Walden University

COLLEGE OF EDUCATION

This is to certify that the dissertation by

Steven Hess

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Marilyn Simon, Committee Chairperson, Education Faculty
Dr. Barry Persky, Committee Member, Education Faculty
Dr. David Stein, University Reviewer, Education Faculty

Chief Academic Officer

Eric Riedel, Ph.D.

Walden University
2012

Abstract

The Relationship Between Academic Writing Experience and Academic Publishing for Graduate Physics Students

by

Steven Timothy Michael Hess

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Education

Walden University

February 2012

Abstract

Writing for scientific publication represents an opportunity to interact with colleagues and make a positive contribution to the academic community. However, there is a growing concern regarding the ability of graduate students' to transfer writing skill sets learned at the graduate and undergraduate levels into professional settings. The main research question in this quantitative correlational study explored potential relationships between the publication rates and the number and types of English and composition classes taken by survey participants. Fischerian development, life course theory, and phenomenological sociology framed this study. Participants from private, public, and commercial institutions of higher learning in the United States participated. Data were analyzed using correlational, chi-square, ANOVA, and multiple regression techniques to reveal relationships between the number and types of English and composition classes taken and publication rates. Open-ended questions gathered opinions about scientific writing and writing class experiences and helped triangulate the findings. The results suggested a relationship between publication rates and number of English and composition classes among certain physics specializations and a need for physics institutions to create specialized publishing courses. The results may lead to positive social change by facilitating the examination of writing within particular physics specializations and motivating the creation of departmental constructed writing courses targeting the scientific community responsible for producing technically skilled literate workers. This could enable increased sharing of scientific findings with professional societies.

The Relationship Between Academic Writing Experience and Academic Publishing for Graduate Physics Students

by

Steven Timothy Michael Hess

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Education

Walden University

February 2012

Dedication

My life has been a fortunate collusion of talents, opportunities, and roles spanning a life as a professor of physics, a computer science instructor, an apartment complex manager, personal fund manager, GED tutor, caretaker of ducks, and countless other occupations. My histories are filled with colossal successes, memorable failures, and unanticipated surprises – just as any man. Throughout my many histories and self-reinventions, a single supportive influence provided the means and motivation to change – my parents. As I gaze upon the urban environment encapsulating my ambitions and world perspectives, I find myself grateful that my parents struggled to provide private education in an environment rejecting proper education. Amongst the stifling smog, the rise of Culture Industry, struggles to remain employed in a labor force racked by Reaganomics, and breakdown of society in the Bay Area, my parents somehow managed to keep me in private schools; sparing me the *socialized Hell referred to as public education in California*. If they ever read this page, and I hope they do, I want them to know that all I have done, learned, and will experience is dedicated to their hardships and character as parents. I owe them everything, yet have nothing to give of adequate measure in return.

Acknowledgements

There are a few individuals I want to thank for my formal education: Professor Simon, Professor Waite, Professor Nolan, and James Dann. Each has influenced my education at different events in my life; nothing short of defining my life course as a reflection of educational experiences and interactions with the mentioned individuals. Without them, my life would have been vastly different and likely lesser than I care to admit.

The first person I want to thank is Professor Simon due to her patience and willingness to work with a staunch hardheaded man as myself. Although I am certain she wished to whack me upside the head on more than one occasion, she was the constant professional able to pull the complexities of a dissertation into a project. I thank her for all her efforts and refusal to chase me down when I frustrated the writing process.

Professor Waite was my mentor at Walden and provided the means as to survive the mundane required classes. Even when I felt trapped in the maze of online classes, he provided the grounding necessary to continue with the program, assisted with the dreaded KAMs, and managed to keep me on track. I am eternally grateful for his efforts and hope his other students say the same.

Although I have only known him for a brief time, Professor Nolan demonstrated the skills and character lacking in most professors. His wit and honesty reflected the human nature involved with successful emotionally motivated instruction while providing a directness that all academics should strive to embody. Any institution should be proud to house his name and title; without hesitation or doubt. I wish him the best the world has to offer and thank him for being there at a critical point during my education.

The man responsible for introducing me to science and social issues is James Dann. He showed me the universe is a rational machine of unerring precision and simple structure. Somehow, although I do not understand, he managed to see the future scientist in me and allowed me to study physics. His gift was that of scientific curiosity of which I wish I could exercise more often. Nonetheless his lessons forged the scientist quietly holding his tongue while writing this exposition. He will never see these words, but I hope somehow he knows their intent.

That is what I have to say, simple and direct, truthful and without regret. What follow is a homage to the above in the hopes I never betray the gifts they offered.

