level of institution, they're cutting edge or beyond where we might be in many cases, but often the undergraduates are not involved in the research laboratory.

State Support for Research at MSU

Dr. January said he changed his research field from his graduate thesis topic, albeit to a related one. "The current research area is much more applied than the area that I did my graduate thesis work in," he said. "That has multiple career implications, one of which is that by going into an applied area there are a lot more funding agencies that are potential funding sources." January said his new area increases the probability of finding funding for his work and increases the size of the program he can run. "So now I have more postdocs and graduate students than I was able to support in my previous work, even though my previous work was academically well received. I can also get larger student interest." January added that his current research also included the potential for a

patent or royalty, "which didn't exist in my other area." January went on to say that, while MSU is, in his view, an excellent university for his own desire to both teach and do research, "there have been some trade offs as a result." He said, "The resources here to do quality research are less." Although January said he would not want the "pressurized environment" of top-tier research institution, "some students here I don't believe get that total immersion that I was talking about [above]." He added, "We still get quality students here; we still get lots of quality work done. But there is an environmental issue there." January said there is freedom to pursue and employ outside resources at MSU. "It's also been my experience that if you can accomplish something on your own, usually the administration doesn't get in your way," he said. "In other words, you may not be able to get resources out of the administration, but if you can generate the resources on your own, it won't block you from trying to do something." He added, "That's not true in every institution."

Dr. Monday seemed to echo Dr. January's statement regarding an unhindered research environment at MSU. "We figured that we'd have more freedom to really come and set up and build a little enterprise here than we would if we had remained [at his previous institution]," Monday said. "In other words, we really felt the quality and quantity of our research programs could increase here. In fact, I think that they certainly haven't decreased. I think, now that we're getting things established here, that they will

be better than they could have, had we remained [at previous institution]." One feature of the environment at MSU, Monday said, was the unanticipated "negative attitude toward research on campus." He added, "That's been a definite hindrance to our teaching and our research careers. Anytime we have to spend dealing with that kind of BS detracts from the time that we spend with our students, or the time that we spend at the bench doing research." Monday attributed the "negative attitude toward research" to a "small but very vocal minority of people around campus, and specifically, on the faculty council that continually bring this up and present it in a way that makes it seem interesting and controversial, and continually try to get it in *The [Bozeman Daily] Chronicle*." Monday said, "The horrible thing is, as soon as somebody speaks out against those guys it amplifies this appearance that there is some interesting controversy on campus."

Dr. Tuesday, the researcher who said "graduate teaching and research are kind of viewed as one and the same," added that a lack of state support for research at MSU will prevent the benefits to graduate students and programs of an otherwise strong research program. "We [faculty researchers] can do wonders," he said.

But as I said before, we can only do this if the university will provide the resources and facilities—not only the university, but the state of Montana. The state of Montana has got to rank 50th in the support of higher education. That's a real problem. You can bring in five Nobel Prize winners, but if the resources and state support are not there, they'll do their own thing and nothing is going to happen.

Tuesday said the state of Montana will not "build anymore buildings, basically." He said, "Why should any multi-millionaire contribute \$50 million dollars to put up a new [Tuesday's field] building when the state of Montana won't put in a penny? Not to mention, that once the building is up, they won't maintain it. We have to put X million dollars in an endowment to pay for the janitors to clean it. This is insanity."

Dr. Thursday said that it is "very inherent here at MSU that every two years they are always fighting for money from the state." He said:

In the context of writing grants to get money for our own research, sometimes that's taken as a negative. I actually don't. It's frustrating to not get the grant, but to sit down and write out an idea and the experiments and so forth, that's just part of our profession. When in the past funding levels were so low that outstanding grants weren't getting funded, that was incredibly frustrating. But now, funding levels and some of the granting agencies have really moved up. These grants are getting funded. In my view, on the research side of things, frustrations have minimized in recent years at the grant level. Within the state--and this holds true across the board at MSU--just funding in general for the university itself, I think will always be a battle. It's very difficult for a state like Montana to support the number of universities and colleges that it has.

Dr. Friday said one frustrating aspect of his work is "the amount of red tape and writing and paperwork just involved in running a lab now." He said, "The budgeting is a real nuisance. That's an MSU problem...you couldn't possibly trust the university to do your budgeting for you. It's slightly suicidal." Friday said his laboratory has an accountant, and he does some accounting for the program as well. "We do a lot of things that I don't think I was trained to do, including accounting." Friday said, "essentially, I

pay myself. I have to get enough grant funding to cover paying all the people that work in the lab." Friday went on to say that "we get our own indirect cost revenues." He said, "We get a slightly higher rate back, individually. That's if we lose a grant and don't get refunded immediately, we have no income. It's there to kind of soften that kind of situation." Friday said another MSU faculty researcher, "is using all his indirect costs to actually build his project." Friday added, "Some of these people [MSU faculty researchers] are fairly big players in their own fields. When you say to write up a defining document I think it would be extraordinarily difficult, because we all have a slightly different situation and relationship to the university."

Dr. Saturday discussed the nature of his position at Montana State. "I'm a research professor," he said.

That means that I don't have a job that the state pays me. I pay myself by getting grants and contracts, and I also pay the state for the use of their property, like the room, the secretarial staff, the mail service, the lights and all that. It's called indirect charges. That's the cost of doing business. And because the university is a large organization that does a lot of that business, I can capitalize on economies of scale, and get by with something like, 60-70 percent total indirect burden on my salary. So my customer can get my services for a year for about 1.7 or 1.8 times my annual salary, which is considerably cheaper than it would be in private practice.

Saturday then went on to explain, at some length, the context of his work as a research professor at MSU:

Well, look, if a person is on a teaching contract, tenured faculty—tenured tract for teaching, their salary is paid by the state. Also, all the indirect costs associated with the employment of that individual, his housing, lights, telephone, office space, janitor service, toilet paper, etc...all those expenses are also paid by the state. Even if the person never did a lick of research. Now, in principle what the person is supposed to do is to apply for some research support for a portion of his daily activity, say 20 percent of his time one day a week, nominally, to devote to a research program. All right, then the sponsor of that research would be expected to pay for the salary of the individual, plus whatever instrumentation he's going to purchase and the expendables he'll use and all that sort of thing to do that research, *and* the indirect costs associated with his employment: housing and well-being at the institution. The people that cut the grass and deliver the mail and hoist the flag, they have to be paid. And part of his burden, of the research sponsor, is to pay their share. Well, those shares are determined by auditors, who go through the books every year and see what all everything cost. They add it all up, they assign some to indirect costs, some to direct, and then they form a ratio. That ratio is then what's used to calculate how much the indirect cost burden should be that's assessed in the research sponsor. Now, because all of this work is done at the margin, it's logical to argue from economic principles that marginal cost is, in fact, smaller. An increment of another little bit of work is smaller—that it has a lesser burden—than to do it from scratch. If the person does nothing but research, then 100 percent of this indirect expenses should be paid. If he does nothing but teach, then the teaching should pay it all. If teaching "Doug" pays for 80 percent of it, then it's not required to ask for the full other 20 percent from the research sponsor, because most of the incremental costs are much smaller than the total cost. So, it makes economic sense and it's fair. To that, I would say the government wouldn't say, "We won't pay 100 percent of your overhead burden." Say it's 42 percent, we'll only pay 40 percent or 38 percent. Because they worked it out their own heads some figure that said, "Ok, this would be fair." Well, fine. It turns out that they are correct, that a lesser remuneration is adequate, because on the margin it doesn't make that much difference. They take the secretarial salaries and add them up and divide that by my salary and say, "Ok, that's my portion of the secretarial pool of expense." But, they don't really care what I'm working

on. It's not going to change their salary or the flow of money from the state. So, if you do all the sums carefully, they really shouldn't have to pay all of it. But in the case like for me, I'm not paid by the state at all. They have to pay it all or someone else is going to have to pay it. See, there's nothing "in" it for the university, for the department, for the college for me to do research that's sponsored at 98 percent. There's nothing in it for *them*. It's just costing them the 2 percent. So unless they can make a case to the state that this is a good idea and that they should throw some more money our way to do that, they'd have to tighten their belt and do it in some other fashion.

Dr. Saturday said, "Research and outreach are fundamental to the mission of a land-grant university." Saturday added, "The State does fund, to a certain extent, that activity. By this method it's permitted then to direct how the indirect charge collection is to be distributed on campus and how it's to be employed. The only way they can exercise that control is that they're providing a good portion of it." Saturday explained that this semester would be his last at MSU. "It's just that in my particular case," he said:

For whatever reason, the [MSU] Vice President for Research did not see it his position to do the cost sharing. And the Dean of the College did not want to undertake the cost sharing. So as a consequence, it befell the department, which is the only, last step left—to underwrite the cost of sharing requirements in order to get the grant that I'm working on, and that's unfair. It literally takes paper out of the copying machine and keeps people on the faculty from going to technical meetings because the money isn't there.

Saturday added, "I can't ask the department to bear that burden and I don't think they want to."

Dr. Sunday said that he is able to provide valuable laboratory experience to

students of all levels at Montana State because of his research. "Because I have a research laboratory and I have the space," he said, "I have the luxury of being able to do this work for students. If I didn't have a research career and a laboratory, I wouldn't have the funds, the space, the time, anything to do this kind of training and help these kids out." Sunday described a particular problem at Montana State "that is not a problem at other institutions." He said:

When I compete for a grant at the National Science Foundation, I'm competing with faculty at the best institutions in the country. Faculties that have more advantages than I do—lower teaching loads, and all kinds of things. I don't get a break for any of that. If I am successful in getting funded its because of the excellence of my work. Your standing, in terms of a faculty member on campus—which should also be worked into promotions and raises and all the rest of that—should evaluate your standing at the national level, in my opinion.

Results of the Quantitative Data Analysis

Numeric data describing trends at Montana State University identified in chapter 3 of this study are presented in Appendix B. These numeric data are presented in tables and discussed here in relation to the themes that emerged from the qualitative data analysis. When earlier and later year data were available, outside the period of 1989 to 1999, they are included for historical and current interest.

Discussion of Unified Teaching and Research Theme

Institutional data from 1989 and 1999 on research at Montana State University shows extremely strong growth. During that period of time, Grant and Contract activity at Montana State rose from approximately \$15 million annually to \$60 million (Table 1 and Figure 1). As a percentage of Montana State's total expenditures, Grant and Contract activity rose from about 30 percent to 50 percent of the total budget (Table 1).

Table 1. Grants and Contracts at Montana State University

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib
76-77	0	0	4,566,563	16,165,991	28.25%	0
77-78	0	0	7,085,000	19,654,143	36.05%	604,500
78-79	0	0	7,663,000	21,122,657	36.28%	618,300
79-80	0	0	9,707,000	24,830,663	39.09%	625,000
80-81	0	0	11,248,000	27,602,250	40.75%	675,000
81-82	0	0	10,115,972	30,029,515	33.69%	475,363
82-83	0	0	9,834,709	32,312,533	30.44%	533,090
83-84	0	0	9,064,796	33,654,644	26.93%	639,482
84-85	0	0	9,641,035	34,568,552	27.89%	627,467
85-86	7,604,916	531,015	10,745,945	44,069,444	24.38%	383,587
86-87	7,316,560	376,288	13,162,059	45,183,142	29.13%	531,107
87-88	7,614,640	401,982	14,946,631	46,860,223	31.90%	559,003
88-89	7,803,978	474,846	15,775,928	47,499,288	33.21%	1,341,040
89-90	8,110,613	602,547	17,236,262	51,466,563	33.49%	1,068,314
90-91	8,437,523	619,197	18,985,452	55,021,891	34.51%	1,134,761
91-92	9,051,583	615,402	24,493,736	64,399,928	38.03%	1,894,009
92-93	9,047,610	613,753	25,976,344	67,791,470	38.32%	2,212,863
93-94	9,113,131	666,751	30,592,402	72,262,027	42.34%	3,575,720
94-95	9,057,512	711,897	36,258,600	78,071,470	46.44%	4,021,511

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib
95-96	8,797,943	745,709	38,681,240	82,253,932	47.03%	4,940,805
96-97	9,203,766	664,739	41,604,061	88,784,269	46.86%	4,799,310
97-98	9,959,144	667,746	51,934,607	101,369,171	51.23%	6,859,062
98-99	10,358,864	514,383	49,741,406	100,859,464	49.32%	6,664,127
99-00	10,301,608	618,467	61,031,150	114,467,873	53.32%	8,748,150
00-01	10,396,068	566,950	61,023,155	115,004,258	53.06%	9,511,545

Doctoral production from 1989 to 1999 did not rise as robustly at Montana State, however. While sharply spiking in 1996-1997 to 66 doctorates awarded, doctoral production was flat between 1989-1999; comparing the two endpoint years of this study, doctoral production actually fell, from 42 doctorates awarded in 1989-1990 to 32 doctorates in 1999-2000 (Table 2 and Figure 2). Total doctoral production at Montana State University decreases when the number of Ed.D. degrees awarded by the College of Education, Health & Human Development (EHHD) are subtracted (Figure 2). It also helps to explain the spike of MSU doctoral production in 1996-1997, when 29 of the 66 doctorates awarded were from the EHHD College. Still, even without doctorates from EHHD, Montana State reached its highest doctoral production since 1976 in 1996-1997, with 37 Ph.D.s awarded (Table 2). The 1996-1997 spike of doctoral production at MSU cannot be fully accounted for by removing doctorates produced by the College of EHHD.

Table 2. Montana State University total Doctor's Degrees Awarded with and without College of Education, Health, and Human Development

Fiscal Year	MSU Doctor's Awarded	EHHD Doctor's Awarded	MSU Doctor's Without EHHD
76-77	30	12	18
77-78	23	5	18
78-79	25	12	13
79-80	23	13	10
80-81	10	3	7
81-82	24	6	18
82-83	31	5	26
83-84	23	8	15
84-85	25	8	17
85-86	31	12	19
86-87	24	6	18
87-88	37	15	22
88-89	38	16	22
89-90	42	11	31
90-91	34	10	24
91-92	41	14	27
92-93	43	8	35
93-94	34	13	21
94-95	40	13	27
95-96	44	9	35
96-97	66	29	37
97-98	52	20	32
98-99	43	13	30
99-00	32	12	20

Though rising dramatically from \$500,000 in 1989 to \$3.5 million in 1999 (Figure 13), the College of EHHD is the smallest contributor of Grants and Contracts among

colleges with doctoral production to Montana State's total Grant and Contract Activity (Table 3 and Figure 3). Interviews for the qualitative component of this study were limited to prominent faculty researchers in Montana State's Natural Sciences and Engineering departments, which contribute most to the university's Grant and Contract Activity (Figure 3). Separating EHHD doctoral production and Grant and Contract Activity in the quantitative descriptions here allows an examination of the levels of Grant and Contract Activity and doctoral production at Montana State more tightly linked to the qualitative component of the study. Quantitative data including the College of EHHD are included here. It should also be noted that the Carnegie Foundation for the Advancement of Teaching's classification system of higher education institutions does not distinguish between Ed.D. and Ph.D. degrees in its consideration of doctoral production.

Table 3. Montana State University Grants and Contracts with and without College of Education, Health and Human Development

Fiscal Year	MSU total G&C	EHHD G&C	MSU without EHHD G&C
76-77	4,566,563	213,713	4,352,850
77-78	7,085,000	373,141	6,711,859.00
78-79	7,663,000	286,615	7,376,385.00
79-80	9,707,000	363,657	9,343,343.00
80-81	11,248,000	413,073	10,834,927.00
81-82	10,115,972	500,337	9,615,635.00
82-83	9,834,709	387,487	9,447,222.00
83-84	9,064,796	422,853	8,641,943.00

Fiscal Year	MSU total G&C	EHHD G&C	MSU without EHHD G&C
84-85	9,641,035	550,000	9,091,035.00
85-86	10,745,945	885,595	9,860,350.00
86-87	13,162,059	990,773	12,171,286.00
87-88	14,946,631	671,257	14,275,374.00
88-89	15,775,928	517,286	15,258,642.00
89-90	17,236,262	476,186	16,760,076.00
90-91	18,985,452	312,723	18,672,729.00
91-92	24,493,736	307,992	24,185,744.00
92-93	25,976,344	642,507	25,333,837.00
93-94	30,592,402	2,352,300	28,240,102.00
94-95	36,258,600	3,532,098	32,726,502.00
95-96	38,681,240	3,216,918	35,464,322.00
96-97	41,604,061	2,715,811	38,888,250.00
97-98	51,934,607	2,876,320	49,058,287.00
98-99	49,741,406	2,694,891	47,046,515.00
99-00	61,031,150	3,527,415	57,503,735.00
00-01	61,023,155	3,605,791	57,417,364.00

An examination of doctoral candidates at Montana State University, rather than of doctoral degrees awarded, shows a rise from 224 in 1989-1990 to 281 in 1999-2000, spiking in 1996-1997 to 334 candidates (Table 4 and Figure 4). When EHHD candidates are removed from the total, somewhat more modest growth in doctoral candidates is shown, from 161 in 1989-1990 to 206 in 1999-2000 (Table 4 and Figure 4). And the 1996-1997 spike is partly explained by a college high of 124 doctoral candidates in EHHD that year.

Table 4. Montana State University Doctoral Candidates with and without College of Education, Health, and Human Development Candidates

Fiscal Year	Doctoral Candidates	from EHHD	minus EHHD
76-77	136	44	92
77-78	114	40	74
78-79	108	38	70
79-80	110	35	75
80-81	140	51	89
81-82	155	50	105
82-83	168	53	115
83-84	183	60	123
84-85	167	47	120
85-86	184	60	124
86-87	175	48	127
87-88	206	64	142
88-89	215	54	161
89-90	224	55	169
90-91	219	48	171
91-92	221	59	162
92-93	226	53	173
93-94	251	59	192
94-95	307	81	226
95-96	302	76	226
96-97	334	124	210
97-98	311	106	205
98-99	291	80	211
99-00	281	75	206
00-01	269	72	197

The number of Graduate Teaching Assistants was 178 in 1990 and 233 in 1999, spiking at 247 in 1992 (Table 5). The trend in the numbers of Graduate Teaching Assistants between 1990 and 1999 is essentially flat (Table 5 and Figure 5). Not unlike

the numbers of Graduate Teaching Assistants, the number of Graduate Research Assistants was 178 in 1990 and 223 in 1999, spiking in 1994 at 298 (Table 5 and Figure 6). Except for the single large spikes in numbers of Graduate Teaching and Research Assistants, in 1992 and 1994 respectively, the trends show no rise between 1990 and 1999 comparable over the same period of time to Grant and Contract activity at Montana State University, which more than tripled. Postdoctoral researchers at Montana State, however, grew in numbers from 10 in 1990 to 64 in 1999, with no spikes and—except for 1992—steady increases over the period (Table 5 and Figure 7).

Table 5. Graduate Research and Teaching Assistants, and Postdoctoral Researchers at Montana State University

Year	Research Asst	Teaching Asst	Postdocs
1990	178	178	10
1991	212	217	8
1992	194	247	7
1993	263	235	14
1994	298	220	20
1995	259	219	28
1996	229	219	34
1997	213	202	43
1998	231	207	56
1999	223	233	64

The annual, average cumulative grade point average of Montana State University doctoral candidates, on a 4-point scale, rose from 3.63 in 1989-1990 to 3.72 in 1998-1999 (Table 6 and Figure 8). While not a significant rise in itself, it should be viewed in light of the fact that admission to graduate study at Montana State University became much more open to applicants over the same period of time.

Table 6. Cumulative Grade Point Average of Montana State University Doctoral Candidates

Fiscal Year	Cum Dr. GPA (4-point scale)
89-90	3.63
90-91	3.67
91-92	3.68
92-93	3.71
93-94	3.69
94-95	3.71
95-96	3.75
96-97	3.74
97-98	3.73
98-99	3.72
99-00	3.71

Annual, Full-time Equivalent (FTE) tenurable Montana State University faculty remained essentially flat at about 400 FTE from 1989-1990 to 1999-2000 (Table 7 and Figure 9). Full-time Equivalent nontenurable Montana State University faculty rose from 396.17 FTE in 1989-1990 to 526.08 FTE in 1999-2000. The rise in Grant and Contract

Activity at Montana State University over this period of time has been accompanied, perhaps not surprisingly, by a rise in the use of nontenurable faculty for instruction (Table 7 and Figure 9).