Table of Contents

List of Tables v

Chapter 1: Introduction 1

Background of the Study 2

Problem Statement 4

Purpose of the Study 5

Nature of the Study 6

Research Questions 7

Hypotheses 7

Theoretical Base 8

Definition of Terms 11

Assumptions 12

Limitations 12

Delimitations 14

Significance of the Study 15

Summary and Transition 16

Chapter 2: Literature Review 19

Documentation 20

Overview of Literature Review 21

Fischerian Perspectives and Graduate Physics Students 23

Patchwork Wanderings: Trajectories and Development 38

A Curious Article: Laying the Foundation of This Study 53

Dualism Unifying Known Research, the Patchwork Student, and Potential for Constructivism 58

Final Conflicting Thoughts Before the Survey 67
Chapter 3: Research Method 71
Research Design 71
Procedure 74
Appropriateness of Design 75
The Role of the Researcher 76
Pilot Study Justification 76
Research Questions 77
Hypotheses 77
Sampling Frame 78
Informed Consent 79
Confidentiality 79
Geographic Location 80
Instrumentation 80
Proposed Pilot Tests 80
Data Collection 81
Data Analysis 81
Further Information on Hypothesis Testing 84
Validity, Reliability, and Statistical Significance 84
Contribution to Social Change 85
Summary 87
Chapter 4: Findings and Results 89
General Description of Participants 89
Results of Hypothesis Tests 96

Qualitative Results 103
Summary 104
Chapter 5: Summary, Conclusions, and Recommendations 108
Summary of the Study 108
Ethical Dimensions 108
Limitations 109
Overview of the Study Population and Sampling Method 109
Data Collection Processes 110
Synopsis of Data Analysis 110
Summary of Findings 111
Definitions Revisited 113
Explanation of Findings 114
Recommendations 123
Final Summary 124
Implications for Social Change 125
References 128
Appendix A 138
Appendix B 139
Curriculum Vitae 164

List of Tables

Table 1. Counts of Degree Programs 90

Table 2. Counts of Publication Types 91

Table 3. Counts of Time Passed Since Initial Publication 92

Table 4. Counts of Currently Attended Institution Types 93

Table 5. Counts of Employment Status 94

Table 6. Counts of Institution Type Where Participants Took Undergraduate English and Composition Classes 95

Table 7. ANOVA for Publication Rates and Institutional Type Currently Attended 99

Table B1. Counts of Specializations 139

Table B2. Counts of Undergraduate English and Composition Classes Taken by the Participant 141

Table B3. Counts of Writing Skills or Activities Covered in Undergraduate English and Composition Classes 143

Table B4. ANOVA for Publication Rates and Specialization in Physics 145

Table B5. ANOVA for Publication Rates and Undergraduate English and Composition Classes Experienced 148

Table B6. Multiple Regression Table of the Third Model Utilizing only Specialization 150

Table B7. Multiple Regression Table of the Third Model Utilizing only Publication Types 153

Table B8. Multiple Regression Table of the Third Model Utilizing Specializations and Publication Types 155

Table B9. Multiple Regression Table of the Third Model Utilizing Publication Types and Undergraduate Writing Experience 159

Chapter 1: Introduction

Since the mid-1980s, the contributions of graduate students, especially graduate physics students, to academic and professional journals have been dubious. Herubel (2008) observed that papers submitted for publication were severely fragmented and were coupled to a wide variety of publication rates. Hyperspecialization of linguistic skills and financial incentives favoring less technical publications signaled Shumar's (1997) commodification commentary discussing how higher education transformed into a monetized commodity. Thus commodification of publishing likely reflects the prevailing economic climate, goals, and activities in higher education favoring graduate students unable to publish in prestigious journals and developing writing skill sets suitable for prestigious journals (Brown, Dickson, Humphreys, McQuillan, & Smears, 2008; Butler, 2003; Herubel, 2008; Rawson, Quinlan, Cooper, Fewtrell, & Matlow, 2005).

Upon exiting graduate institutions, physics students enter a myriad of institutions, including academe, industrial, and service orientated workforces. Although their exit from graduate studies and into the workforce is the culmination of dedication and study, Quible and Griffin (2007) voiced concerns that many of these graduates lack writing skill sets due to improperly completed paperwork and incorrect management decisions grounded in poorly written reports. Further, Quible and Griffin (2007) explored employer frustration with an influx of graduate applicants lacking necessary writing and communication skills. Researchers searching for the root of the emerging problems, foreshadowed by Paulos's (1998, 2001) innumeracy arguments about the populace's inability to grapple with numerical languages, led to Lambie, Sias, and Davis (2008)

demanding open forums to address such concerns because educators are ethically bound to provide communicative technical and information workers.

The investigation of this disquiet led to papers like Butler (2003), Carpenter (2008), and Lambie et al. (2008), which framed the above concerns about communications and publications as a problem with educational experience. Gray, Emerson, and Mackay (2005) implicitly sketched a threefold problem faced by business and society. These included (a) the response of the commodification of education and journal publications via changes in funding formulas, (b) an observable breakdown of writing skills in students destined to become academics and professionals responsible for the continuance of society, and (c) the production of a workforce lacking the proper communicative skill sets needed to function in a desired industry.

Thus the problem is not strictly confined to academic institutions or commercialized expectations, but likely resides in the intersection at which commodification encodes societal interests into graduate education systems via joint ventures sponsored by industries seeking affordable research (via sponsored laboratories and paid student staffs) and development while educating potential employees and intellectual properties.

Background of the Study

Many scientific studies suffer from *periodization* when authors attempt to categorize or partition historical events and their important questions into discrete units using accepted languages and writing skills suited to the era of writing. Periodization forces important research questions to languish as historical artifacts until the research

community can no longer avoid them (Herubel, 2008). Educators have been aware of writing deficiencies in graduate students since the advent of the Ph.D. granting institutions. However, only since the late 1980s have researchers such as Brown et al. (2008), Butler (2003), Gilbert, Balatti, Turner, and Whitehouse (2004), and Usher and Barnacle (2003) acknowledged that periodization of journal publications and variations in publication rates can lead to degradation in journal publications. The authors of these germinal studies suggested that variation in publication rates might relate to previous educational experiences. Lambie et al. (2008) extended the research into an ethics commentary, noting that most graduate institutions do not prepare students to communicate in the real world.

Butler's (2003) realization that academic-industrial joint venture and their cash flows affected publication rates triggered future researchers such as Gray et al. (2005) and Rawson et al. (2005). Their research determined that newly hired graduate students lacking proper writing skills affected cash flows in business and health industries. Effects included cash outflows due to improperly completed paperwork, incorrect management decisions grounded in poorly written reports, and employer frustration with an influx of graduate applicants lacking necessary writing and communication skills. Not only was academic publication affected by graduate students underperforming, as determined by Butler (2003), but also so were the workforces comprising former graduate students. Butler's (2003), Gray et al. (2005), and Rawson et al. (2005) indicated that an academic problem of developing communicative skill sets manifested as the

production of graduate students unable to communicate ideas, publish in respected journals, and operate as communicative information workers.

This research into graduate publication rates suggested that disciplines outside of physics manifest varying publication rates reflecting commoditization and periodization efforts. As graduate students experienced joint ventures between industry and education, cash flows and commercial interests led to Herubel's (2008) observation of fragmentation in journal literature and the hyperspecialization of writing skills. Recasting Herubel's (2008) findings into Butler's (2003) study yields a societal concern due to a lack of publications in prestigious journals emerging from commoditized graduate programs and failing to educate communicative information workers responsible for the technological progress of society. Such findings motivated this study exploring the relationship between university level composition and English classes taken and publication frequencies of graduate physics students.

Problem Statement

Physicists affect the philosophical and technological futures of society through their theoretical and experimental contributions disseminated in journals. Although journal publications might trigger sociotechnological change, Brown et al. (2008) explored concerns about student writing and publication frequency shared by Butler (2003), Gilbert et al. (2004), and Usher and Barnacle (2003). Their concerns indicated that variation in publication rates might train graduate students who are unable to transfer their written language skills sets into social-professional and technological settings considered beneficial to society. If their findings are the case, then the inability to

transfer skill sets can damage the ability of scholarly journals to publish frequently while acting as a socially transformative force. The study addressed the gap in the literature by extending the preexisting research to elucidate how experience in university level composition and English classes affect publication rates. Further, in this study I sought to integrate graduate physics student attitudes regarding writing experience and publication efforts. Publishing research studies is critical to the progress of science and graduate physics education.

Purpose of the Study

The purpose of this quantitative correlational study was to determine the relationships between the number of and type of college level writing classes experienced by the participants given their peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year. The secondary purpose of this survey was to present the perspectives of graduate physics students concerning their participation in college level writing classes, and reveal how they perceived these experiences influenced their publication rates. Since the educational histories of participants differ, the study controlled for the number of years in a graduate physics program, type of institution, and specialization. The independent variable was the number of and type of college level writing classes experienced by the participants. All participants attended a graduate physics program at accredited institutions. The study surveyed 143 graduate physics students located in the United States as to ensure a 90% confidence level with a suitable power analysis.

Nature of the Study

A correlational study was appropriate to determine relationships between observable independent and dependant variables. Although a correlational study may have been subject to the correlation-causality fallacy, correlational studies produce only a relationship and not a causal inference between observables. The correlational approach allowed for attenuation and range corrections to the data, chi-square analyses, regressions, and cross-validation for subgroups extracted from survey data. An online survey obtained the data given the diversity in the specializations and educational experiences represented in the sample. Smith (1987) claimed internal validity is not applicable when a study does not include any causal claims, as is the case in this study. Two pilot tests ensured the survey could obtain consistent data, ensure clarity of the questions, and verify the accessibility that is critical for a successful survey instrument.

The nature of the study involved graduate physics students, a rarely considered populace worthy of investigation for their potential impact as information brokers in a technologically dependent society, and provided the chance for educational research to explore graduate physics environments. Such explorations will allow future researchers to suggest causal analyses (and systems theories) responsible for refining the correlations established in this study into model theories of graduate physics education. In turn, the theories may suggest new praxes or curriculum refinements to tackle the problematic intersection of graduate writing, disjoint notions of Fischerian development, physics education, and phenomenological expression discussed in chapter 2. This study offered

the potential to trigger interest in transforming graduate physics into interdisciplinary graduate science courses able to produce outstanding scientific writers.