Table 7. Montana State University Full-time Equivalent of Tenurable and Nontenurable Faculty

Fiscal Year	Tenurable AYFTE	Non-tenurable AYFTE
76-77	444.61	485.55
77-78	439.45	480.92
78-79	458.64	473.9
79-80	443.1	474.69
80-81	449.66	484.86
81-82	473.12	512
82-83	481.92	522.25
83-84	455.71	545.99
84-85	463.67	546.46
85-86	461.52	533.47
86-87	412.71	490.28
87-88	398.25	487.51
88-89	414.69	468.61
89-90	396.17	477.1
90-91	401.45	483.97
91-92	391.07	487.03
92-93	397.89	500.6
93-94	402.65	497.46
94-95	379.06	494.34
95-96	385.45	500.01
96-97	390.67	512.02
97-98	392.04	515.47
98-99	406.87	519.61

Fiscal Year	Tenurable AYFTE	Non-tenurable AYFTE
99-00	397	526.08
00-01	403.42	529.23

College of Agriculture

As a percent of the total expenditures in the College of Agriculture, Grant and Contract Activity rose from 35.08 percent in 1989-1990 to 54.37 percent in 1998-1999 (Table 8). In dollar amounts, it is an increase from \$4,333,778 to \$12,732,021 (Figure 10). Doctoral candidates in the College of Agriculture rose from 27 in 1989-1990 to 35 in 1999-2000 (Figure 11). The College of Agriculture's Indirect Cost (IDC) dollars as a percent of the college's Grant and Contract Activity rose from 2 percent in 1989-1990 to 13 percent in 1999-2000. IDC monies are distributed by Montana State University's Office of the Vice President for Research.

Table 8. Montana State University Grants and Contracts and Indirect Cost Distribution in College of Agriculture

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
76-77	0	0	1,409,011	2,510,439	56.13%	0	0%
77-78	0	0	1,021,208	2,184,001	46.76%	0	0%

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
78-79	0	0	1,122,142	2,354,474	47.66%	0	0%
79-80	0	0	1,731,997	3,133,632	55.27%	39,596	2%
80-81	0	0	2,035,709	3,620,879	56.22%	26,500	1%
81-82	0	0	1,822,341	3,674,907	49.59%	48,638	3%
82-83	0	0	1,889,236	3,685,234	51.27%	54,082	3%
83-84	0	0	1,882,172	3,683,880	51.09%	59,657	3%
84-85	0	0	2,527,112	4,412,709	57.27%	37,930	2%
86-87	5,697,705	0	2,676,411	10,095,730	26.51%	29,968	1%
87-88	5,946,110	0	2,555,765	10,203,380	25.05%	34,300	1%
88-89	5,984,330	0	3,075,490	10,753,894	28.60%	64,000	2%
89-90	6,203,984	0	4,333,778	12,354,940	35.08%	73,598	2%
90-91	6,487,357	0	4,619,391	13,033,663	35.44%	69,403	2%
91-92	6,994,869	0	4,905,440	13,907,421	35.27%	163,605	3%
92-93	7,103,504	0	6,055,570	15,196,041	39.85%	97,677	2%
93-94	7,003,649	0	6,720,813	15,641,373	42.97%	276,667	4%
94-95	7,243,718	0	7,295,006	16,259,518	44.87%	488,875	7%
95-96	7,046,308	0	7,522,691	16,383,428	45.92%	754,970	10%
96-97	7,297,836	0	9,407,079	18,665,998	50.40%	342,655	4%
97-98	8,009,297	0	15,196,513	25,276,817	60.12%	473,128	3%
98-99	8,369,694	0	12,732,021	23,417,117	54.37%	479,642	4%
99-00	10,144,581	0	13,490,006	26,133,932	51.62%	1,778,352	13%
00-01	8,424,255	0	14,340,430	25,418,533	56.42%	1,900,515	13%

Doctoral production in the College of Agriculture was six doctor's degrees awarded in 1989-1990 and five degrees awarded in 1999-2000, with a high of seven in 1992-1993 and a low of two in 1990-1991 (Table 9). The amount of Grant and Contract

Activity in the College of Agriculture per doctorate the college awarded rose from \$722,296 in 1989-90 to \$2,698,001 in 1999-2000 (Table 9 and Figure 12).

Table 9. Montana State University Graduate Degree Production and Grants and Contracts in College of Agriculture

Fiscal Year	Master's Degrees	Doctor's Degrees	G&C Activity	G&C dollars per doctorate
76-77	29	3	1,409,011	469,670
77-78	27	4	1,021,208	255,302
78-79	27	4	1,122,142	280,535
79-80	18	3	1,731,997	577,332
80-81	32	2	2,035,709	1,017,854
81-82	34	6	1,822,341	303,723
82-83	46	7	1,889,236	269,890
83-84	34	0	1,882,172	Not Applicable
84-85	38	4	2,527,112	631,778
85-86	38	4	No data	-
86-87	37	4	2,676,411	669,102
87-88	30	5	2,555,765	511,153
88-89	39	5	3,075,490	615,098
89-90	28	6	4,333,778	722,296
90-91	32	2	4,619,391	2,309,695
91-92	25	6	4,905,440	817,573
92-93	25	7	6,055,570	865,081
93-94	28	5	6,720,813	1,344,162
94-95	27	4	7,295,006	1,823,751
95-96	41	4	7,522,691	1,880,672
96-97	30	4	9,407,079	2,351,769
97-98	30	6	15,196,513	2,532,752
98-99	28	5	12,732,021	2,546,404
99-00	27	5	13,490,006	2,698,001

College of Education, Health and Human Development

The percent of Grant and Contract amounts in the total expenditures of the College of Education, Health and Human Development increased from 18.37 percent in 1989-90 to 50.87 percent in 1999-2000 (Table 10). In dollar amounts, it is an increase from \$476,186 to \$3,527,415 (Figure 13). The college's IDC monies from MSU's Office of the Vice President for Research came to 3 percent of its Grant and Contract Activity in 1989-90, jumping to a record high of 13 percent in 1990-1991, and to 8 percent in 1999-2000 (Table 10).

Table 10. Montana State University Grants and Contracts and Indirect Cost Distribution in College of Education, Health, and Human Development

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
76-77	0	0	213,713	1,648,984	12.96%	0	0
77-78	0	0	373,141	1,926,221	19.37%	0	0%
78-79	0	0	286,615	1,958,760	14.63%	0	0%
79-80	0	0	363,657	2,167,829	16.78%	19,458	5%
80-81	0	0	413,073	2,288,051	18.05%	18,524	4%
81-82	0	0	500,337	2,689,215	18.61%	519	0%
82-83	0	0	387,487	2,485,416	15.59%	2,789	1%
83-84	0	0	422,853	2,553,504	16.56%	965	0%
84-85	0	0	550,000	2,735,777	20.10%	10,097	2%
85-86	86,576	0	885,595	3,137,621	28.23%	11,487	1%
86-87	78,324	0	990,773	3,041,645	32.57%	7,875	1%

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
87-88	17,009	0	671,257	2,648,656	25.34%	0	0%
88-89	21,706	0	517,286	2,545,214	20.32%	15,814	3%
89-90	22,999	0	476,186	2,592,606	18.37%	12,220	3%
90-91	20,624	0	312,723	2,641,966	11.84%	39,891	13%
91-92	25,208	0	307,992	2,837,418	10.85%	11,914	4%
92-93	19,144	0	642,507	3,268,591	19.66%	15,105	2%
93-94	14,121	0	2,352,300	4,881,423	48.19%	44,970	2%
94-95	0	0	3,532,098	6,304,676	56.02%	35,099	1%
95-96	0	0	3,216,918	6,227,165	51.66%	26,102	1%
96-97	0	0	2,715,811	5,999,437	45.27%	53,666	2%
97-98	2,671	0	2,876,320	6,081,719	47.29%	76,729	3%
98-99	0	0	2,694,891	6,018,839	44.77%	44,429	2%
99-00	0	0	3,527,415	6,934,280	50.87%	270,208	8%
00-01	0	0	3,605,791	7,030,872	51.29%	266,928	7%

Doctor's degrees awarded in the College of Education, Health and Human Development numbered 11 in 1989-1990 and 13 in 1999-2000, peaking in 1996-1997 at 29 degrees (Table 11). Doctoral candidates in the College of Education, Health and Human Development rose from 55 in 1989-1990 to 75 in 1999-2000 (Figure 13). The amount of Grant and Contract Activity in the college per doctorate awarded was \$43,289 in 1989-1990 and \$293,951 in 1999-2000 (Table 11 and Figure 15).

Table 11. Montana State University Graduate Degree Production and Grants and Contracts in College of Education, Health, and Human Development

Fiscal Year	Master's Degrees	Doctor's Degrees	G&C Activity	G&C dollars per Doctorate
76-77	46	12	213,713	17,809
77-78	61	5	373,141	74,628
78-79	50	12	286,615	23,884
79-80	71	13	363,657	27,973
80-81	86	3	413,073	137,691
81-82	59	6	500,337	83,389
82-83	72	5	387,487	77,497
83-84	71	8	422,853	52,856
84-85	87	8	550,000	68,750
85-86	67	12	885,595	73,799
86-87	92	6	990,773	165,128
87-88	83	15	671,257	44,750
88-89	67	16	517,286	32,330
89-90	73	11	476,186	43,289
90-91	73	10	312,723	31,272
91-92	74	14	307,992	21,999
92-93	62	8	642,507	80,313
93-94	53	13	2,352,300	180,946
94-95	68	13	3,532,098	271,699
95-96	65	9	3,216,918	357,435
96-97	91	29	2,715,811	93,648
97-98	44	20	2,876,320	143,816
98-99	43	13	2,694,891	207,299
99-00	45	12	3,527,415	293,951

College of Engineering

The MSU College of Engineering's Grant and Contract Activity rose as a percentage of its total expenditures from 38 percent in 1989-1990 to 61 percent in 1998-1999 (Table 12). In dollar amounts, this is an increase from \$2,194,556 to \$8,693,829 (Figure 16). As

a percentage of its Grant and Contract Activity, the College of Engineering received 4 percent in IDC distribution from the Office of the Vice President for Research in 1989-1990 and 20 percent in 1999-2000 (Table 12).

Table 12. Montana State University Grants and Contracts and Indirect Cost Distribution in the College of Engineering

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
76-77	0	0	760,062	2,409,386	31.55%	0	0%
77-78	0	0	853,378	2,569,375	33.21%	0	0%
78-79	0	0	763,296	2,613,542	29.21%	0	0%
79-80	0	0	1,024,275	3,196,762	32.04%	62,850	6%
80-81	0	0	1,233,168	3,625,978	34.01%	29,722	2%
81-82	0	0	1,435,817	4,610,428	31.14%	47,985	3%
82-83	0	0	1,255,945	4,133,623	30.38%	65,100	5%
83-84	0	0	1,111,346	4,461,105	24.91%	41,588	4%
84-85	0	0	1,118,968	4,459,243	25.09%	26,860	2%
85-86	111,429	372,802	1,216,677	4,945,275	24.60%	48,311	4%
86-87	107,734	300,044	1,775,100	5,230,907	33.93%	78,674	4%
87-88	113,578	347,856	1,698,150	5,198,085	32.67%	90,881	5%
88-89	114,227	341,193	1,934,378	5,295,220	36.53%	133,820	7%
89-90	120,512	390,024	2,194,556	5,785,908	37.93%	82,780	4%
90-91	114,245	436,110	3,493,837	7,301,967	47.85%	47,850	1%
91-92	128,542	434,155	5,407,745	9,883,046	54.72%	100,808	2%
92-93	127,860	437,785	4,072,164	8,922,184	45.64%	181,674	4%
93-94	84,104	451,809	4,426,140	9,073,452	48.78%	789,765	18%
94-95	73,591	467,798	5,434,944	10,236,621	53.09%	500,161	9%
95-96	89,081	413,943	6,388,307	11,170,679	57.19%	690,503	11%
96-97	84,739	421,004	7,670,483	13,182,845	58.19%	893,026	12%
97-98	67,506	404,665	7,769,220	13,169,683	58.99%	1,165,221	15%
98-99	69,135	320,392	8,693,829	14,257,131	60.98%	920,868	11%

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
99-00	60,212	411,924	8,961,078	14,785,455	60.61%	1,792,180	20%
00-01	54,229	344,317	9,965,170	15,741,303	63.31%	1,825,928	18%

Three Doctor's degrees in Engineering were awarded in 1989-1990 and two in 1999-2000, with a high of six awarded in both 1990-1991 and 1998-1999 and a low of one degree in both 1993-1994 and 1996-1997 (Table 13). Doctoral candidates in the College of Engineering rose from 17 in 1989-1990 to 21 in 1999-2000, with a peak of 27 candidates in 1998-1999 (Figure 15). Grant and Contract dollars per Engineering doctorate awarded came to \$731,519 in 1989-1990 and \$4,480,539 in 1999-2000 (Table 13 and Figure 18).

Table 13. Montana State University Graduate Degree Production and Grants and Contracts Activity in the College of Engineering

Fiscal Year	Master's Degrees	Doctor's Degrees	G&C Activity	G&C dollars per doctorate
76-77	54	1	760,062	760,062
77-78	22	5	853,378	170,675
78-79	37	3	763,296	254,432
79-80	24	0	1,024,275	not applicable
80-81	37	0	1,233,168	not applicable
81-82	38	3	1,435,817	478,605
82-83	49	3	1,255,945	418,648
83-84	42	3	1,111,346	370,448

Fiscal Year	Master's Degrees	Doctor's Degrees	G&C Activity	G&C dollars per doctorate
84-85	41	1	1,118,968	1,118,968
85-86	45	4	1,216,677	304,169
86-87	52	4	1,775,100	443,775
87-88	49	4	1,698,150	424,537
88-89	43	2	1,934,378	967,189
89-90	44	3	2,194,556	731,518
90-91	34	6	3,493,837	582,306
91-92	38	3	5,407,745	1,802,581
92-93	36	5	4,072,164	814,432
93-94	51	1	4,426,140	4,426,140
94-95	66	5	5,434,944	1,086,988
95-96	55	4	6,388,307	1,597,076
96-97	53	1	7,670,483	7,670,483
97-98	43	4	7,769,220	1,942,305
98-99	48	6	8,693,829	1,448,971
99-00	65	2	8,961,078	4,480,539

College of Letters and Science

The College of Letters and Science saw an increase in Grant and Contract Activity as a percent of its total expenditures from 41 percent in 1989-1990 to 57 percent in 1999-2000 (Table 14). In dollar amounts, this is an increase from \$6,163,717 to \$17,905,757 (Figure 19). As a percentage of its Grant and Contract Activity, the College of Letters and Science received 3 percent in IDC distribution from the Office of the Vice President for Research in 1989-1990. In 1999-2000, the college's IDC monies amounted to 20 percent of its Grant and Contract expenditures (Table 14).

Table 14. Montana State University Grants and Contracts and Indirect Cost Distribution in the College of Letters and Science

Fiscal Year	Ag Exp Station	MSU Research	Grants & Contracts	Inst & Res Expenditures	Percent G&C	VPR IDC Distrib	VPR IDC per G&C
76-77	0	0	1,722,701	6,116,076	28.17%	0	0%
77-78	0	0	1,823,336	6,690,092	27.25%	0	0%
78-79	0	0	2,073,643	7,338,557	28.26%	0	0%
79-80	0	0	2,850,715	8,710,890	32.73%	260,788	9%
80-81	0	0	3,170,395	9,465,004	33.50%	205,159	6%
81-82	0	0	2,591,634	10,077,056	25.72%	241,072	9%
82-83	0	0	2,806,210	10,106,738	27.77%	273,278	10%
83-84	0	0	2,651,264	10,531,662	25.17%	274,577	10%
84-85	0	0	2,825,444	10,726,872	26.34%	234,202	8%
85-86	290,601	0	3,346,598	11,589,850	28.88%	147,402	4%
86-87	258,533	0	4,749,487	12,765,347	37.21%	274,174	6%
87-88	321,024	0	6,503,666	14,610,594	44.51%	416,799	6%
88-89	327,398	0	6,397,913	14,491,760	44.15%	209,504	3%
89-90	337,223	0	6,163,717	14,867,455	41.46%	200,990	3%
90-91	361,962	0	5,456,183	14,725,896	37.05%	304,912	6%
91-92	351,880	0	6,245,201	16,356,485	38.18%	693,774	11%
92-93	228,838	0	7,691,421	18,316,165	41.99%	602,026	8%
93-94	194,322	0	9,451,311	19,676,964	48.03%	1,344,108	14%
94-95	144,623	0	11,594,604	21,837,670	53.09%	1,360,358	12%
95-96	100,510	0	12,642,994	23,652,784	53.45%	1,548,986	12%
96-97	90,418	0	12,792,806	24,611,499	51.98%	1,609,819	13%
97-98	103,257	0	15,536,487	27,966,076	55.55%	2,277,725	15%
98-99	98,241	0	15,642,404	28,396,987	55.08%	2,452,193	16%
99-00	96,815	0	17,905,757	31,477,191	56.88%	3,520,461	20%
00-01	38,605	0	19,527,405	32,756,107	59.61%	4,002,696	20%

The College of Letters and Science awarded 22 doctorates in 1989-1999 and 13 in 1999-2000 (Table 15). Doctoral candidates in the College of Letters and Science rose from 120 in 1989-1990 to 150 in 1999-2000, with a peak of almost 175 in 1995-1996 (Figure 17). Grant and Contract dollars per doctorate awarded by the College of Letters and Science totaled \$280,169 in 1989-1990 and \$1,377,366 in 1999-2000 (Table 15 and Figure 21).

Table 15. Montana State University Graduate Degree Production and Grants and Contracts in the College of Letters and Science

Fiscal Year	Master's Degrees	Doctor's Degrees	G&C Activity	G&C dollars per doctorate
76-77	53	14	1,722,701	123,050
77-78	49	9	1,823,336	202,593
78-79	49	6	2,073,643	345,607
79-80	54	7	2,850,715	407,245
80-81	43	5	3,170,395	634,079
81-82	45	9	2,591,634	287,959
82-83	48	16	2,806,210	175,388
83-84	55	12	2,651,264	220,939
84-85	51	12	2,825,444	235,454
85-86	57	11	3,346,598	304,236
86-87	72	10	4,749,487	474,949
87-88	69	13	6,503,666	500,282
88-89	32	15	6,397,913	426,528
89-90	59	22	6,163,717	280,169
90-91	89	16	5,456,183	341,011
91-92	59	18	6,245,201	346,956
92-93	66	23	7,691,421	334,410

Fiscal Year	Master's Degrees	Doctor's Degrees	G&C Activity	G&C dollars per doctorate
93-94	72	15	9,451,311	630,087
94-95	67	18	11,594,604	644,145
95-96	72	27	12,642,994	468,259
96-97	77	32	12,792,806	399,775
97-98	76	22	15,536,487	706,204
98-99	66	19	15,642,404	823,284
99-00	75	13	17,905,757	1,377,366

Summary of Unified Research and Teaching Theme

Increases in Grant and Contract Activity appear not to have increased doctoral production at Montana State University from 1989 to 1999. Examining the relationship between Grant and Contract dollar amounts and the number of doctorates produced at Montana State University reveals that, without EHHD Grants and Contracts and doctoral production, the university spent approximately \$500,000 for each doctorate produced in 1989-1990 (Figure 22). In Fiscal Year 1999-2000, again without EHHD, the amount of Grant and Contract Activity per doctoral degree awarded at Montana State University was nearly \$3,000,000 (Figure 22). The College of EHHD produces doctorates (the Ed.D.) in relation to its Grant and Contract expenditures far below any other college at Montana State, or about \$50,000 per Ed.D. in 1989-1990 and \$300,000 in 1999-2000 (Figure 15). When EHHD doctoral production is included in the Montana State

University total, Grant and Contract dollars spent per doctorate produced remain close to \$500,000 in 1989-1990, but are slightly below \$2,000,000 in 1999-2000 (Figure 23).

These data reveal that Grant and Contract expenditures at Montana State University have risen without a corresponding rise in doctoral production. This trend apparently belies the benefits described in the literature on faculty research and teaching, as well as the unified approach to research and teaching described by the prominent Montana State University faculty researchers in the qualitative component of this study.

Discussion of Postdoctoral Researchers and Students Theme

The prominent Montana State University faculty researchers interviewed for this study stressed that all levels of students worked in their respective laboratories according to their abilities rather than according to their status. Several faculty remarked that postdoctoral researchers were generally more able to work independently and take initiatives without direct guidance from the faculty researcher, or principal investigator. Further, several Montana State University faculty researchers said that postdoctoral researchers were especially useful in interdisciplinary laboratories where skills outside the scope of the principal investigator's field. No significant growth in the numbers of Graduate Teaching and Research Assistants appears to have taken place during the growth of Grant and Contract Activity at Montana State University from \$15 million to

\$60 from 1989-1999 (Figure 1). Numbers of postdoctoral researchers at Montana State University have risen significantly, from 10 in 1990 to 65 in 1999 (Figure 7). While doctoral production at Montana State University remained essentially flat from 1989 to 1999 (Figure 2), the number of doctoral candidates at Montana State University increased from 224 candidates in 1989-1990 to 281 in 1999-2000 (Figure 4).

Discussion of Montana State's Assessment of Faculty Teaching and Research Theme

As the primary theme to emerge from the Montana State University faculty researchers interviewed for this study, faculty identified their strong belief in the unity of their respective teaching and research efforts. On the other hand, several faculty researchers criticized either a hostile environment at Montana State University for the integration of research and teaching, or administrative policies that seemed to the researchers to artificially separate either their teaching from their research work, or vice versa. In two cases, Montana State University researchers explained that administrative calculations of departmental instructional productivity excluded their teaching because of the nature of their professional appointments (i.e., 100-percent research). While the number of doctoral candidates has grown in every doctorate-granting college at Montana State University, the numbers of doctor's degrees awarded are essentially flat (Figure 2). While data on attrition rates for doctoral candidates at Montana State University were not

available for this study, there appears to be a significant difference between the growing enrollment of doctoral candidates and relatively flat number of doctorates awarded by Montana State University. The number of nontenurable faculty has risen significantly during the period of this study, while tenurable faculty has remained flat (Figure 9).

Discussion of State Support for Research Theme

For those colleges awarding doctoral degrees, all of them have shown an increase in Grant and Contract Activity as a percentage of their respective total expenditures (Tables 1,8,10,12,14). Many of the faculty researchers interviewed for this study noted the decline and general dearth of financial support for Montana State University from the state of Montana. Reactions to the lack of state support for the university varied from complacent acceptance, to exasperated resignation, to alarmist warnings about its detrimental effects on the institution both for instruction and research. As an institution, the percentage of the total Montana State University budget made up by Grant and Contract Activity has risen significantly from a historical low in 1985-1986 of 25 percent to a high of 50 percent in 1998-1999 (Table 1).

Chapter Summary

This chapter presented the qualitative and quantitative findings of the study.

Analysis of the qualitative data subsumed under the quantitative data was presented and discussed. The qualitative data were gathered in structured interviews with Montana State University faculty selected by the Dean of the College of Graduate Studies for the prominence of their respective research in Engineering and the Physical Sciences. The quantitative data, gathered from institutional sources with permission, are presented with tables in this chapter and with figures in Appendix B. The discussion section of this chapter addressed the significance of the qualitative and quantitative data. Themes that emerged in the qualitative component were considered in light of the description of Montana State University offered by the quantitative, institutional data.

CHAPTER 5

CONCLUSIONS

Chapter IntroductionSummary of Problem, Methodology and Results

The number of doctoral degrees awarded at Montana State University from 1989 to 1999 has remained relatively constant during a dramatic increase in grant and contract activity at the university, from \$15 million in 1989 to \$50 million in 1999 (Figures 1 and 4). By more than tripling its funded research activity between 1989 and 1999, Montana State University appeared to be capitalizing on federal and commercial demands for its research capacity.

The negative institutional effects on universities competing for research funding, however, has led the Carnegie Foundation for the Advancement of Teaching to undertake substantial revisions of its widely recognized classification system of higher education institutions (McCormick, 1999). "The drive to 'move up' in the classification system can affect resource allocation and hiring, possibly at the expense of other components of institutional mission that are less finely measured or absent from the classification's definitions," (McCormick, 1999, p. 1). The problem this study addressed is whether

Montana State has compromised its graduate instructional mission during its dramatic increase in research activity. With the 1999 announcement of interim reforms in its classification system, the Carnegie Foundation has de-emphasized Grant and Contract Activity and increased the significance of doctoral production and institutional mission. The Foundation is poised to reinforce this shift when it is expected to announce its classification system revisions in 2005.

In order to assess how increased levels of faculty-directed research affected graduate production at Montana State University, this study included both a qualitative and quantitative component. The questions developed for the qualitative approach followed a phenomenological approach (Moustakas, 1994). The Montana State University faculty researchers selected by the Dean of the College of Graduate Studies for interviews had generated large grants and contracts at the University and worked in the natural sciences or engineering. Eight interviews, lasting between 45 minutes and 2 hours, were recorded and professionally transcribed. Three faculty researchers contacted by the dean and the researcher did not respond or were unable to participate in the interviews. The researcher also relied upon regular meetings and correspondence with the Dean of the College of Graduate Studies and the researcher's doctoral committee chair for ongoing outside verification of the interpretation of the interview data.

The theme that emerged most significantly in the analysis of the participants' statements was that they performed research and teaching duties as a single, unified activity. The strength of the qualitative results of this phenomenological approach "depends, in part, on whether the researcher can subsume them under other data," (Creswell, 1998: 207). A phenomenological approach employs the use of a very open, central question, followed by somewhat more topical interview questions (Creswell, 1998: 51). The quantitative component of this study subsumed the results of the phenomenological (i.e., qualitative) approach under descriptive institutional data from Montana State University. Increased Grant and Contract Activity, from about \$15 to \$50 million, appears not to have increased doctoral production at Montana State University from 1989 to 1999 (Figures 1, 2, 22 and 23). These data suggest that, on the whole, doctoral education at Montana State University is not measurably benefiting from increased research activity.

Interpretation of Results

The dominant theme of the qualitative component of this study was that prominent Montana State faculty researchers viewed research and teaching as unified, either inseparable or not worth separating. However, while doctorate awarding colleges at Montana State University significantly increased their Grant and Contract Activity from

1989 to 1999 (Figures 1, 10, 13, 16 and 19), the number of doctorates awarded at Montana State is essentially flat over the same period (Figure 2). The disparity in these two trends suggests that Montana State University research between 1989 and 1999 appeared to advance independently of doctoral production. The number of doctoral candidates has slightly increased in the four doctorate producing colleges between 1989 and 1999 (Figures 4, 11, 14, 17 and 20).

Another theme in the interviews was that MSU faculty researchers treat postdoctoral, doctoral and nondoctoral students individually (i.e., based on their abilities to function in the laboratory rather than based on their status at the university). The added Grant and Contract expenditures at Montana State between 1989 and 1999 appeared to do little to sustain growth in the number of Graduate Teaching Assistants (Figure 5) and Graduate Research Assistants (Figure 6). On the other hand, the number of postdoctoral researchers at MSU steadily increased, from 10 in 1990 to 64 in 1999 (Table 5 and Figure 7). Postdoctoral researchers by definition have more academic preparation for laboratory work than doctoral candidates. They also by definition demand less of the academic support from faculty researchers that doctoral candidates require. Montana State University faculty researchers in this study did not report that they favored postdoctoral researchers over doctoral candidates—in a few cases, just the opposite. Trends in the number of Graduate Teaching and Research Assistants (Figures 5 and 6) and postdoctoral

researchers (Figure 7) suggest that increased Grant and Contract expenditures supported increased numbers of postdoctoral researchers. They do not appear to have supported additional graduate students with assistantships in Montana State University laboratories and classrooms. Funding of doctoral candidates, particularly in the form of assistantships, has been associated with lower attrition rates nationally among doctoral candidates (Lovitts, 2000). Federal and private funding for doctoral programs and candidates helped create the national boom of doctoral production in the 1960s (Bowen & Rudenstine, 1992, p.355).

Administrative evaluation of faculty teaching and research were viewed by the Montana State University faculty researchers of this study as mostly harmless and necessary. Faculty with 100 percent research appointments reported seeking formal representation to the Montana Board of Regents for the purpose of being included in departmental calculations of instructional productivity, which at the time of the interviews (fall 1999) did not recognize their work as instructors. Adjunct or nontenurable faculty often serve as instructors in place of tenured or tenurable faculty engaged in research. Between 1989 and 1999, the annual full-time equivalent (AYFTE) of tenured or tenurable faculty at Montana State has remained flat, at about 400 AYFTE (Figure 9). Historically, this represents a significant decline from 1976 to 1989, however, when tenurable faculty averaged around 450 AYFTE, peaking in 1982-1983 at 482

AYFTE (Table 7 and Figure 9). Nontenurable faculty at Montana State rose from about 470 AYFTE in 1989 to 526 AYFE in 1999 (Table 7 and Figure 9). In the late 1960s, a former president of Princeton University described the harmful signal sent about status when teaching loads are reduced for university faculty researchers. Dr. Robert F. Goheen wrote:

I am concerned here particularly with the drift toward sharply reduced teaching loads in many universities. It seems to me to have gone dangerously far...All college or university-level faculty members should have the time to do research, in their chosen fields of study. What I am dubious about is that by-product of today's intense competition for faculty wherein part of the lure is a weekly teaching assignment of no more than a few hours—and sometimes none at all. Whether they mean to or not, institutions which go in heavily for this kind of enticement are making the avoidance of teaching a reward and a mark of status in a way that can only be harmful to higher education.” (1969, p.85)

This study did not analyze student evaluation of instruction data gathered by Montana State University colleges and departments, which, as described in chapter 3, use a wide variety of methods for collecting such data. It would have benefited this study to have been able to assess whether students in graduate courses at Montana State reported a decline in the quality of instruction during the period of increased Grant and Contract Activity when the numbers of nontenurable instructors rose. This study recommended such an analysis in chapter 3 for further research.

Faculty researchers interviewed for this study generally said state financial support for research was lacking at Montana State University, though opinions regarding the actual effect on the institution from this lack of support ranged from negligible to serious. Those faculty who found a lack of state support less of a problem said Montana State University policies allowed them to pursue outside Grant and Contract funding with little interference from the university with regard to how those funds were employed in the conduct of their research, particularly when it came to interdisciplinary collaboration. The Montana State University faculty who found the lack of state funding damaging to the success of their work said an inadequate physical infrastructure at the university could not accommodate expanding research and instructional opportunities. The percentages of total instructional and research expenditures at Montana State University coming from Grant and Contract dollars increased from 33 percent in 1989 to 53 percent in 1999 (Table 1).

The increase in the percentage of Grant and Contract dollars compared to Montana State University's total instructional and research expenditures supports the contention of the faculty researchers who said that the state of Montana did not sufficiently support the expanded research activities of the university from 1989 to 1999. Montana State University spent a significantly increasing amount of Grant and Contract funds as a percentage of its total expenditures between 1989 and 1999. Because Grant

and Contract funds are regulated as to how they may be spent, Montana State University cannot treat these funds as replacement dollars for building and instructional funding from the state of Montana. One faculty researcher said that, because of the lack of state support and limitations on the use of Grant and Contract funding, it would require the support of a private foundation to construct a new laboratory building in his field at Montana State University. The researcher quickly added that the foundation would also have to set up a fund to afford custodians and other maintenance personnel who would work in the building. "What kind of foundation is going to support that?" he asked rhetorically. The question of whether a lack of state financial support affected graduate instruction and doctoral production at Montana State University between 1989 and 1999 is related to but was not addressed in this study. The question addressed here was whether increased Grant and Contract Activity at the university has affected graduate study at the doctoral level.

Montana State University appeared to have significantly increased its Grant and Contract Activity between 1989 and 1999 without increasing its doctoral production. This relationship runs contrary to the benefits of faculty research for advanced students described in the literature reviewed for this study. It also runs contrary to the primary theme that emerged from interviews with prominent Montana State University faculty researchers on their unified approach to research and teaching. Finally, and not least

significantly, it runs contrary to how the Carnegie Foundation for the Advancement of Teaching has decided to revise its classification system for higher education institutions. For its widely respected classification system, Carnegie has raised the significance of the breadth and depth of an institution's doctoral production and has lowered the stand-alone significance of Grant and Contract Activity (McCormick, 1999).

Corresponding Conclusions Drawn from Interpreted Results

What did Montana State University leaders intend to achieve for the university when strategic decisions were made and tactically carried out over years to increase research productivity? This study attempted to document in Chapter 2 that Montana State University leaders pursued a path toward increasing institutional prestige. Until its interim revisions were announced in 1999, Grant and Contract Activity largely determined a research university's classification within the Carnegie Foundation for the Advancement of Teaching's standards for higher education institutions. What is the explanation for Montana State University's apparent institutional failure between 1989 and 1999 to translate research success—as measured by Grant and Contract Activity—into graduate instructional success—as measured by doctoral production? A broad and long-standing institutional policy goal to boost research productivity at Montana State University may partly explain the failure of research success to translate into graduate

instructional success. There was little to no evidence in the literature that the effects on graduate study were considered as Montana State University leaders chose a path toward prestige using Grant and Contract Activity as a vehicle. As discussed in Chapter 2, the Montana Legislature worked with Montana State University on the Productivity, Quality and Outcomes agreement, which exclusively focused on undergraduate education.

“Most universities, and many celebrated colleges, yearn for the prestige which above all is earned by a publishing faculty doing research. *The corporation’s ‘profit center’ is the university’s ‘prestige center.’ The bulls-eye of that prestige center is the scholar* [author’s italics],” (Huber, 1992, p.9). Huber goes on to write:

A university’s reputation is not made by superior undergraduate teaching. It is established by a steady flow of money from government, corporations, alumni, and foundations. A productive faculty converts the money into knowledge, hopes for a favorable evaluation by its peers, and returns to patrons for further sustenance, (1992, p.39).

The apparent disconnect between strong Grant and Contract Activity and unaffected doctoral production at Montana State University runs contrary to the primary theme that emerged from interviews with its prominent faculty researchers on their unified approach to research and teaching. Montana State University’s apparent pursuit of prestige was shown in this study to have been strategically led by University administrators years before Grant and Contract Activity actually began to rise significantly. Montana State University’s policy makers and faculty researchers may do

well to recognize that the Carnegie Foundation for the Advancement of Teaching has moved its prestigious, classification target. The arrow of research activity alone will no longer find its mark without the well-strung bow of productive graduate instruction.

Princeton's Goheen wrote:

In general, though, I believe that the tension between good research and good teaching is a balanced one and will remain so, and that the common sense of America's academic folk will prevail so that good teaching will have its proper place of honor among them. Meanwhile it falls to all of us to help to keep that balance and preserve the dignity of the teacher-scholar as teacher, not solely as scholar. This cannot be the concern of deans and presidents alone, but must be that of departments and individual faculty members as well. It is precisely there that the battle for effective teaching will be fought and won, (1969, p.86).

Discussion of Broader Implications of the Findings

Theoretical Implications

American higher education beginning in the late nineteenth century was partly modeled after German research institutions in which academic study was largely research and laboratory based (Veysey, 1965). At German institutions, learning was as much a matter of professional apprenticeship as it was a matter of studying textbooks and listening to lectures. Having adopted much of this model for a century, American universities are widely recognized as the most productive in the world, both in terms of the quality of education and the quality and quantity of research (Graham & Diamond,

1997). Historically, then, it seems odd to argue that research and teaching are somehow incompatible, except to the extent that institutional policies set up conflicts over resources, or create a reward structure that fails to encourage the integration of both sets of duties.

It would be unwise to presume on the basis of the qualitative component of this study that all Montana State University researchers are uniformly enthusiastic toward the whole teaching mission of the university. Nor does this study suggest that the effort to support quality research on any campus can proceed without infringing on resources and space needed for teaching, or that personnel policies and other institutional arrangements are easily adjusted to accommodate both teaching and research goals. Some research faculty may have no interest in teaching, and some universities may willingly compromise their educational mission, especially for undergraduates, in order to serve their research agenda. What this study contributes is some debunking of the assertion that research and teaching cannot get along, and that conflict is inevitable. If administrative policies create strong Grant and Contract Activity without strong doctoral production, then presumably policy changes can bring about a better balance.

Top research faculty on this campus echoed the historical view that research and teaching function best in a symbiotic relationship. If this is true, then university administrators are challenged to design policies that formally strengthen that relationship.

How can policies such as promotion and tenure, institutional support and resource allocation be developed to support the faculty's integration of teaching and research?

If research and teaching can strengthen one another, as the remarks of these eight distinguished researchers would seem to reveal, then how does the university establish mechanisms to mentor faculty toward the kind of integration of duties attained almost intuitively by these researchers? And if this integration of functions works so well at the level of individual faculty members, how does an institution achieve a comparable configuration at the level of the institution itself? Can policies and processes be established that allow the research function and the teaching function to support and to strengthen one another? The faculty interviewed for this study made clear their belief that research does well in a climate of good teaching, and that good teaching benefits from a climate of active research.

Practical Implications

This study was supported by the Dean of the College of Graduate Studies in order to provide data and analysis for what he called "the big picture" of Montana State University research and graduate instruction in his October 6, 1999, memorandum of introduction of the researcher to prominent faculty researchers interviewed for the qualitative component of the study. This researcher hoped to provide practical data and

analysis of “the big picture” to its primary consumer, the dean. Describing the failings of an elaborate statistical study for Harvard University administrators, it was pointed out, “If you organize your project for senior administrators, we urge you to consult regularly with them to determine how you can present results in the most useful way. Results that are crystal clear to one audience may be murky to another,” (Light, Singer & Willet, 1990, p.240). Except for a period of unbeknownst technical errors with the university’s electronic mail system, this researcher met and corresponded regularly with the dean as the study progressed.

The Montana State University faculty researchers interviewed for this study revealed strong beliefs and numerous day-to-day practices demonstrating the unity of research and teaching in their work. The quantitative component of this study reveals that these beliefs and practices do not appear to be having significant effect on Montana State University’s doctoral production. It is left as a policy and practical challenge to the Montana State University leadership and faculty to translate success in Grant and Contract Activity to doctoral production (i.e., increasing the number of doctorates awarded). There are many incentives reviewed in the literature for connecting research activity more closely with graduate education, including Montana State’s mission as a public, Land Grant university.

In its past pursuit of the prestige in part earned by increased Grant and Contract

Activity, Montana State University has a record of some success. If the institution is to continue this success, it would seem that an examination of policies governing the relationship between its research and instructional endeavors is in order. The Carnegie Foundation for the Advancement of Teaching's further revisions in its classification system, expected in 2005, are anticipated to build on its recent shift—toward emphasizing doctoral production over Grant and Contract Activity—by taking a particular institution's mission statement into greater account for classification purposes. The results of this study, particularly in the qualitative component, reveal that Montana State University appears ready and able to make instructional gains, particularly in doctoral production, as it has capitalized on the research capacity of the institution.

Montana State University policy leaders are now challenged to determine how to develop policies that effectively allow MSU faculty researchers as a whole to fulfill their joint research and teaching duties just as the prominent faculty researchers in this study have eloquently articulated. Since these prominent faculty researchers spoke of the unified nature of their research and teaching work, policies that reward faculty equally for research and teaching production may allow Montana State University to better balance these institutional missions. Certainly, given the changes made and expected in the Carnegie classification system, Montana State will have to achieve greater instructional success and doctoral production if its prestige strategy is to continue to benefit the

institution.

Limitations of the study

This study has been limited to Grant and Contract Activity and graduate education at Montana State University and should not be applied without due caution to any other university, even peer universities as defined by like size, mission and enrollments. The qualitative component of the study draws upon interviews with prominent Montana State University research faculty, who should not be understood as a representative sample of any kind. The Dean of the College of Graduate Studies, who initiated and supported this study, selected these faculty for their record of strong Grant and Contract Activity in the natural sciences and engineering. The dean is intended to be the primary consumer of this study. The study should not be expected to provide a sufficiently detailed picture of Montana State University's College of Graduate Studies or Montana State's Grant and Contract Activities to the casual, even local academic, reader.

Summary of Conclusions

Answer to Question

The quantitative results of this study appear to challenge its primary qualitative result, namely, that Montana State University faculty researchers view and practice

research and teaching as unified activities. Doctoral production (i.e., the number of doctorates awarded) was flat from 1989 to 1999, while Grant and Contract Activity more than tripled.

Implementation of Findings

Policy changes at Montana State University may be able to correct the disconnect between what on the one hand are the views of the faculty researchers interviewed, the literature on the benefits to both university research and teaching, the university's own instructional mission and the Carnegie Foundation for the Advancement of Teaching's revised classification system, and what on the other hand are graduate education, graduate assistantships and doctoral production. This study was intended to provide data and analysis to the Dean of the College of Graduate Studies for the purpose of considering possible policy changes to reconnect research activity to graduate education at Montana State University.

REFERENCES CITED

REFERENCES

- Aleamoni, L. M. (1975). MSU council instruction evaluator questionnaire [Abstract]. *Arizona CIEQ*.
- Balderston, F. E. (1995). *Managing today's university: Strategies for viability, change, and excellence*. San Francisco: Jossey-Bass Publishers.
- Barzun, J. (1968). *The American university: How it runs, where it is going..* New York: Harper & Row Publishers.
- Boom, D. (2000). *Evldept.doc* [Electronic mail data file].
- Bowen, W. G., & Rudenstine, N. L. (1992). *In pursuit of the Ph.D.* Princeton, NJ: Princeton University Press.
- Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professorate*. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.
- Brainard, J. (2001, August 10). Separating fact from myth about pork-barrel spending and academe. *The Chronicle of Higher Education* 47(48). Retrieved September 9, 2001, from <http://chronicle.com/free/v47/i48/48a02201.htm>
- Brainard, J., & Southwick, R. (2001, August 10). A record year at the federal trough: Colleges feast on \$1.67-Billion in Earmarks. *The Chronicle of Higher Education* 47(48). Retrieved September 9, 2001 from <http://chronicle.com/free/v47/i48/48a02001.htm#recipients>
- Breneman, D. W. (1975). *Graduate school adjustments to the "new depression" in higher education*. Washington, D.C.: National Board on Graduate Education.
- Brewer, D. J., Gates, S. M., & Goldman, C. A. (2001). *In pursuit of prestige: Strategy and competition in U.S. higher education*. New Brunswick, NJ: Transaction Publishers.