Research Questions

The research questions that guided this study were:

Research Question 1: What is the relationship between the number and types of university level composition and English classes taken by the graduate physics students and their publication rates in peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year?

Research Question 2: What is the perspective of graduate physics students on how their writing classes affected their publications and publication rates?

Hypotheses

The following hypotheses were tested:

Ha_1: A relationship exists between the number of English and composition classes taken by the participant and publication rates.

$H0_1$: No relationship exists between the number of English and composition classes taken by the participant and publication rates.

Ha_2: A relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

$H0_2$: No relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

Ha_3: A relationship exists between publication rates and institution type currently attended for graduate studies.

$H0_3$: No relationship exists between publication rates and institution type currently attended for graduate studies.

Ha_4: A relationship exists between publication rates and specialization in physics.

$H0_4$: No relationship exists between publication rates and specialization in physics.

Ha_5: A relationship exists relationship exists between English and composition classes taken by the participant and publication rates.

$H0_5$: No relationship exists between English and composition classes taken by the participant and publication rates.

Ha_6: A relationship between a linear combination of independent variables and publication rates exist.

$H0_6$: No relationship between a linear combination of independent variables and publication rates exist.

Theoretical Base

The study relied upon the neo-Piagetian perspectives of Fischer as the theoretical base of the study. I chose Fischerian skill theory to examine graduate students' development and ability to produce written products. Thus the study was framed by Fischer (1980, 2004, 2006a, 2006b), and Fischer and Pare-Blagoev (2000) as applied to graduate-age students able to integrate abstract systems and subsystems into skill sets involving principled actions, thoughts, and expressions. Although the study remained confined to education research and graduate physics, it remains open to skill set

dominated areas such as law, physics, medicine, and other professional fields since the Fischerian framework acknowledges generalized skill sets.

The Fischerian (1980) assumption underlying the study emerged as a dialectical response to Piagetian (2005) empiricism and the lack of a scientific understanding of neurological development. Unlike his predecessor Piaget, Fischer (1980) posited variability in development remains on par with observable sequences in cognitive development. Fisher asserted that the observation of skill set development directly measured the development of the cognitive systems responsible for integrating the neurological development and actions of an individual given a contextualized learning environment. Such variability in writing and communicative skill sets appears in the contextualized graduate physics environment responsible for publication and degree completion—thus Fischer's perspective was the nontemporal developmental sequence of importance in this study and formed the theoretical lens.

Fischer (1980) described a five-tiered universal development sequence critical for understanding the cognitive development, skill set evolution, and actions of individuals—including graduate-age students. The last two known tiers of development, known as *abstraction* and *principles*, explore the cognition of abstract properties of objects often serving as the basis of scientific thought, the intercoordination of abstractions into a complex concept such as the formation of physical laws, and the integration of complex concepts into principles suitable for written expression. These tiers model the development of graduate physics aged students embodying principled thought and systems thinking (Fischer, 2009). Thus the study included theories presented by Fischer

(1980, 2004, 2006a, 2006b) and Fischer and Pare-Blagoev (2000). Fischer (2009) provided the transition of the theoretical base into an applicable form suited for the study.

Fischer's theory of human development presented a scientific inquiry into human development by abstracting mechanistic neurobiological processes into a holistic theory of Elder's life course (Fischer, 1980). Although the theory accounted for numerous stages of biological and staged development, it neglected its application given an arbitrary sociological context. Fischer (2009) proposed an application of his theory by allowing practitioners and researchers to formulate research questions linking praxes and policies while refusing the neo-classical practice of confining the fruits of research to educational and commoditized interests. As explained in the following chapter, a subtle blending of Elder's life course and Fischer's efforts provides the study with the means to model the skill development and educational trajectories (including the socially contextualized act of publication) for graduate aged students embedded into a complex learning environment. Such integration incorporates commoditized interests, various skill and personal developments, emotions, desires, lifespan, free agency, embedding societies, and writing accomplishments of graduate physics students. Thus the unity of trajectories, life course theory, and the Fischer's work builds the core of the theoretical base.

The study was an acknowledgment linking education, skills, and biologically motivated developmental transitions into a tractable application of Fischerian theory (Fischer, 2009). Because Fischer (1980, 2004, 2006a, 2006b) and Fischer and Pare-Blagoev (2000) demonstrated that the evolution of neurological structures of the brain are

a function of at least the individual's experiences (including experiential education). Thus, one cannot avoid the implication that the educational and research experiences are a contributing factor to the neurological structures of the brain and emergent skill sets exhibited during development given a variety of contextualized environments education activities such as writing and publishing. Such linkages indicate that a survey of graduate students must include the educational histories and the plasticity of graduate students given the Vygotskian and Fischerian perspectives within graduate physics departments.

The theoretical and applied aspects of the Fischerian perspective of the study modeled the participants in the study while acknowledging their diverse contextualized graduate education in the physical sciences. In addition, the Fischerian perspective facilitated the construction of the survey because surveys allow the cataloguing and analysis of acquired skill sets utilizing asynchronous communications. Such a combination yielded the Elder-Fischerian perspective as a proper theoretical base and application for the study.