- Bromley, D. A. (1992). *The national research and education network program: A report to congress* [Submitted by the director, Office of Science and Technology Policy, in response to a requirement of the High Performance Company Act of 1991(P.L. 102-194)]. Washington, D.C.: Executive Office of the President, Office of Science and Technology Policy.
- Bronfenbrenner, K., & Juravich, T. (2001, January 19). *The Chronicle of Higher Education*.
- Burgan, M. (1999). Welcome letter to graduate students. In *AAUP Home Page*. Washington, D.C.: American Association of University Professors. Retrieved October 24, 2000, from <http://www.aaup.org>
- Cartter, A. M. (1966). *An assessment of quality in graduate education: A comparative study of graduate departments in 29 academic disciplines*. Washington D.C.: American Council on Education.
- Colebeck, C. L. (1998). Merging in a seamless blend: How faculty integrate teaching and research. In *The Journal of Higher Education* (6th ed., Vol. 69, p. 647). Ohio State University Press.
- College of Graduate Studies. (2001). Retrieved from <http://www.montana.edu>
- Commission on Colleges. (1999). *Evaluation committee report* [A confidential report that represents the views of the Evaluation Committee]. Bozeman, MT: Montana State University.
- Creswell, J. (1998). *Qualitative inquiry and research design*. Thousand Oaks: Sage Publications Inc.
- Damrosch, D. (1995). *We scholars: Changing the culture of the University*. Cambridge, MA: Harvard University Press.

- Dukes, S. (1984). Phenomenological methodology in the human sciences. *Journal of Religion and Health*, 23(3), 197-283.
- Geiger, R. L. (1993). *Research and relevant knowledge*. New York: Oxford University Press.
- Getman, J. (1992). *In the company of scholars: The struggle for the soul of higher education*. Austin, TX: University of Texas Press.
- Goheen, R. F. (1969). *The human nature of a university*. Princeton, NJ: Princeton University Press.
- Goldman, C. A., & Williams, T. (2000). *Paying for university research facilities and administration*. Santa Monica, CA: Rand.
- Graham, H., & Diamond, N. (2000). *The rise of American research universities*. Baltimore: Johns Hopkins Press.
- Greenburg, D. S. (2001, January 19). Science in the public sector: Who's making the decisions? *The Chronicle of Higher Education*, 47(19). Retrieved March 20, 2001, from <http://chronicle.com/weekly/v47/i19/19b01001.htm>
- Grigg, C. M. (1965). *Graduate Education*. New York: The Center for Applied Research in Education, Inc.
- Herbst, J. (1965). *The German Historical School in American Scholarship*. Ithica, NY: Cornell University Press.
- Hofstadter, R., & Metzger, W. P. (1955). *The development of academic freedom in the Unites States*. New York: Columbia University Press.
- Huber, R. M. (1992). *How professors play the cat guarding the cream: Why we're paying more and getting less in higher education*. Fairfax, VA: George Mason University Press.

- Jutilla, J. W. (1980). *An outline of research activities at MSU.: Vol. . A supplement to the 1980 accreditation review of research activities at Montana State University-Bozeman.*
- Kellogg Commission on the Future of State and Land-Grant Universities. (2000). *Renewing the covenant: Learning, discovery, and engagement in a new age and different world.*
- Kennedy, D. (1997). *Academic duty.* Cambridge, MA: Harvard University Press.
- Kerr, C. (1964). *The uses of the university.* Cambridge, MA: Harvard University Press.
- Krohn, J. R. (1992). *Advancing research universities: A study of institutional development, 1974-86.* Unpublished manuscript, Pennsylvania State University.
- Lehming, R. F. (1997, July 18). Do academic research costs drive up undergraduate tuition? *National Science Foundation*, 97(313).
- Light, R. J., Singer, J. D., & Willet, J. B. (1990). *By design: Planning research on higher education.* Cambridge, MA: Harvard University Press.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Newbury Park, CA: Sage Publications Inc.
- Lovitts, B. E. (2001). *Leaving the ivory tower: The causes and consequences of departure from doctoral study.* London: Rowman & Littlefield Publishers, Inc.
- Magner, D. K. (2000, April 17). An overhaul of Ph.D. training is urged, as survey suggests frustrations of doctoral students. *The Chronicle of Higher Education*. Retrieved November 31, 2000, from <http://chronicle.com/daily/2000/04/2000041705n.htm>
- Malone, M. (1995). *September 1 memorandum to Jeff Baker, Commission on Higher Education.*

- Malone, M. (1997). *Interim report on PQ&O agreement, with October 13 cover memorandum on Richard Crofts*. Bozeman: Montana State University.
- Martino, J. P. (1992). *Science funding: Politics and pork-barrel*. New Brunswick, NJ: Transaction Publishers.
- McCleod, B. (2000, December 14). *Correspondence*.
- McCormick, A. (1999). *Plans for the 2000 edition of the Carnegie classification: A presentation to the Washington Higher Education Secretariat*.
- Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.
- Minow, T. *November 22 Press Release*. Helena, MT: Montana Education Association & Montana Federation of Teachers.
- Montana State University. *Mission Statement*. Retrieved, 2000, from <http://www.montana.edu>
- Montana State University. *Office of institutional research*. Retrieved, November 30, 2000, from <http://www.montana.edu>
- Montana State University- Bozeman. (1999). *Institutional Self Study*. Bozeman, MT: Montana State University.
- Mooney, E. (1998). MSU, economic growth and resident tuition. In *MSU Professor's web-site*. Retrieved July 29, 2000, from <http://www.montana.edu>
- Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage Publications.
- Mudd, J. O. (1990). *Montana crossroads: Montana higher education in the nineties* [Report of the Education Commission for the nineties and beyond]. Helena, MT: Montana Education Commission.

- Newman, J. (1976). I. T. Ker (Ed.), *The idea of the university defined and illustrated*. Clarendon: Oxford.
- Orlans, H. (1962). *The effects of federal programs on higher education: A study of 36 universities and colleges*. Washington, D.C.: The Brookings Institution.
- Pelikan, J. (1983). *Scholarship and its survival: Questions on the idea of graduate education*. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.
- Peterson, M. W., Dill, D. D., Mets, L. A., & associates. (1997). *Planning and management for a changing environment: A handbook on redesigning post-secondary institutions*. San Francisco: Jossey-Bass Publishers.
- Rapaport, A. I. (1998, December 2). How has the field mix of academic r & d changed? *National Science Foundation*, 99(309).
- Regets, M. C. (1998, December 2). Has the use of post-docs changed? *National Science Foundation*, 99(309).
- Roloff, C. (2001). MSU rectifies error in collecting receivables from students. In *Press Release*. Bozeman, MT: Montana State University.
- Rydell, R., Safford, J., & Mullen, P. (1992). *In the people's interest: a centennial history of Montana State University*. Bozeman, MT: Montana State University Foundation.
- Sanderson, A. R., Dugom, B., Hoffer, T., & Selfa, L. (1999). *Doctorate recipients from U.S. universities: Summary report 1998*. Chicago: National Opinion Research Center at the University of Chicago.
- Serow, R. C., & Demery, J. (1999, November). *Faculty perspectives on teaching at a research university*. Paper presented at the meeting of the Association for the Study of Higher Education, San Antonio, TX.

- Shulman, L. S. (2000). *Carnegie classifications of higher education institutions*. Menlo Park, CA: Carnegie Foundation for the Advancement of Teaching. Retrieved December 14, 2000, from <http://www.carnegiefoundation.org>
- Syverson, P. D. (1997, April). *It's not just employment/unemployment anymore: Realities of Ph.D labor market lead to more complex measures of post-graduation employment*. Washington, D.C.: American Association for the Advancement of Science. Retrieved March 2, 2001, from <http://nextwave.org>
- Taylor, N. (1974). *Technical report on faculty research*. Helena, MT: Commission on Post-Secondary Education.
- Tribune Editorial. (2001, May 29). We hope regents haven't pushed tuition hikes too far. *Great Falls Tribune*.
- Trout, P. (2000, March 13). Low marks for top teachers: College students have a powerful say in how their teachers are graded. *Washington Post*, p. A17.
- University Teachers Union, University of Montana, & Montana University System. (1999). [Collective Bargaining Agreement].
- Veysey, L. (1965). *The emergence of the American university*. Chicago: The University of Chicago Press.
- Western, K. H. (1984). *The risks of excellence: The role of research at Montana State University*. Montana State University, Bozeman, MT.
- Whitehead, A. N. (1932). *The aims of education and other essays*. London: Williams & Norgate Ltd.
- Williams, R. L. (1991). *The origins of federal support for higher education: George W. Atherton and the land-grant college movement*. University Park, PA: The Pennsylvania State University Press.

- Winston, G. C., Carborne, J. C., & Lewis, E. G. (1998, March). What's been happening to higher education? In *The Williams Project on the Economics of Higher Education*. Retrieved January 30, 2001, from <http://www.williams.edu/Mellon>
- Wittenburg, K. (2000, December 15). Electronic Publishing: A 'whether' report. *The Chronicle of Higher Education*, 47(16). Retrieved March 2, 2001, from <http://chronicle.com/weekly/v47/i16/16b02401>
- Yin, R. (1994). *Case study research: Design and methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Zuckerman, H. (1977). *Scientific elite: Nobel laureates in the United States*. New York: The Free Press.

APPENDICES

APPENDIX A

QUALITATIVE COMPONENT QUESTIONS

To: Distinguished Faculty Members, Montana State University
Fr: Chris Junghans, doctoral candidate in education, Montana State University
Re: Faculty research study

October 11, 1999

I am writing to ask your participation in a qualitative study of current Montana State University faculty research. As Dr. Bruce McLeod, dean of the College of Graduate Studies, explained in his letter of Oct. 6, you are one of ten distinguished MSU faculty researchers selected for the study.

I estimate that participation will require about a half an hour of your time, either in interview with me or in written response to the interview questions below (also attached in Rich Text Format). Please contact me to set up an appointment for an interview by replying to this email message (junghans@montana.edu) or by calling me at 522-6259 (daytime with voicemail) or 585-0286 (home with message machine). I will follow this email with a hard copy of the same delivered to you by campus mail this week.

I teach at Bozeman High School, and therefore would like to set up an interview with you at your office or laboratory on any weekday at 4:15 p.m. beginning Wednesday, October 13, through Friday, November 5, with the exception of October 21 and 22. In addition, I can meet with you at any time on a Saturday through November 6.

While an interview would be preferable to me for the purposes of this descriptive study, I understand that your schedules are very full and this is short notice. If you cannot allow me an interview under the time constraints given here, please participate in this study by sending me your written responses to the questions below (per email to: junghans@montana.edu or mailed to me at: 2615 Daffodil Drive, Bozeman MT 59718).

Dr. Albini suggested to Dr. McLeod that it would be useful for me to get background information regarding your respective research projects from the proposals on file with MSU's Grants and Contracts office. I would like to act on this suggestion, but need your permission to do so. Please contact Mr. Bob Pfister at the Grants and Contracts office in order to allow me access to this useful background information (Mr. Pfister's email is: bpfister@montana.edu and his phone number is 994-2381. His fax number is 994-7951).

This study will help me develop a dissertation topic for next year and serve as my final requirement this semester for EDCI 507 (*Qualitative Research*, taught by Dr. Ken Borland). The results of the study will be shared with you upon request.

Thank you for your time. If you cannot participate in this study, or have any questions before you participate, please let me know.

Interview Questions

1. *What does your current research mean to your career?* Please be expansive about the origins of your research in relation to your academic training and your current faculty position at MSU. Include some consideration as to where the research may take you, career-wise, on or off the MSU campus. (If you are responding in writing, please think in terms of 5-7 sentences for an answer to this and the following three questions).

2. *What does your current research with postdoctoral researchers mean to you (if applicable)?* Without naming anyone, please describe your general working relationship with these researchers. How do you expect their current research with you to affect their respective academic or non-academic career goals, as you understand them?

3. *What does your current research with MSU doctoral candidates mean to you (if applicable)?* Without naming anyone, please describe your general working relationship with these students. Specify whether you serve on any doctoral committees for them and how you expect their current research with you to serve their intended career goals, as you understand them.

4. *What does your current research with all non-doctoral MSU students (i.e., non-degree, master's and undergraduate) mean to you (if applicable)?* Without naming anyone, please describe your general working relationship with these students. How do you expect their work with you to serve their intended career goals, as you understand them?

5. Please estimate below the number of hours you spend per week in contact with each category of researcher or student (below), as a result of your current research.

1. Postdoctoral researcher(s) _____ (hours per week)

2. Doctoral candidate(s) _____ (hours per week)

3. Undergraduate student(s) _____ (hours per week)

6. In general, about how many hours do you spend per week at MSU on the following duties?

5. Research _____ (hours per week)

6. Teaching (undergraduate) _____ (hours per week)

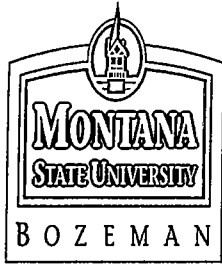
7. Teaching (graduate) _____ (hours per week)

8. Administration _____ (hours per week)

9. Other academic duties _____ (hours per week).

Please specify _____

7. Lastly—and especially if you are responding in writing—this researcher would be glad to have any additional comments you may wish to make regarding your experience as an MSU faculty researcher.



College of Graduate Studies

Office of the Dean

Montana State University- Bozeman

P.O. Box 172580

Bozeman, Montana 59717-2580

Telephone: (406) 944-4145

Fax: (406)-994-4733

Email: mcleod@montana.edu

10/6/02

To: Distinguished Faculty Members

Fr: Bruce R. McLeod

Re: Pilot Research Project

I would like to introduce Mr. Chris Junghans, a Doctoral candidate for the Ed.D. degree. The College of Graduate Studies (CGS) is supporting Mr. Junghans on his degree plan and I am also a member of his graduate committee.

He has proposed a pilot project, which will eventually be a part of his dissertation, that involves gathering information concerning research on the MSU campus from about ten prominent researchers. After Chris came to me with the idea for the pilot project (he proposes to also use this as his final project for EDCI 507, Qualitative Research), I considered his reasoning and decided that it was a good idea. He has developed a "request for basic information" form that would give us basic information about your research and he would also like to arrange an in-depth interview with each of you. Since he would like to use this for the EDCI 507 course, it puts him on a pretty tight time line. I would consider it a great favor from each of you if you could find the time to supply us with the basic information and to speak with Chris about your research.

The reason I am supporting Chris's research is that I feel we need solid data about where we are currently with respect to research on this campus before we can set realistic goals for the next few years (e.g. moving toward a R2 or R1 status). I obtained some information about our current "capacity" from my recent survey of all of the Ph.D. or Doctoral granting departments across campus and now we are trying to get data about current research. I compiled a list of ten researchers that I felt represented a good cross-section of the most distinguished researchers on the campus. I also felt that each of you would be inclined to support this effort because each of you have considerable depth in your respective fields as well as a good sense of the "bigger picture" on this campus.

I hope each of you will agree to participate in this pilot project because it will provide us with some key information. I would also invite each of you to contact me with other ideas or observations you might have with respect to where we are and where you would like to see MSU in three to five years. Chris will be contacting each of you shortly to ask for your participation and, if you are agreeable, to set up an interview time.

Thanks,

Bruce R. McLeod
Dean of the College of Graduate Study

APPENDIX B

FIGURES

Figure 1: Grants and Contracts at Montana State University

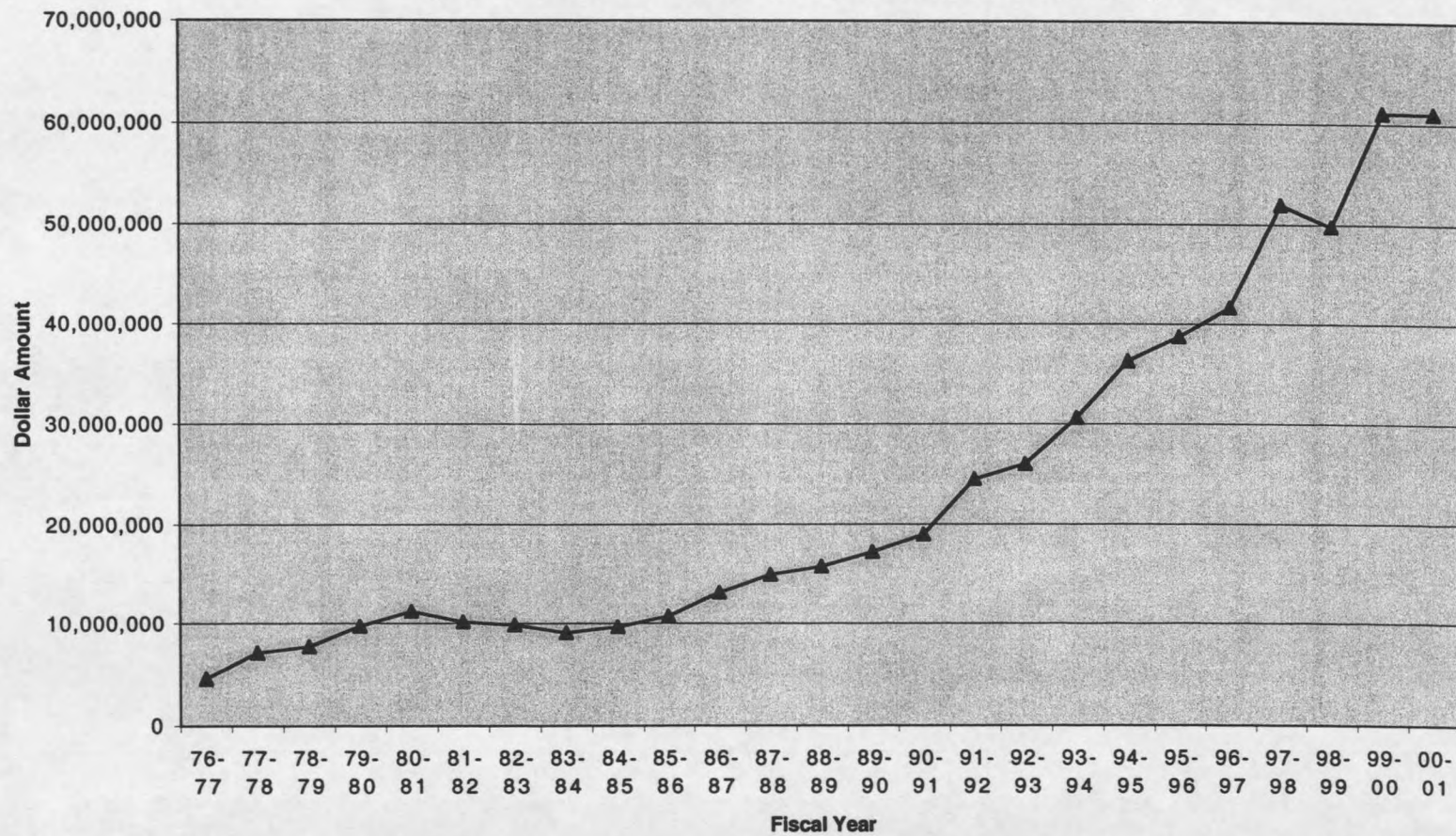


Figure 2: Montana State University Doctor's Degrees Awarded

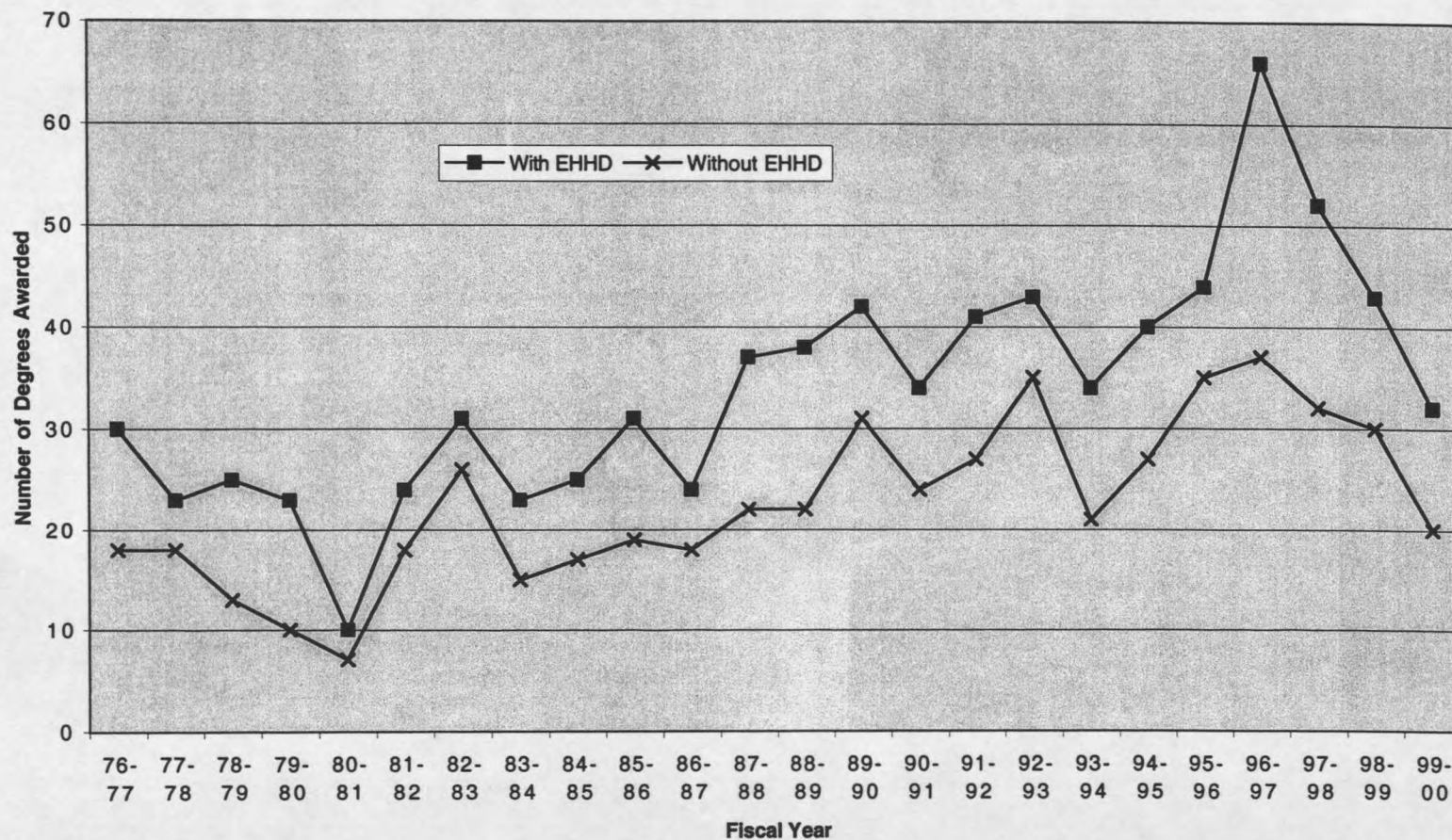


Figure 3: Montana State University Grants & Contracts with and without College of Education, Health, and Human Development

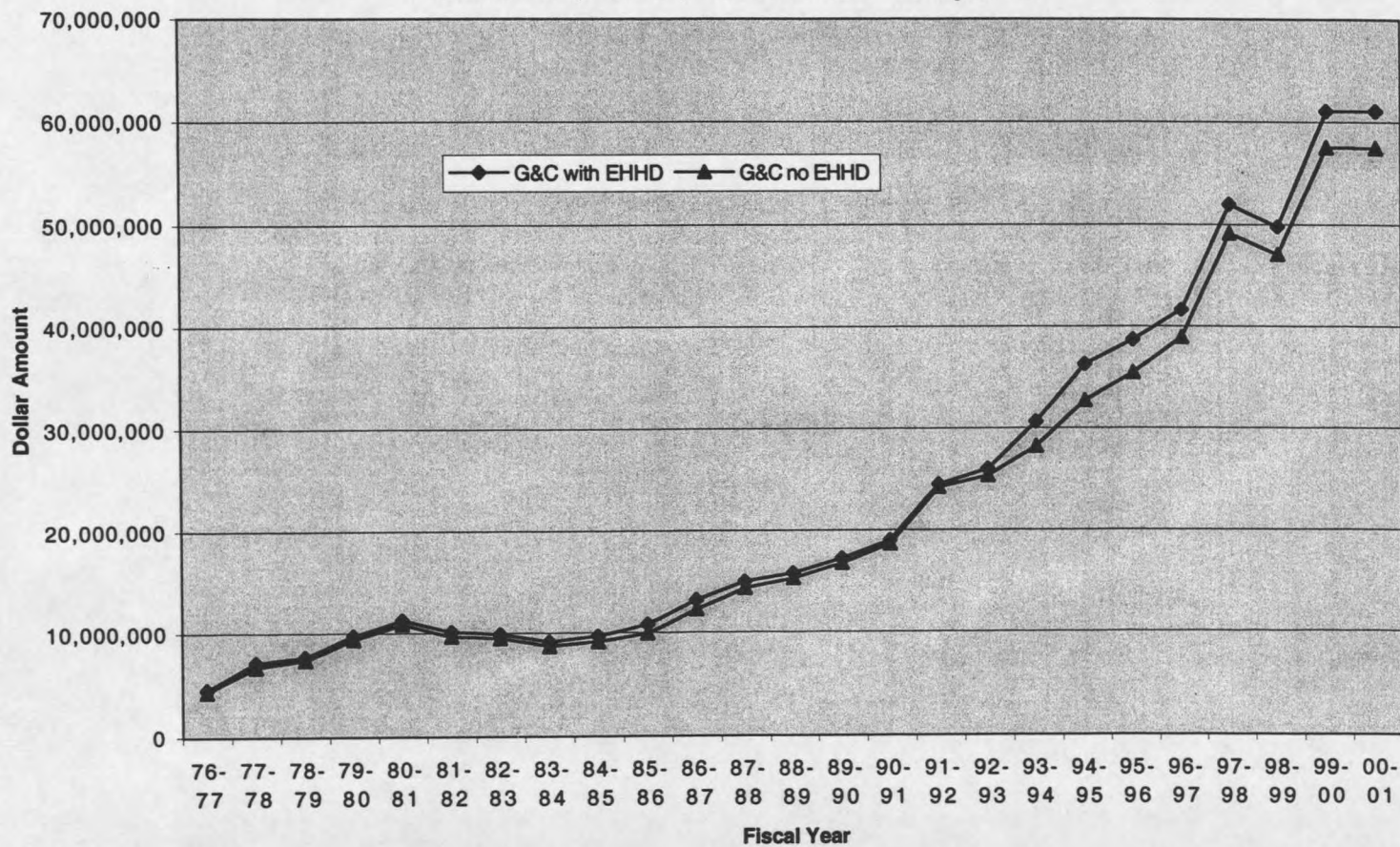


Figure 4: Montana State University Doctoral Candidates with and without College of Education, Health, and Human Development candidates

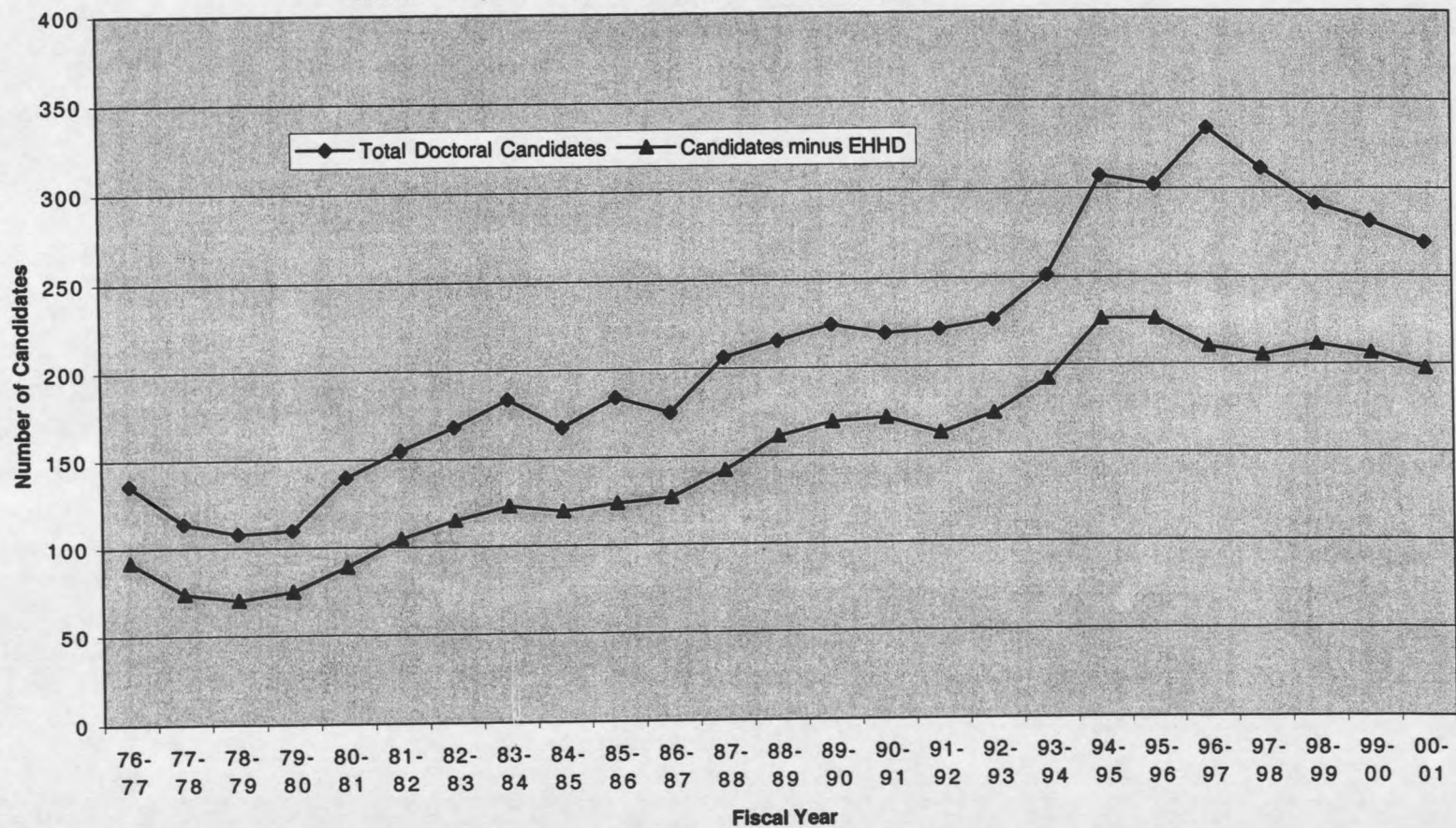


Figure 5: Montana State University Graduate Teaching Assistants

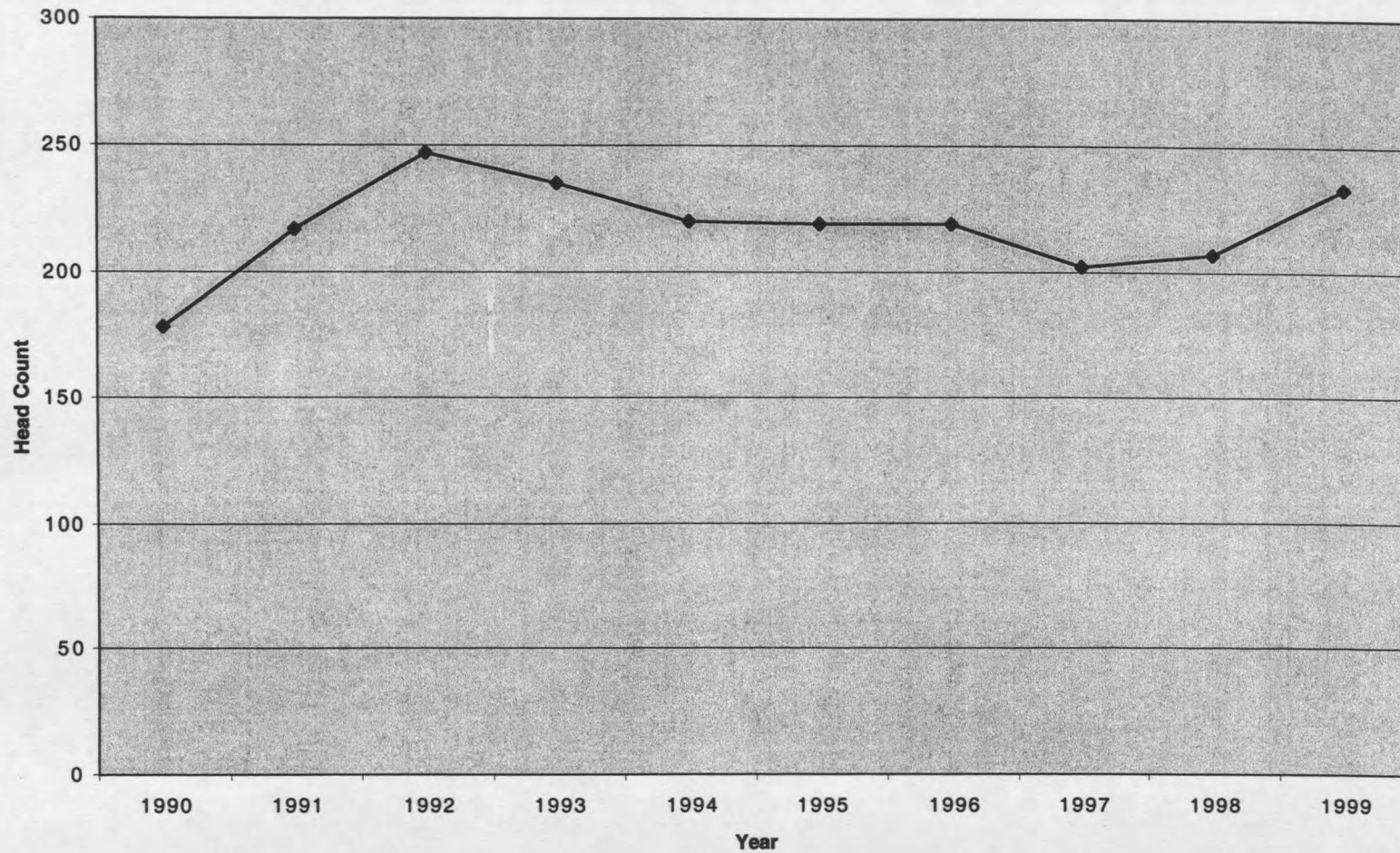


Figure 6: Montana State University Graduate Research Assistants

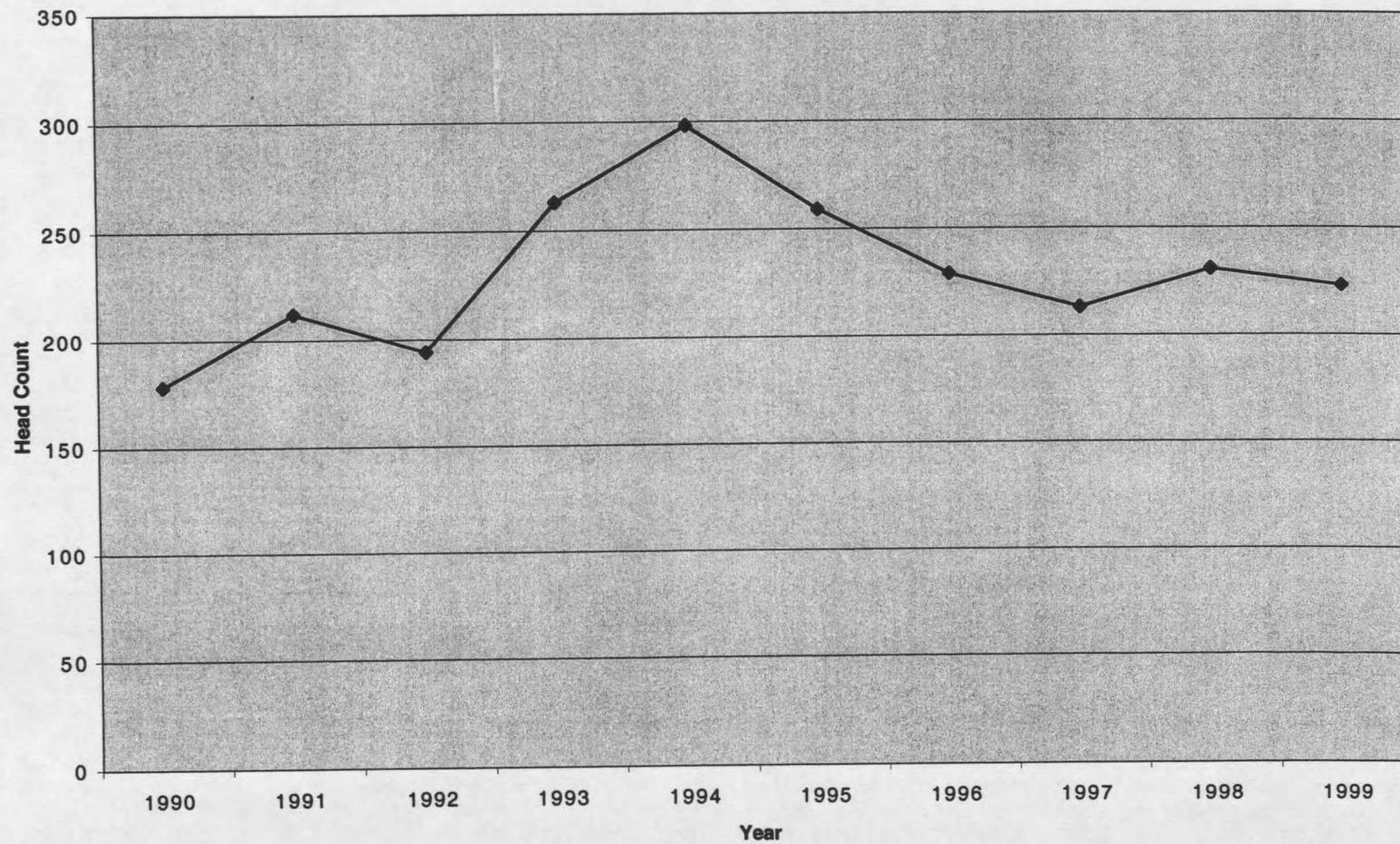


Figure 7: Montana State University Postdoctoral Researchers

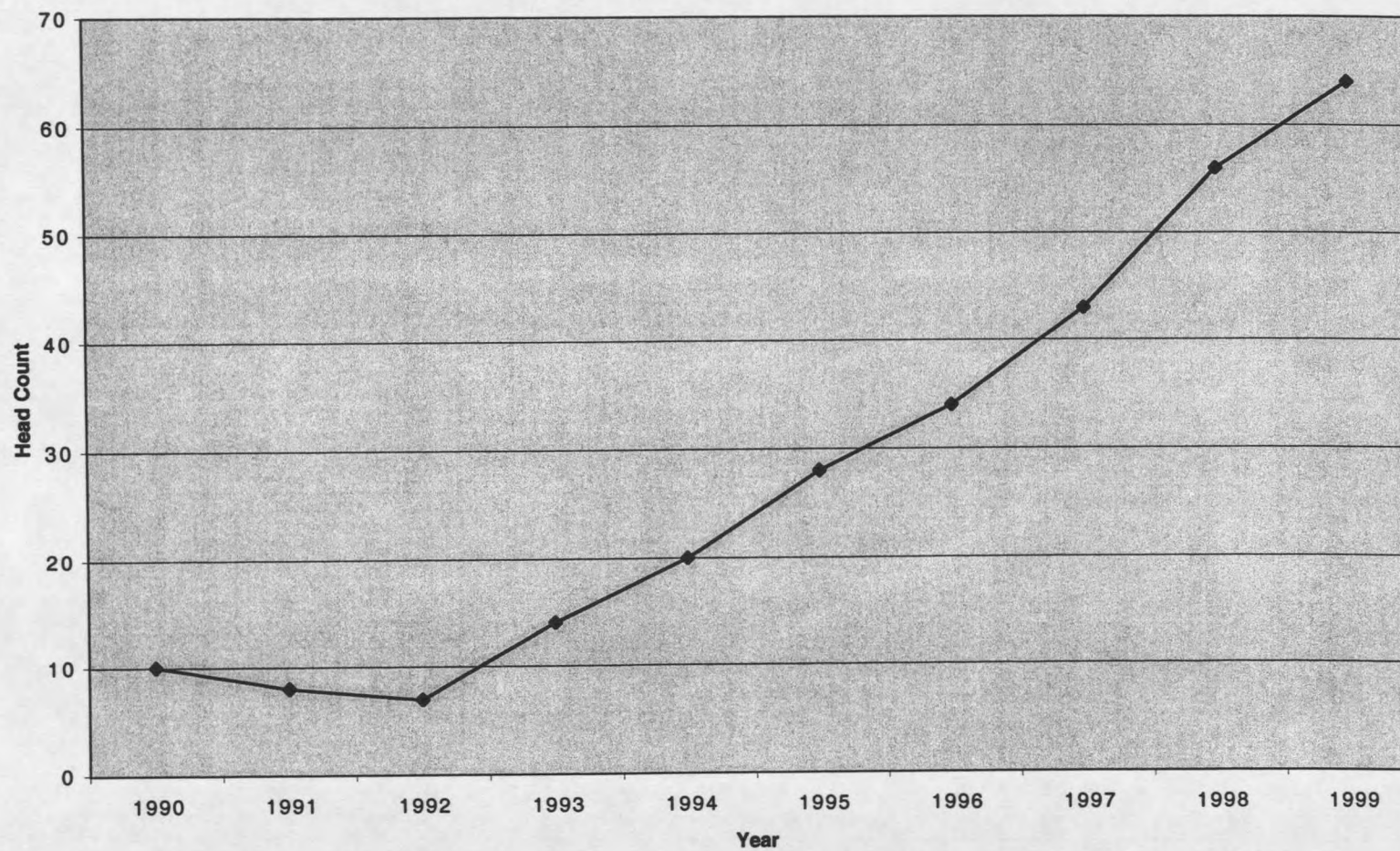


Figure 8: Annual Cumulative Grade Point Average of Montana State University Doctoral Candidates