Definition of Terms

Classes taken by the participant. A list of English and composition classes taken by the participant. The list of classes submitted by the participant utilized an extensive multiple-choice selection on the survey. The list of classes facilitated hypothesis testing, checking for differences between groups, and statistical tests afforded by the data.

Good standing. A student remains in good standing when they satisfy the academic requirements of their department.

Number of years in a graduate physics program. The time spent in the current physics program in good standing.

Observables. Eigen values derived from the survey corresponding to a measurement using frequency counts, factor analysis, or other mathematical process allowing a desired observation. A simple example may be that a statistically signification portion of the sample attended a technical writing class; this observation may serve to be the dominant influence during hypothesis testing.

Peer-reviewed journal or nonpeer reviewed journal. Journals recognized by the physics community due to a willingness to publish in such journals. The journals might or might not be subject to a peer-review or industry-review process.

Publication rate or frequency. Defined as the number of publications in nonpeer reviewed journals, peer-reviewed journals, and specialty magazines per calendar year.

Specialization. The participant's field of interest forming the bulk of their graduate physics education. Examples are cosmology, condensed matter, particle physics, theoretical physics, and other jargon commonplace in the physics community. Hybrid specializations are possible and include biophysics, earthquake prediction, and philosophy of science.

Type of institution. The charter of the educational institution of the English and composition classes: private, public, or other.

Assumptions

The key assumptions for this study originated from the use of a survey instrument. With most surveys there is an assumption of weaknesses in measurement, problems with

sample selection, biases, and erroneous survey designs due to uncontrollable factors involving language, sociocultural beliefs and practices, and emotions of participants. Such assumptions can serve to enhance validity and data collection despite their generic nature and hampering of survey-based research.

The primary assumption was the assumed American ethnocentricity in the survey. Although the assumption of ethnocentricity is undesirable for a survey, the ethnocentric assumption minimized the uncontrolled impacts of unknown linguistic and sociocultural biases embedded in the international physics community. This assumption yielded a sample of convenience confined to North America as to exploit the commonalities in writing, English, and literature classes via matriculation agreements. The result of accepting such an assumption ensured that an intentionally large sample of convenience yielded a balanced sample sharing common matriculation requirements and academic writing experiences suitable for sound statistical analyses.

Limitations

Limitations involved flawed survey design and ill-handled results inherent in most survey-based studies. Surveys should be well written, simple to read, and be time efficient as to combat nonresponse problems while ill-handled results may skew the data utilized in statistical tests. Thus, the survey was pilot-tested by small groups and reviewed by experts relevant to the study. In the case of this study, research experts from Walden University and UC Davis provided consultation as to ensure a sound survey instrument. Ill-handled results emerge when a researcher ignores the impact of survey time requirements, timeframes, and number of times the researcher contacts a participant.

The effects of ill-handled results were unavoidable but controlled by utilizing asynchronous online surveying software as to ensure that each potential participant had a chance to complete the survey given their personal schedules and needs. Thus, this paring forced the assumption of a valid pilot-tested asynchronous survey methodology as the proper mechanism to address data collection and survey design problems.

Another limitation emerged from the use of survey instruments: the nonresponse and question and answer biases as unavoidable properties of surveys. Since surveys rely upon personal communications, they are subject to the biases embedded questions and the potential unwillingness of participants to respond to sensitive questions. An online survey incorporating confidentiality clauses, full disclosure results, and introductions to the researcher minimized the impact of the assumptions while promoting open communications. I could not eliminate nonresponse bias since the participant cannot control complications in memory recall except for asking redundant questions verifying recall.

Delimitations

The study involved the use of a cross-sectional design measuring beliefs, educational history, and publication activities of participants using qualitative and quantitative sections in the survey. In this study, I disregarded a mixed methods approach since the survey lacked the ability to collect appropriate qualitative data. Despite the exclusion of mixed methods and interest into the beliefs of the participants, in this study I was able to investigate the research questions while affording statistically significant hypothesis testing.

The study included 143 postgraduate and graduate physics students located in the United States. Although the sample size was of significant statistical power, it indicated that a sample of convenience is appropriate for the correlational study despite potential problems with generalization. The results of the study were ethnocentric because the study utilized a single country, thereby neglecting the educational variations between Western, European, and Asian graduate physics departments. In addition to the ethnocentric nature of the study, the Fischerian framework remains unproven in educational research involving graduate students despite its use in special education.

Significance of the Study

The socioeconomic significance of the study was threefold. These were: (a) the response of commodification of education and journal publications via changes in funding formulas, (b) an observable breakdown of writing skills in students destined to become academics and professionals responsible for the continuance of society, and (c) the production of a workforce lacking the proper communicative skill sets to function in a desired industry. The threefold path of significance offered insights affecting the academic, professional, and industrial workforces.