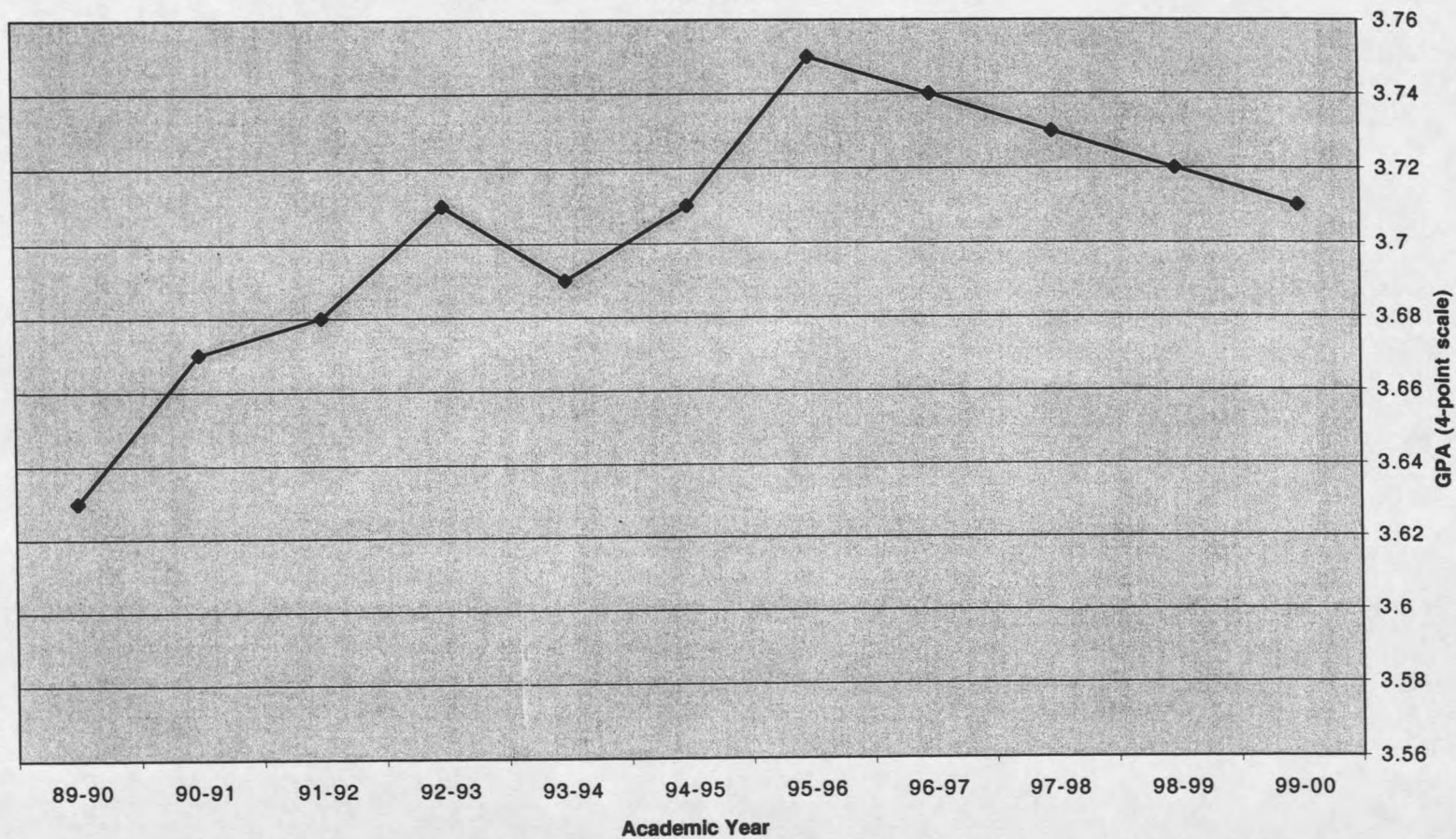


Figure 9: Montana State University Full Time Equivalent Faculty

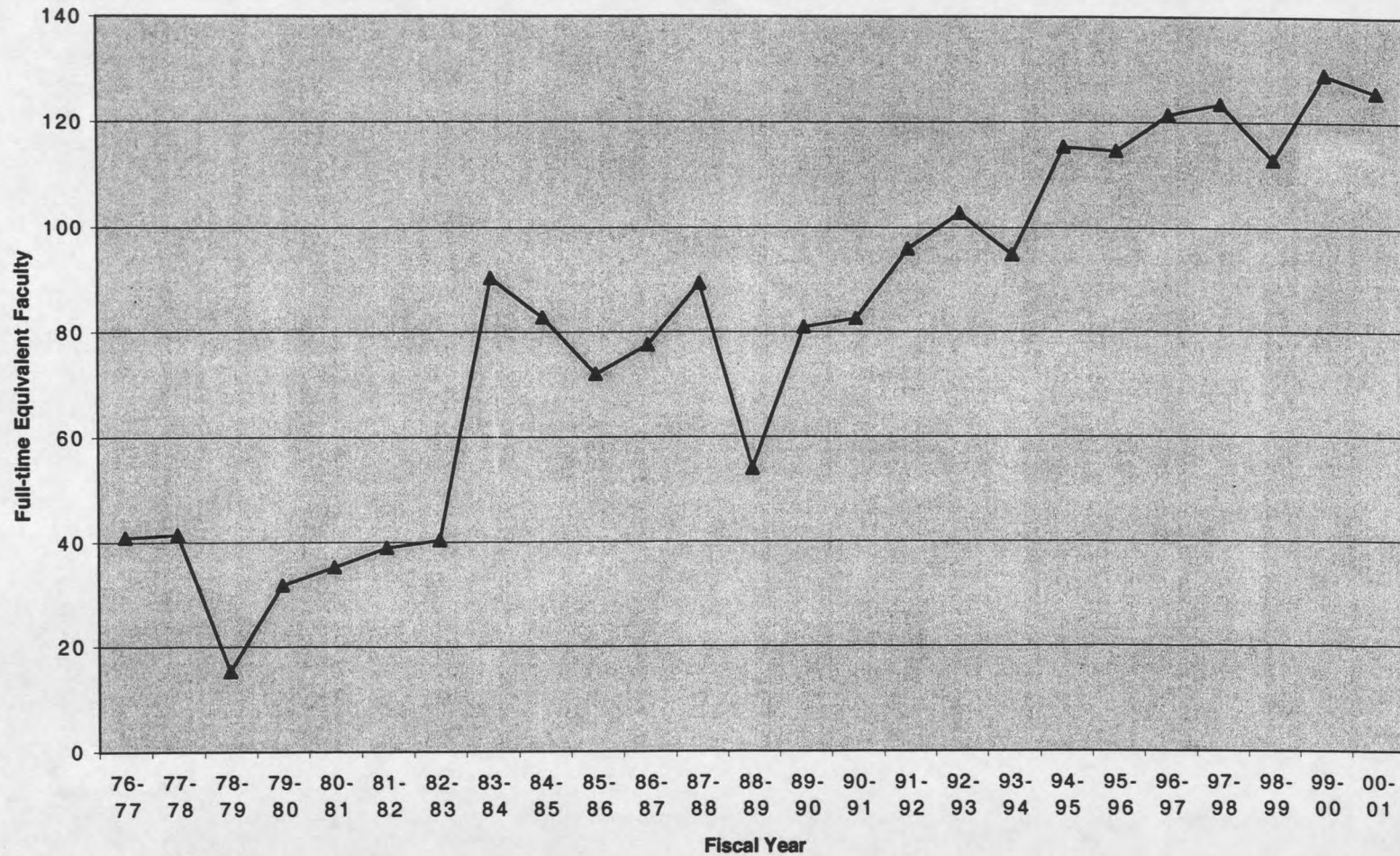


Figure 10: Montana State University Grants and Contracts in the College of Agriculture

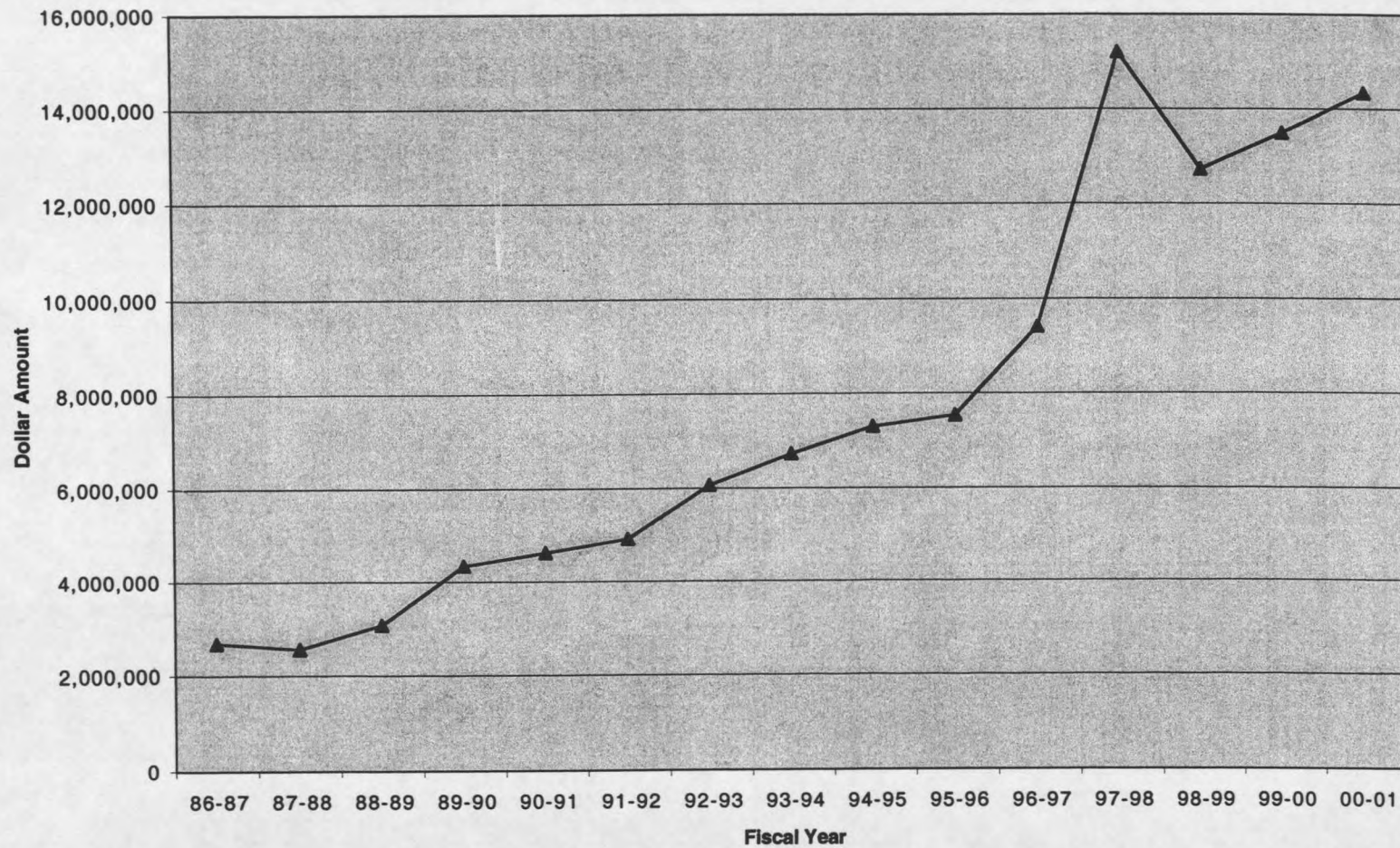
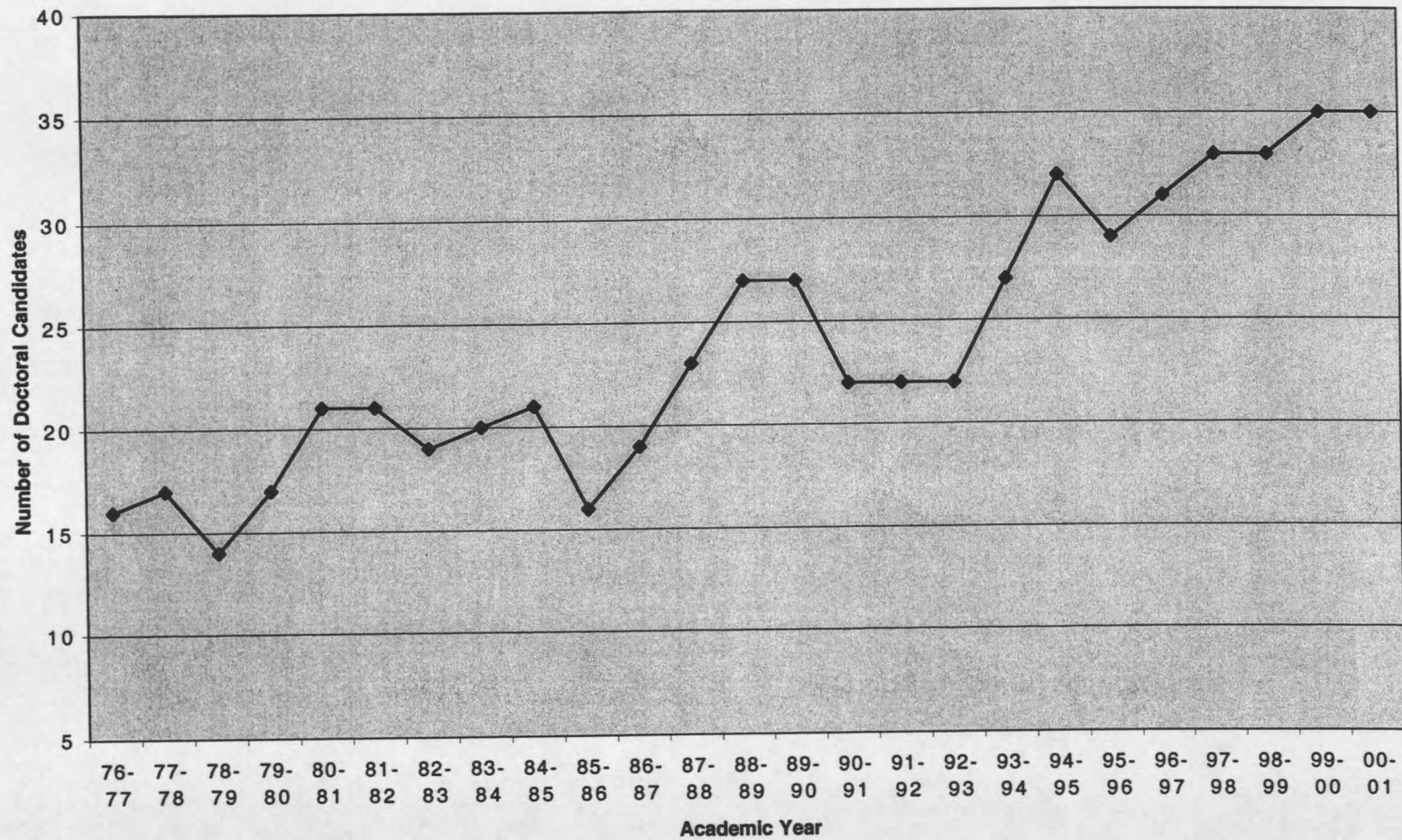
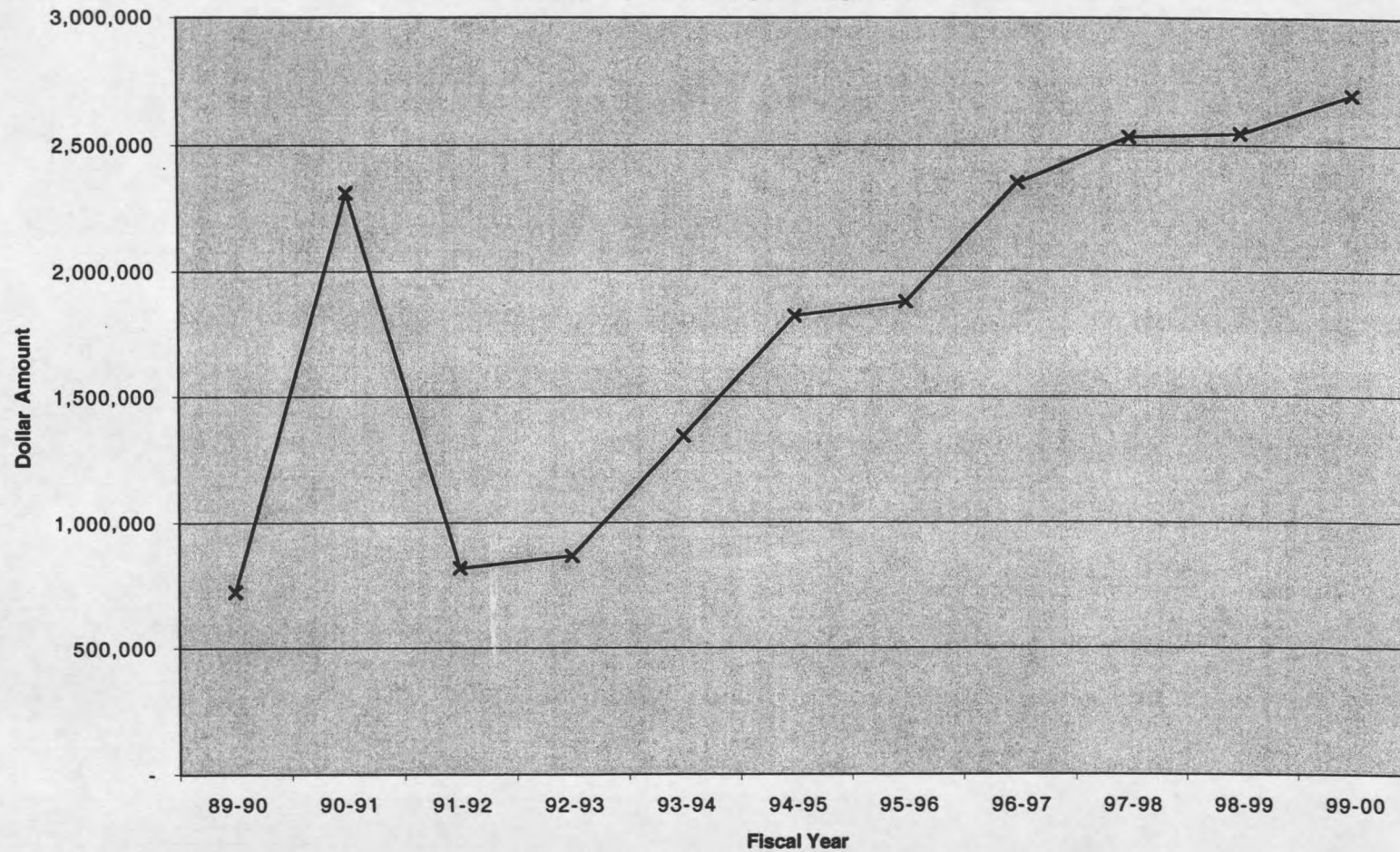


Figure 11: Montana State University Doctoral Candidates at College of Agriculture



**Figure 12: Montana State University Grants and Contracts Per Doctor's Degree
Awarded in College of Agriculture**



**Figure 13: Montana State University Grants and Contracts in College of Education,
Health, and Human Development**

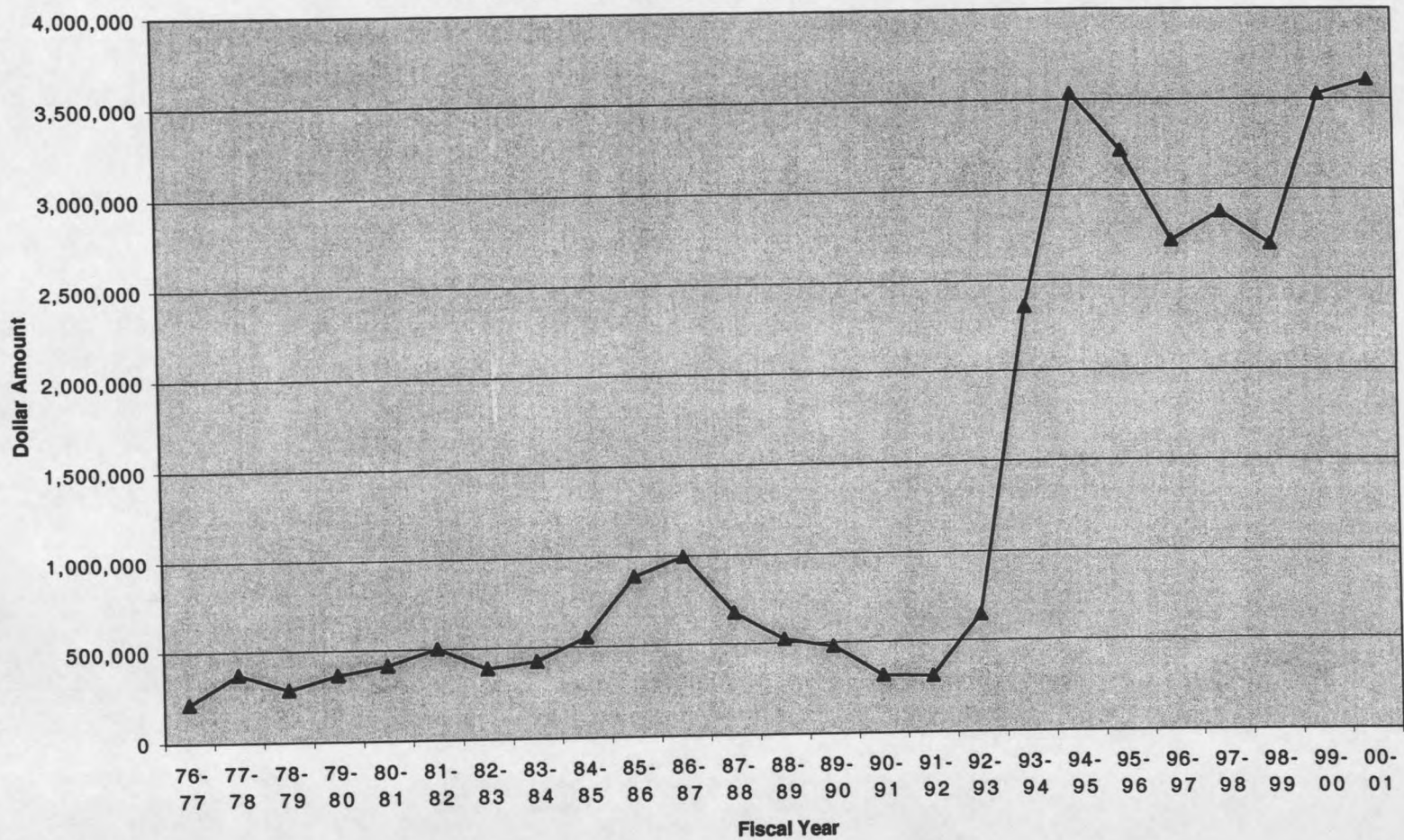


Figure 14: Montana State University Doctoral Candidates in College of Education, Health, and Human Development

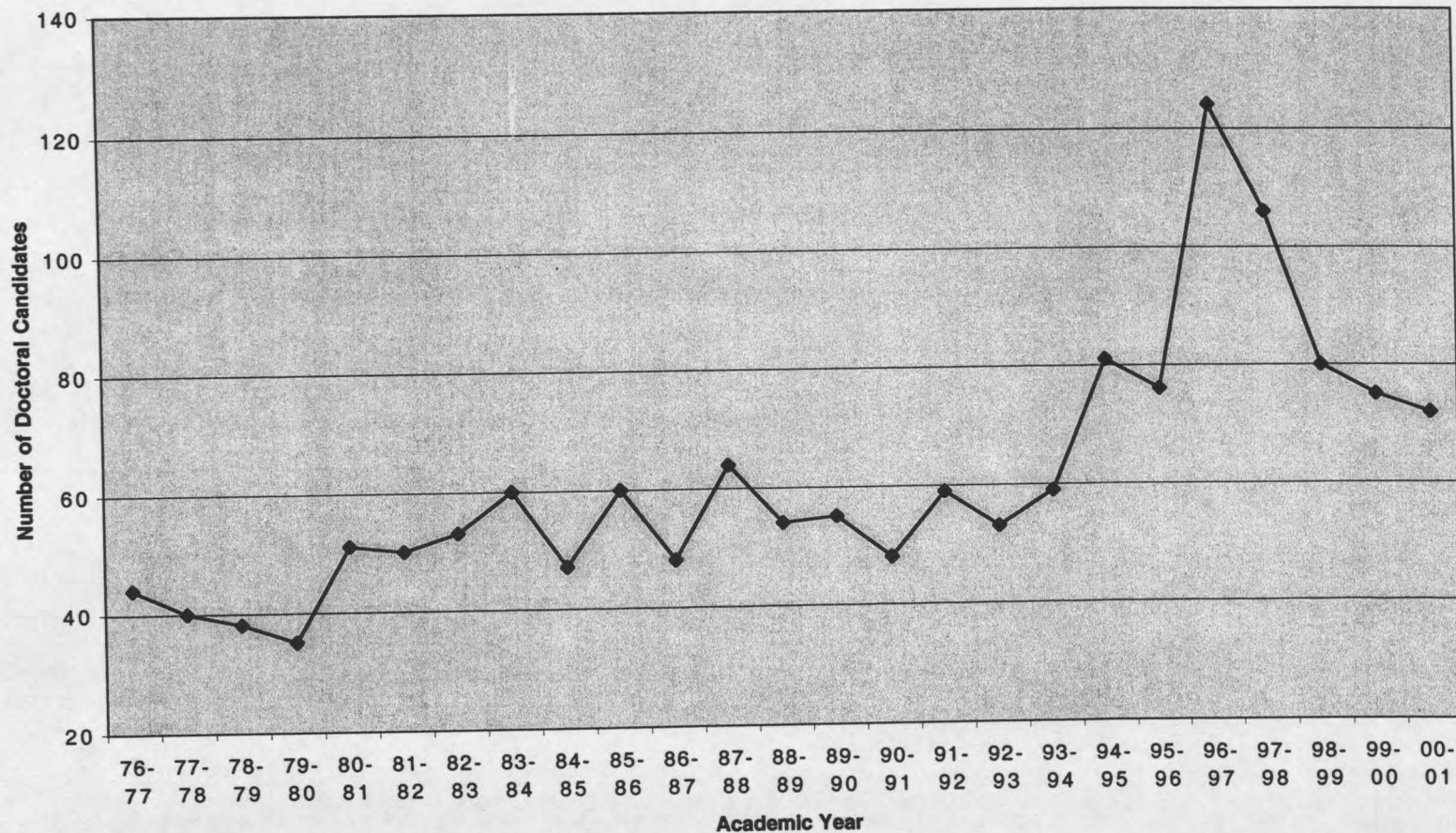


Figure 15: Montana State University Grants and Contracts Per Doctorate in College of Education, Health, and Human Development

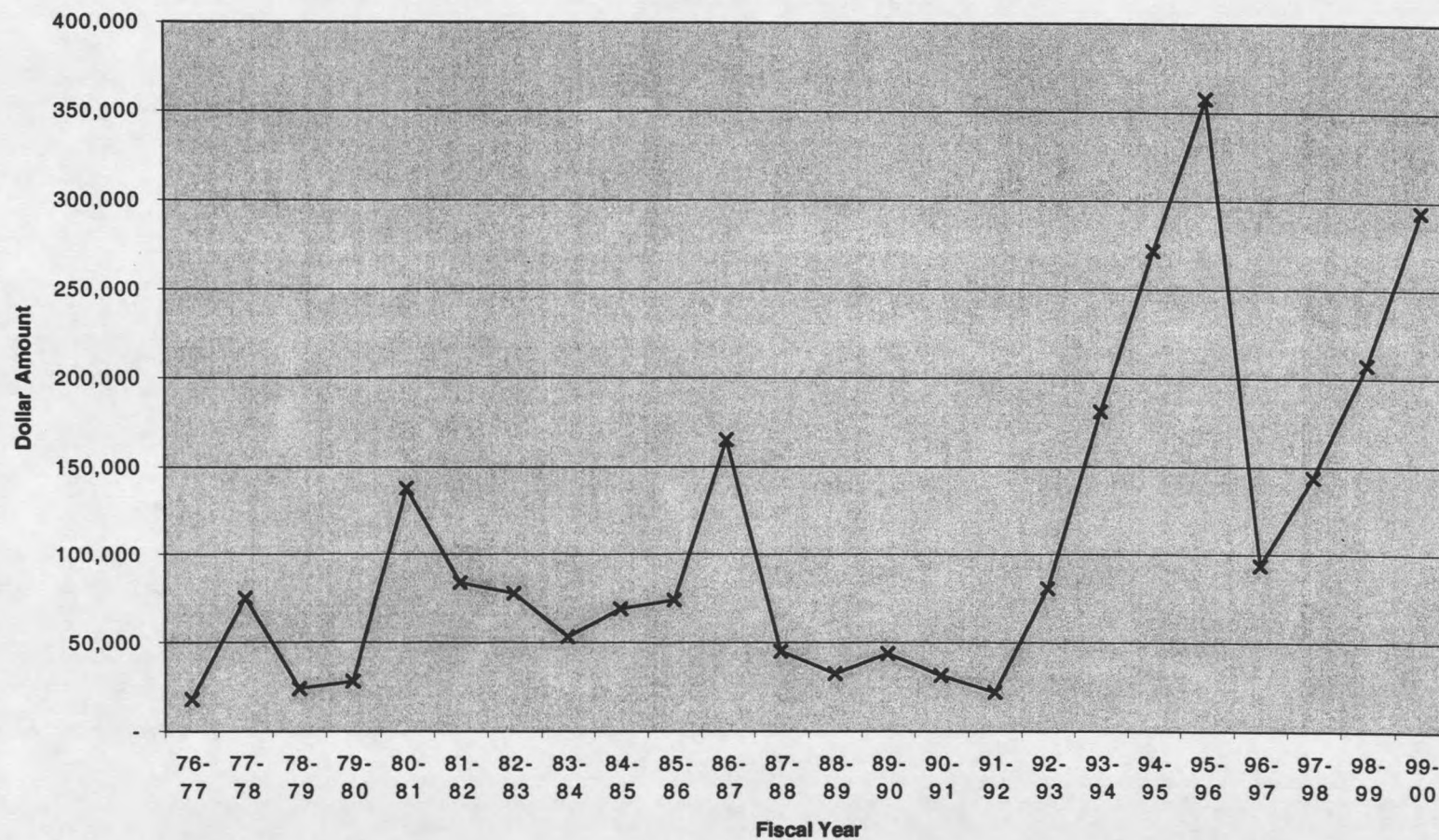


Figure 16: Montana State University Grants and Contracts in College of Engineering

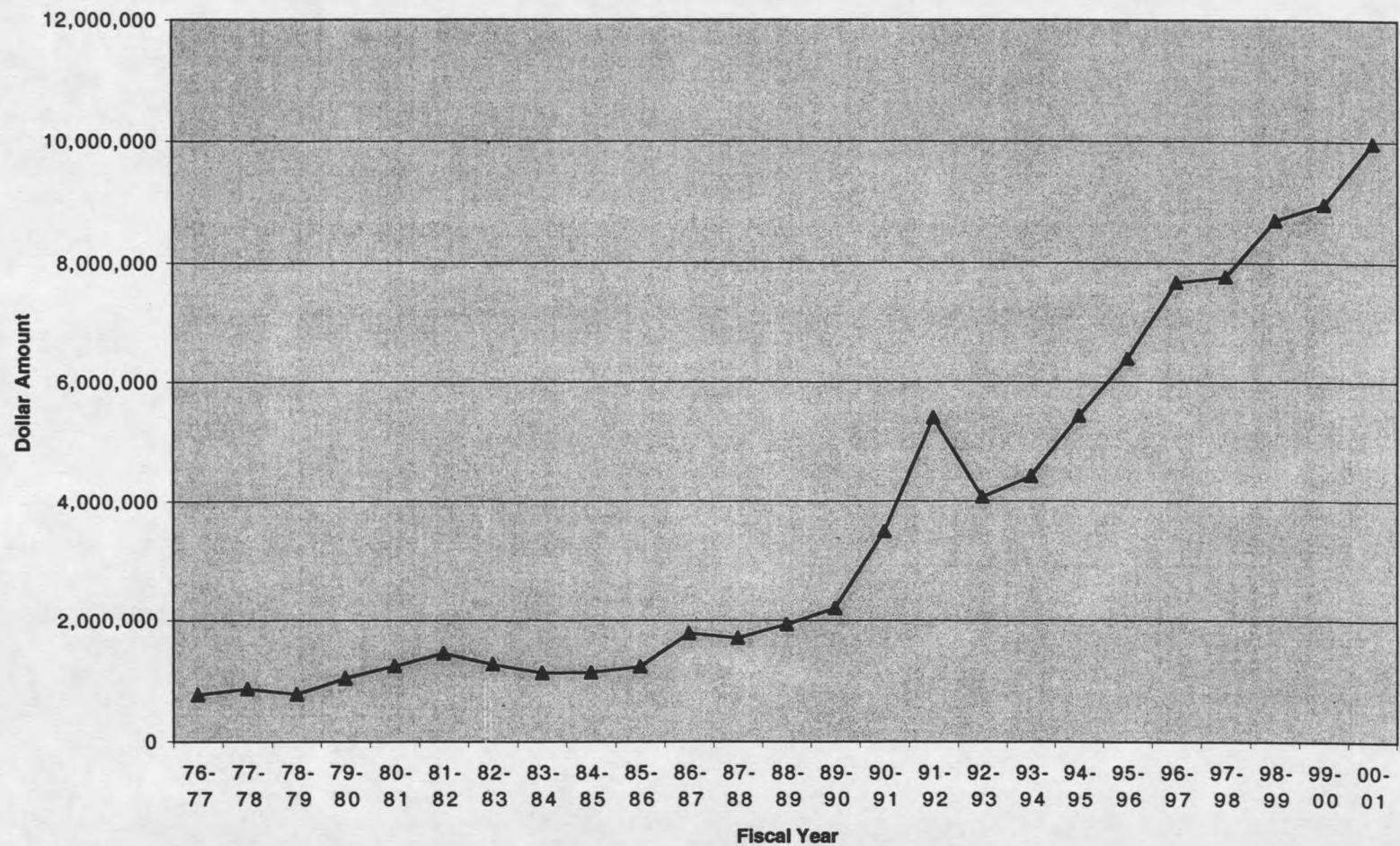


Figure 17: Montana State University Doctoral Candidates in College of Engineering

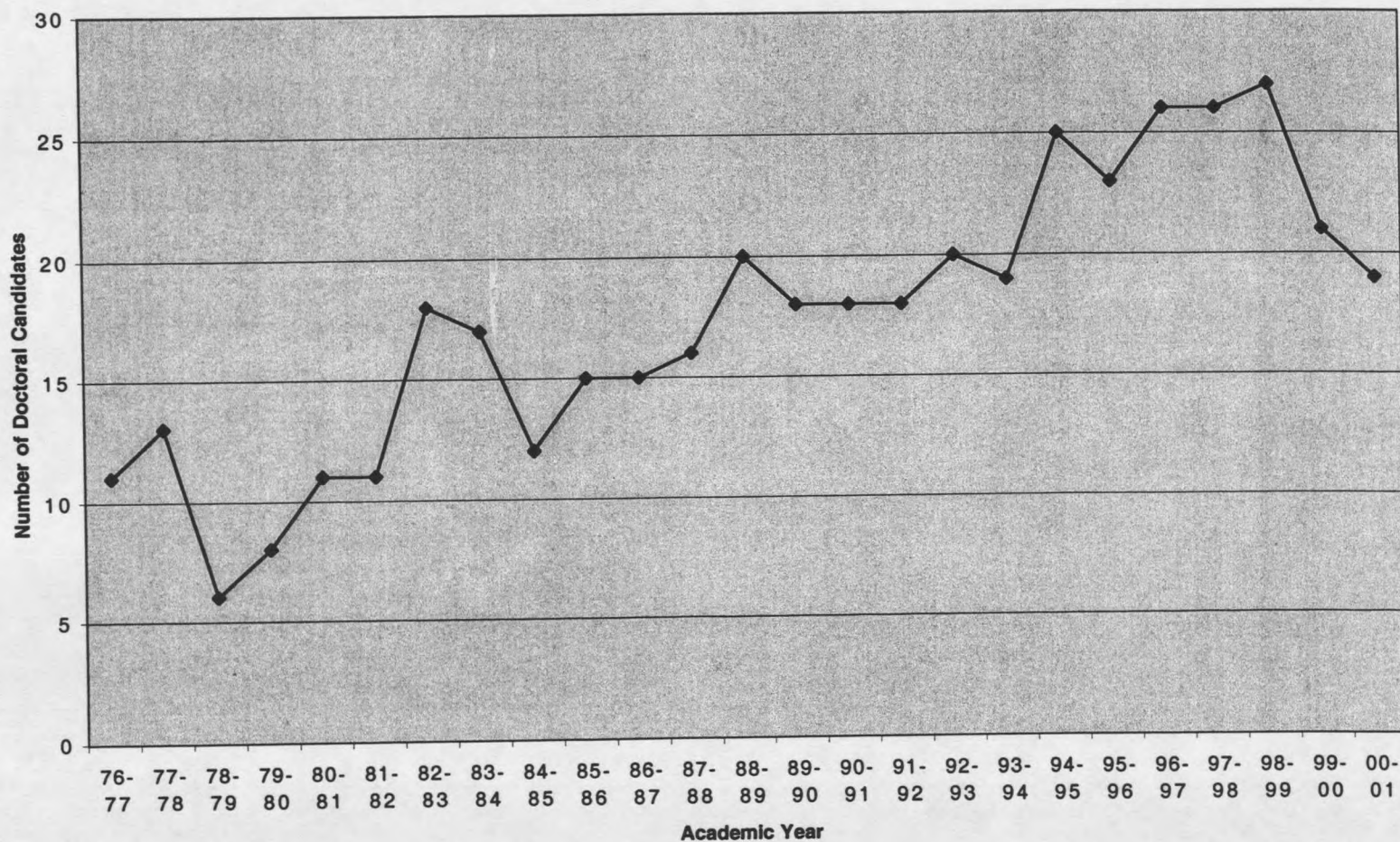


Figure 18: Montana State University Grants and Contracts Per Doctorate Awarded in College of Engineering

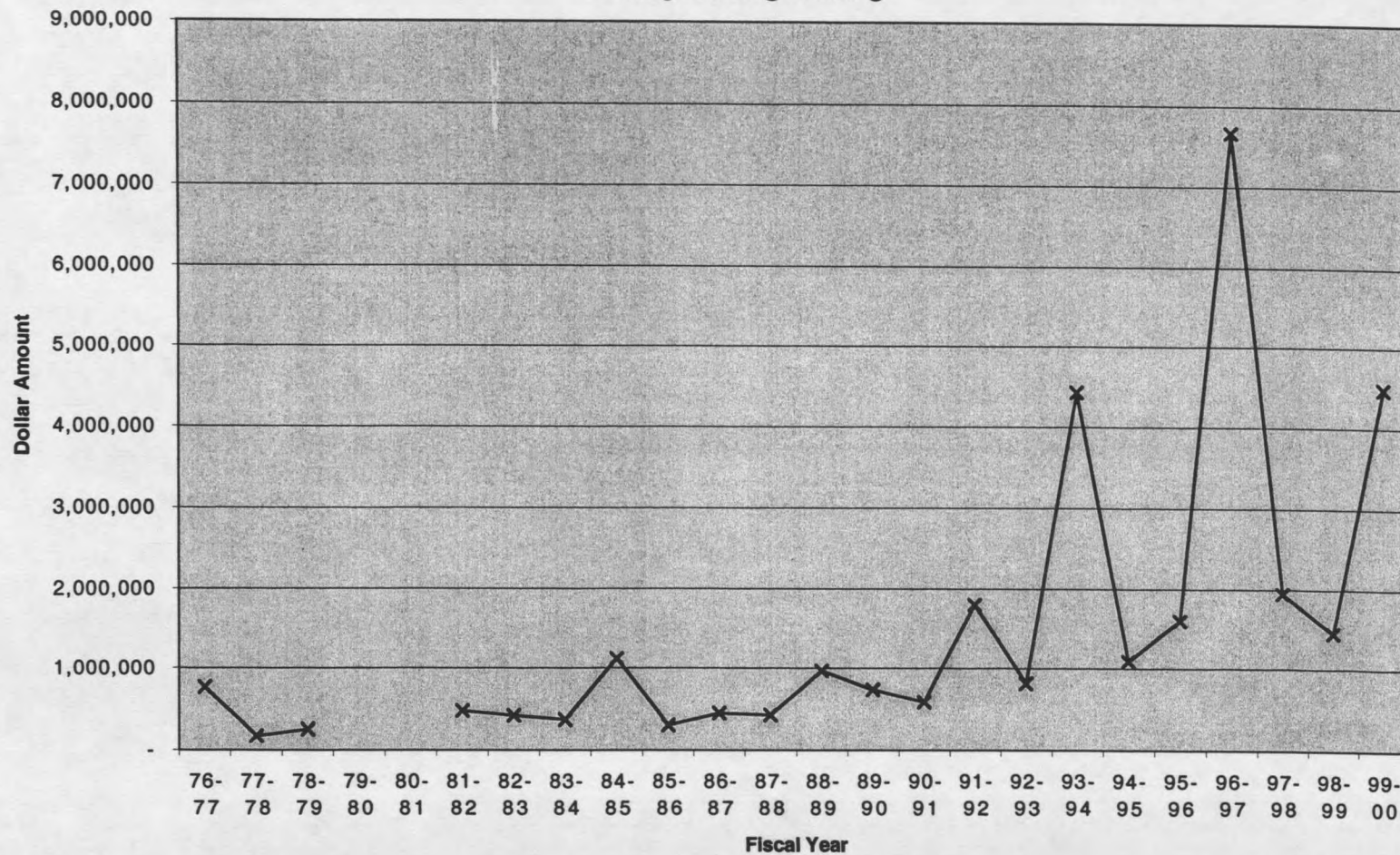


Figure 19: Montana State University Grants and Contracts in College of Letters and Science