Butler (2003) identified trends in academic publishing that maximize institutional funding at the expense of publishing in a prestigious journal. Although the number of journal articles in physics exploded relative to historical rates during the era considered by Butler (2003), the articles favored the bottom tiers of publications due to economic incentives to publish large volumes targeting a paying audience. Compounding this phenomenon was the observations of Robertson (2004) and Rawson et al. (2005), who

noted that Butler's trends later manifested as problems in professional activities responsible for translating academic skills into a professional context benefiting a technologically advanced society. Thus, Paulos (1998/2001) indirectly suggested the significance of the study, to identify the societal consequences of an educated workforce unable to address the needs of a technologically orientated society utilizing potentially ineffective communicative skill sets propagated by institutions of higher education. This focus, although simple, offers the core social concern that motivated this study.

Further, the study could contribute to the literature by examining publication frequencies with respect to (a) the number of years in a graduate physics program as defined by the last academic year in good standing, (b) type of institution as defined by the appropriate charter, and (c) specialization. When combined with opinions of graduate physics students regarding composition classes, the findings of the study might assist in coordinating the commoditized academic and professional environments to pursue an interdisciplinary graduate science curriculum in the hopes of developing academics, professionals, and writers with the communication skills suitable for undertaking future sociological, technological, and industrial problems.

Summary and Transition

This chapter included an outline of the correlational study involving a search for the relationships between educational experience in university level composition and English classes and the publication rates of physics graduate students, controlling for the number of years in a graduate physics program, type of institution, and specialization. The study included a cross-sectional design that focused on the independent variables

English and composition classes taken by the participant. The dependant variables included: (a) number of years in a graduate physics program as defined by last academic year in good standing, (b) type of institution as defined by the appropriate charter, and (c) specialization as defined by those participating in the survey. Cross-validations performed between randomly selected subsamples using chi-squared analyses controlled error and sampling

Chapter 1 also included an outline of the threefold socioeconomic significance of the study. This consisted of: (a) the response of commodification of education and journal publications via changes in funding formula, (b) the observable breakdown of writing skills in students destined to become academics and professional responsible for the continuance of society, and (c) the production of a workforce lacking the proper communicative skill sets needed to function in a desired industry. The threefold path highlights the significance of the study in the academic, professional, and social aspects of everyday life as communication skill sets are the keystone of innovation along the three paths. The associated findings might assist administrators in coordinating an interdisciplinary graduate science curriculum integrating communication skills classes into graduate classrooms intending to provide the communication skills sets necessary to tackle future sociological, technological, and industrial problems collaboratively.

The literature review found in chapter 2 expounds upon the social nature of the problem, the theoretical base, and the application in developmental contexts while illustrating a need to understand if relationships exist between variables in the study. Chapter 3 includes a discussion on the survey-based methodology of data collection and

the coding and analysis of the survey results, presented in chapter 4. The dissertation concludes with a final chapter commenting upon the study and directions for future research.

Chapter 2: Literature Review

Butler (2003) and Gray et al. (2005) posited a threefold socioeducational problem faced by business and society. This included: (a) the response of the commodification of education and journal publications via changes in funding formulas, (b) an observable breakdown of writing skills in students destined to become academics and professionals responsible for the continuance of society, and (c) the production of a workforce lacking the proper communicative skill sets needed to function in a desired industry. Butler and Gray et al. indicated the problem is not strictly confined to academic institutions in the United States or commercialized expectations, but likely resides in the intersection at which commodification encodes societal interests into graduate education systems. These problems and journal publications reinforced the need for the correlational study.

The literature review includes an analysis of graduate publications and corresponding rates of publications, commodification and funding formulas, and the socioeducational aspects of writing in graduate physics. The review includes how authors target audiences, how authors obtain publications in peer-reviewed journals, and empirical insights to understand how publishing and writing activities affect undergraduate and graduate students, professionals, and technical writers.

A fundamental weakness in the literature review emerged when less than five journal publications directly addressed the publication rates of graduate physics students. Although the weakness indicates a gap in the literature, it also requires that the strengths of the assumed Fischerian framework integrate numerous skill set dominated disciplines into a nexus suitable for a literature review. The assumed framework spans multiple

disciplines, stages of development, and skill set developments. Thus, the inclusion of the integrative Fischerian framework provides an opportunity to draw upon alternative education research involving nonscientific areas. Furthermore, the diversity in the scholarly works covered under the framework offers an interdisciplinary approach to a rarely considered understanding of writing and publication frequencies in graduate physics.

The literature review organizes disjoint topics into the novel perspective underlying the study. The initial topic presents the graduate physics student as an extension of the Fischerian theory of development in the context of theory and education research. Upon such a presentation, the review utilizes anecdotal evidence and commentary fueling current research in nonscience fields and early-stage experiments exploring the links between writing skill sets and student activities across diverse disciplines. The review concludes with known measurements of publication frequencies linked to commodification and commentaries motivating research in publication frequencies. Such organization intends to assist in coordinating a novel understanding of the graduate physics student attempting to integrate communication skills into a contextualized learning environment while introducing the study. The resulting work generalizes to other disciplines in future research since the developmental theories utilized afford universality.