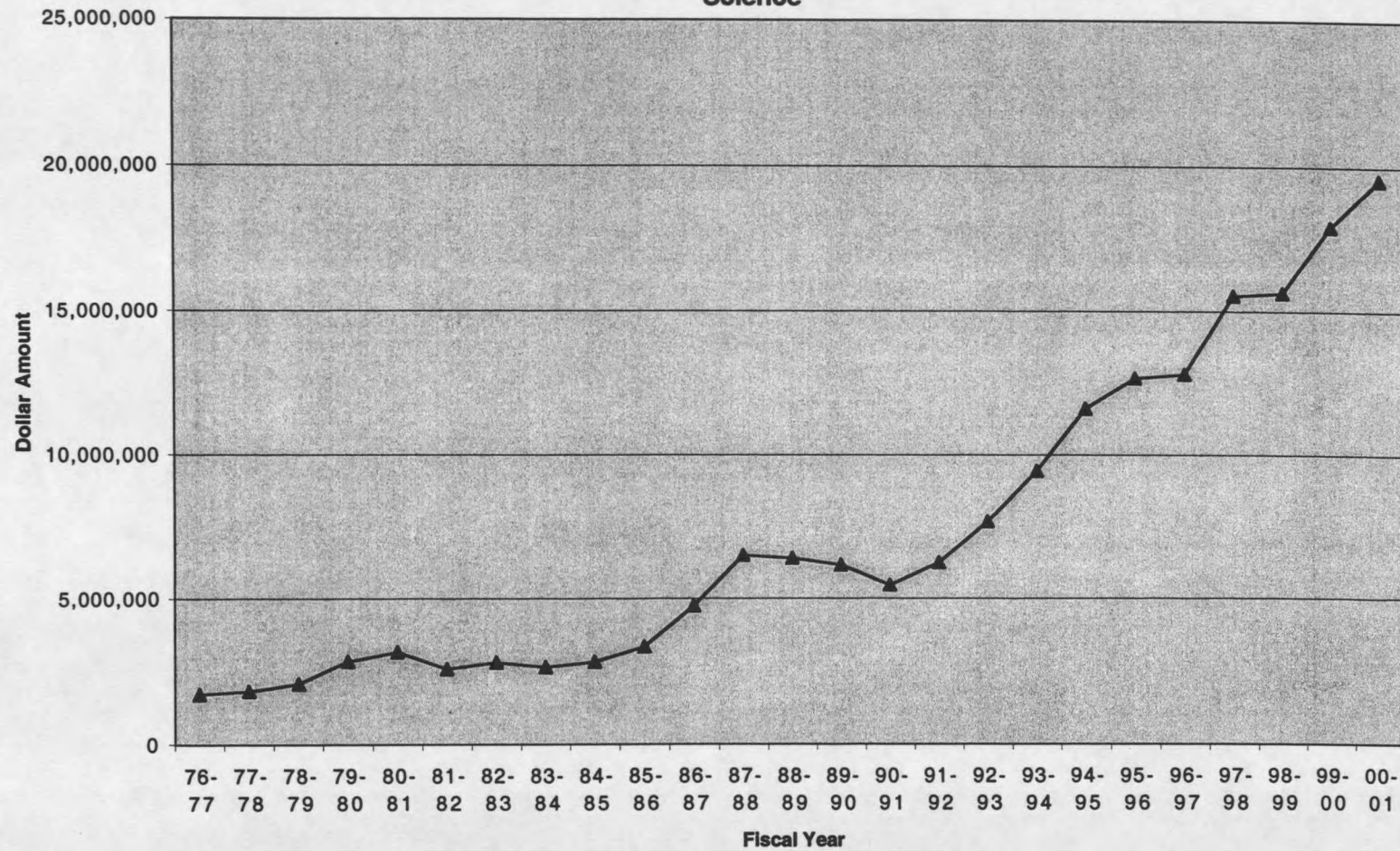


Figure 20: Montana State University Doctoral Candidates in College of Letters and Science

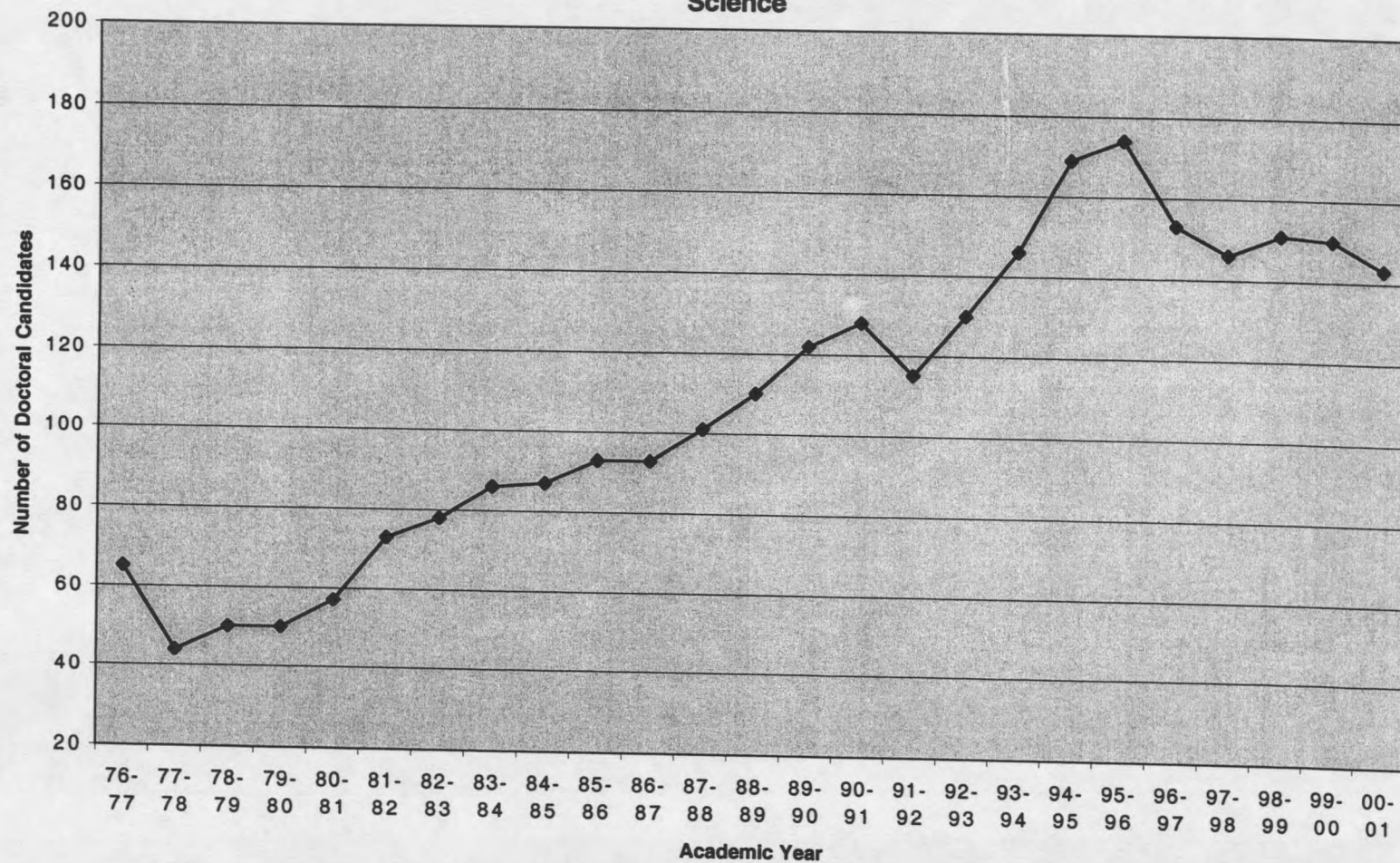


Figure 21: Montana State University Grants and Contracts Per Doctorate in College of Letters and Science

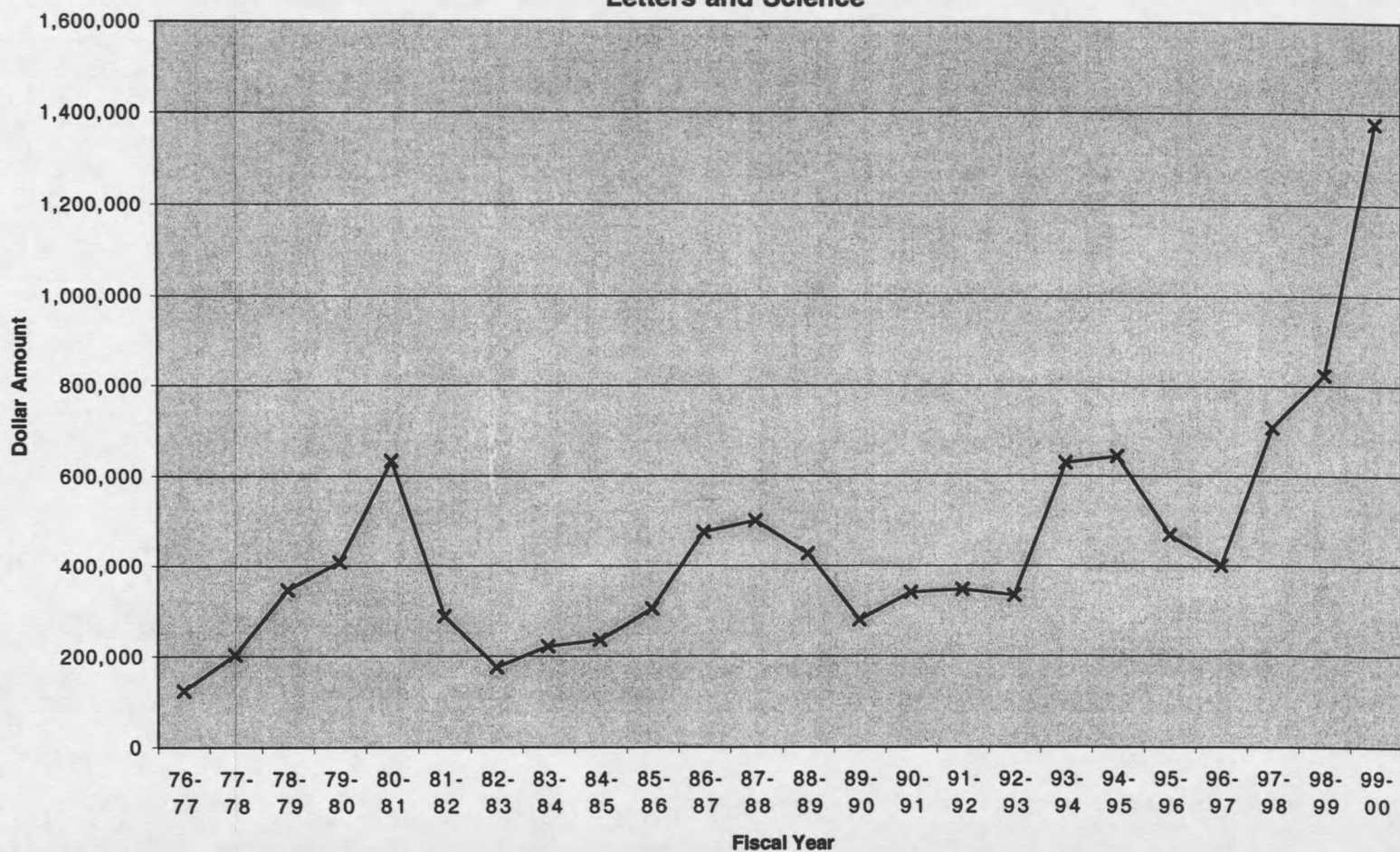


Figure 22: Montana State University Grants and Contracts Per Doctorate (Without College of Education, Health, and Human Development)

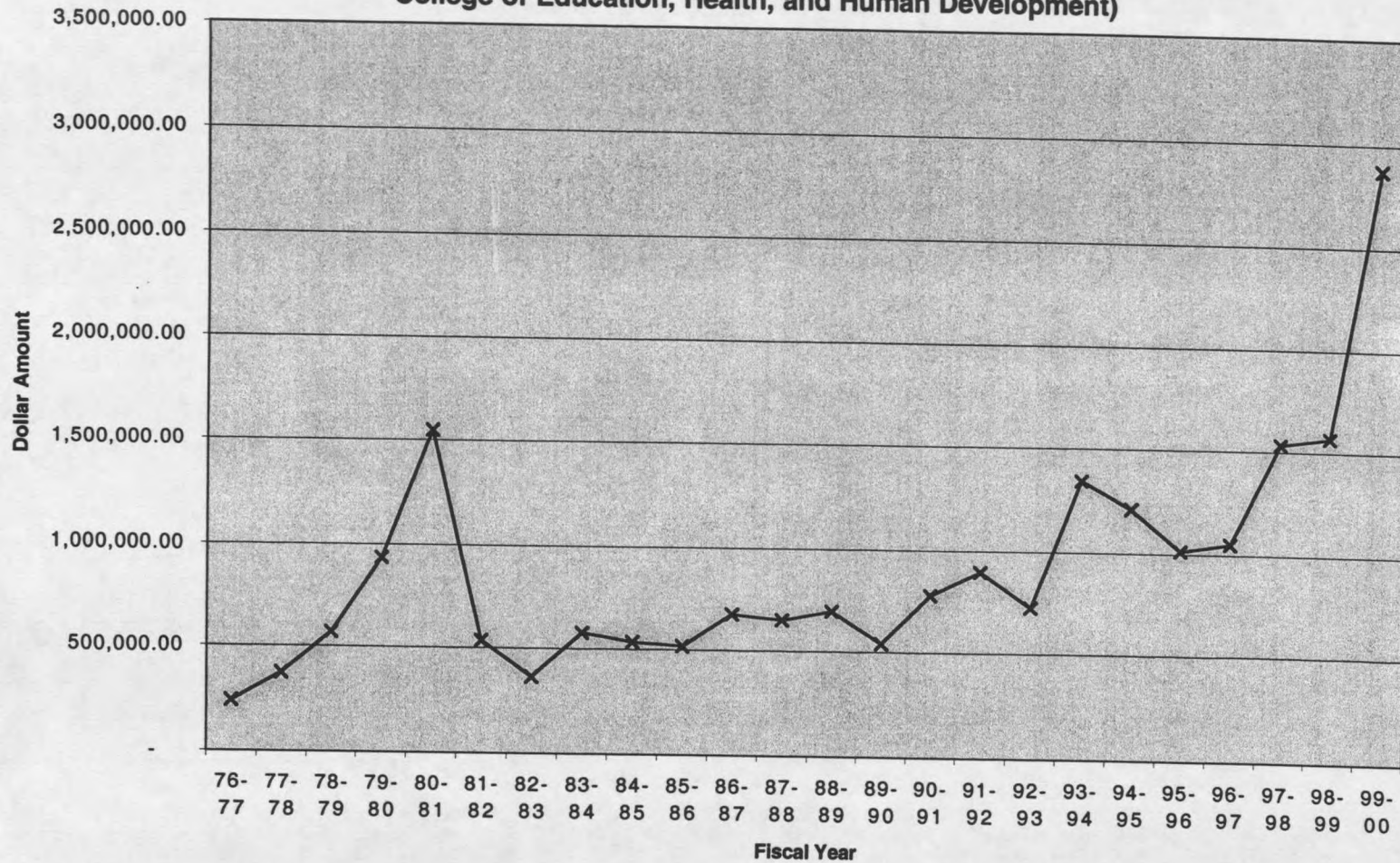
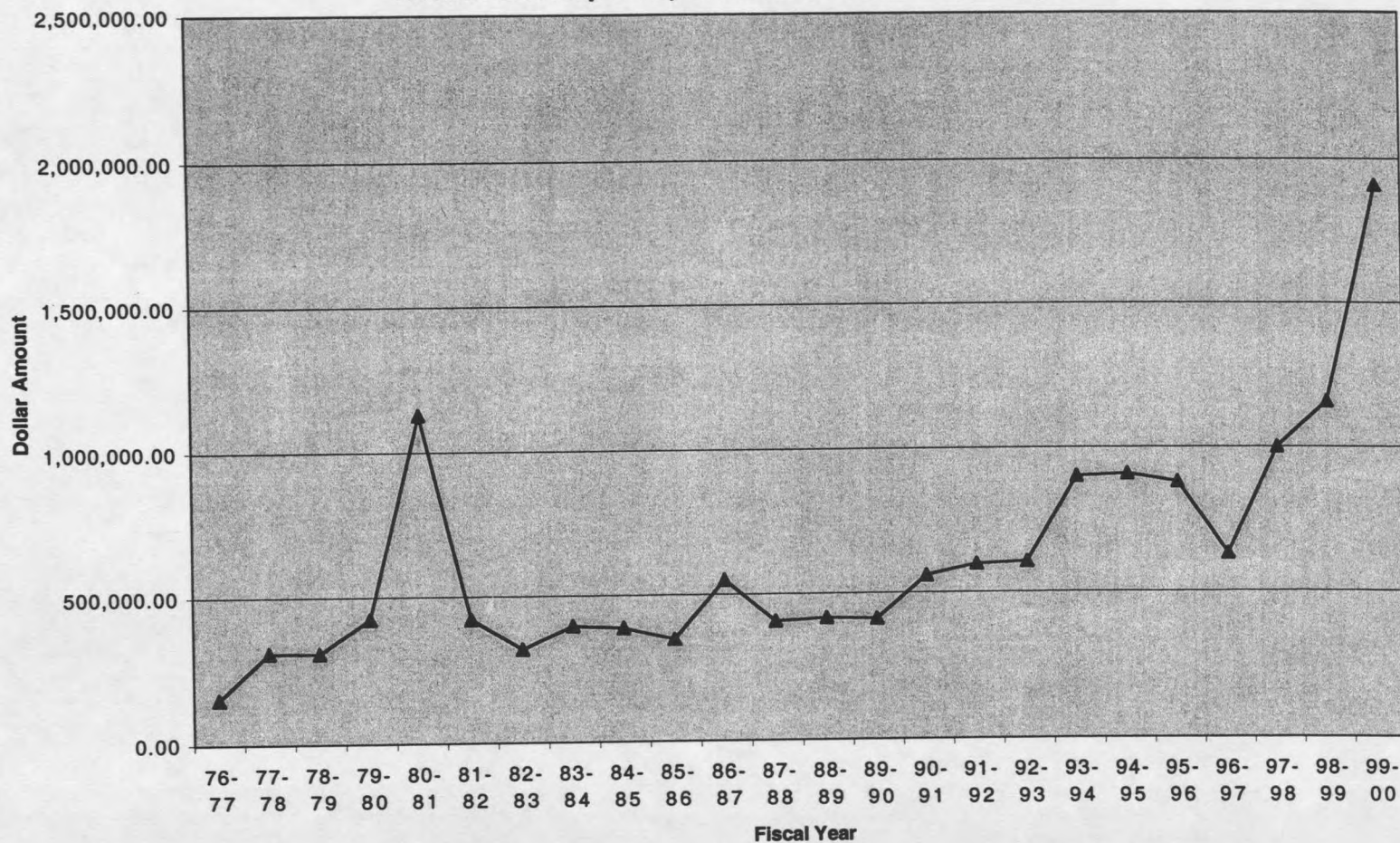


Figure 23: Grants and Contracts Per Doctorate (With College of Education, Health, and Human Development) at Montana State University



MONTANA STATE UNIVERSITY - BOZEMAN



3 1762 10359067 3