Documentation

All journal articles, texts, and other documents referenced in this study originated from Walden University Library Service, and the electronic databases available at Chabot

College. Databases at Chabot College fetched rarer papers and texts. Great care was taken to ensure all references are academic, peer-reviewed, or from trusted professional publications subject to strict policies promoting honest and academic communications.

Keywords and phrases used in the search included the following and many permutations: *graduate physics*, *physics*, *physics publishing*, *physics writing*, *physics journals*, *graduate publishing*, *publishing frequencies*, *publishing rates*, *commoditization*, *physics* and *peer review journal*, *Fischer*, *skill theory*, *skill sets*, *skill set* and *graduate*, *skill set* and *publishing*, *Fischerian*, *Fischer's theory*, *Vygotsky* and *science*, *science publishing*, *phenomenological sociology*, *human development*, *constructivism*, *graduate* and *writing*, *funding* and *publication*, and many other terms selected due to appearances in the papers referenced. Online searches were not limited to keywords capitalized upon internal citations and indirect references in texts.

Overview of Literature Review

Educational research emerges from the subtle blending of psychology and sociology of the early 20th century responsible for producing modern social psychology. Early theorists such as the members of the Frankfurt School, early Parsonian functionalists, and phenomenological philosophers diffused social psychology across numerous disciplines while spawning numerous investigations driving current literature (Anderson & Bo Kaspersen, 1996). Despite such developments, the diversity pursed by such efforts yielded sparse literature regarding relationships between educational experience in university level English classes and the publication rates of physics graduate students.

Such scarcity led to the production of a theoretical lens outlining the key perspectives, abstractions, and known applied research to address the gap in the literature. The following chapter introduces a modified Fischerian development scheme into graduate physics programs and scarce education research. This process naturally emerges by presenting a phenomenological Fischerian learner, placing the learner in a highly contextualized environment, and then discussing educational and developmental trajectories given scant literature relevant to the study.

The first segment of the literature review includes the basic concepts of Fischer's skill theory and their application to the typical graduate student of physics. The basis of the presentation originates from a brief review of skill sets and Fischerian development (Fischer, 1980, 2004, 2006a, 2006b, 2009; Fischer & Pare-Blagoev, 2000). Upon the conclusion of the introduction of skill theory, the graduate student of physics manifests within Fischer's skill theory as a phenomenological individual embodying emotions and free agency. The resulting graduate student participates in an experimental classroom environment as to understand the theory in practice.

The second segment of the literature review explicates the graduate student in a phenomenological Fischerian experiential educational setting. Free agency, skill sets, and the learner's emotional states integrate into the Fischerian framework as to allow the inclusion of Elder's life course theory. In addition, a discussion about the roles of free will and emotion in the development of the graduate student will be included as to prepare the text for Elder's theory. The segment will conclude with an explanation that indicates the study was affected by development in an experiential setting, a relationship

hinted at by Fischer (2009), forcing the theoretical lens beyond the student and into a social perspective of development foreshadowing life course theory.

The concluding segments include a discussion on the sociological extension of the theoretical lens as an element of Elder's life course theory (Elder, 1994). Furthermore, the concept of linked lives will place the student into a complex societal organism responsible for education, commoditized interests, personal educational goals, and other communicative interactions manifesting as pressures upon the developmental and educational trajectories. The conclusion of this segment will finalize the construction of a weak theoretical lens utilized in the study, analyses of scarce journal articles, and offer interpretations of the study.

Fischerian Perspectives and Graduate Physics Students

The underlying theoretical framework of this study originated from Fischer (1980, 2006a, 2009), defining a scaffolding incorporating Fischer's skill theory, neurological development, and linguistic devices from social psychology into a developmental theory. The Fischerian perspective provides the antithesis of the Piagetian assumption about the existence of a generalizable theory of stage-synchronous development and observable stages measurable by qualitative examination.

Fischer (1980, 2009) indicated the inability for Piagetian theories of development to provide adequate criteria defining stage-synchronous human development. Followers of Fischer, including Brown et al. (2008), Butler (2003), Carpenter (2008), Herubel (2008), Rawson et al. (2005), Usher and Barnacle (2003), and other studies relied upon an unspecified nonPiagetian theory suitable for students of graduate school age. To

prevent the use of an unspecified framework, the study utilized the Fischerian antithesis and perspectives in the literature review. The result of assuming the Fischerian framework and perspective is to provide the themes and concepts motivating literature review.

The basic concepts of Fischer's theory. The roots of Fischerian development reside in notion of a skill (or skill set). A skill is the observable control of actions and free agency exhibited by an individual given a contextualized environment, circumstance, task, or interactive process (Ferguson, 2006; Fischer, 2009). Despite the abstractness of skills, there exist simple examples leading to the tractable direct observation of skills. An example would be the classroom environment in which a young learner pursues actions leading to the development of printing and cursive writing abilities. Although the manifested acts of the learner and observation by an instructor might indicate proficiency in the learner's use of the printed alphabet, the learner might not be adept at utilizing a cursive alphabet on ruled paper due to a change in the medium of expression to the paper and complex script. Such a change in environment shows that the skill of being able to write is not generalizable and transferable to variations in environmental contexts. Thus, skills are not characteristics one transfers from one task to the next, but rather mediators-in-context necessary to engage tasks.

Fischer posited that growth and transitions of neural nets in the brain lead to the demonstration of skill sets signifying stages of development (Fischer, 1980, 2004, 2006a, 2006b, 2009; Fischer & Pare-Blagoev, 2000). In addition to the emergence of stages, demonstrable skills rigidly define Vygotky's zone of proximal development (ZPD) as a

developmental range taken as the difference between the exhibition of skills given an optimal and functional environments.

Although the definition of the developmental range appears abstract, Anaya-Prado, Toledo-Pereyra, and Toledo (2006) provided an example of developmental ranges for technical writers in medicine. Medical students, while attending university, perform within a near optimal environment supporting proper writing skills and scientific expression. Upon graduation, the scaffolding provided by the graduate institution vanishes and forces the former graduate student into a functional environment. Thus, the resultant professional medical writer might be unable to produce sound scientific documentation suitable for the professional functional environment. This phenomenon is not restricted to medicine and has been observed in legal, educational, and entrepreneurial professions (Anaya-Prado et al., 2006; Biser, Rubel, & Toscano, 2007; Brown et al., 2008; Carpenter, 2008; Diezmann, 2005; Ellis, Taylor, & Drury, 2007; Gilbert et al., 2004; Gray et al., 2005; Quible & Griffin, 2007; Rawson et al., 2005; Teramoto & Mickan, 2008).

The observation of behavior in a context mediated by skill sets provides the basic unit of observation in Fischerian development (Fischer, 2009). Observation demands the empirical observation of everyday situations requiring the recombination of skills into higher-level skills via compounding, coordination, and differentiation events. Transition implies the individual exhibits a new level of development or a discontinuity in development mimicking a Piagetian stage of development. Fischer (1980, 2006a, 2009) refined such observations into a pseudochronological-biological sequence structured as a

five-tiered universal-development sequence. The last two known levels of development, known as *abstraction* and *principles* tiers, represent the development of skill sets necessary for cognition of abstract properties of objects, the intercoordination of abstractions into a complex concept, and the integration of complex concepts into principles. These tiers provide an understanding of development of individuals over the age of 20 years and graduate aged students.

The descriptions of the final two (adjoining) tiers illuminates the scant research involving the publication rates of physicists and professional writing. The abstraction level explains that graduate students are of an age and development in which their neural nets might relate complex concepts into new skills and knowledge. For example, Brown et al. (2008) explored the ability of students to compound their understanding of simple citation methods with the desires to avoid the ethical dilemmas of plagiarism. Thus, the abstraction level provides the ability for a graduate student writer to manufacture new knowledge ready for professional ethical publication and higher tiers via Fischerian developmental processes as indirectly discussed by Le Roux and Galloway (2008) and Qinh, Lifang, and Xiaochuan (2008).

The principles tier of Fischerian development illustrates the mature graduate student publisher linking systems of abstract concepts into principled systems of thought. Although few studies indirectly acknowledge the principles tier, Biser et al. (2007) provided a study involving deaf college-educated students and their problems in writing professional quality American English documents. By linking the complex abstract system of personal needs for achievement, professional employment requirements, and

widely available writing support systems into an intervention, Biser et al. (2007) constructed the means for deaf college-educated workers to produce American English documents. Although unproven, there exist examples where compounding complex abstractions and representations within education alongside services produces a principled, methodical, and ethical intervention; a compounding showing the utility of Fischer's theories in the real world. Thus Biser et al. (2007) unintentionally used Fischerian development while addressing a pressing socioeducational problem expounded upon by Quible and Griffin (2007).

Despite the presentation of Fischerian development as a mechanistic theory, one must account for the phenomenological roles of emotions in a theory of development. The inclusion of emotions mimics the structure of the phenomenological free agent developed by Ferguson (2006) in which emotions influence the decision-making process involving skill set development. As individuals embody emotional states given a context relating emotional states to manifested skills, their emotions provide the context for the free agent to evaluate their potential actions and exhibit a particular skill in response. Thus emotions directly affect skills and associated development. It is impossible to ignore that development and its variations require address in a phenomenological Fischerian learning environment.

Fischer's classroom—Developing during an experiential education. Fischer (1980, 2006a, 2009) provided the definition of an experiential classroom suitable for Fischerian development. The literature favors a lens emphasizing the classroom and publishing arenas as environments subject to the scientific studies of learning utilizing

biology, cognitive sciences, and evidence gathered in education research. The utility of such a lens is at least twofold: (a) to provide the mechanistic means by which biological processes and phenomenology affect learning and (b) to provide the learning environments unacknowledged in the current literature. This portion of the literature review supports the argument that the twofold lens yields proper observables representing Fischerian development in higher education. The conclusion of this section includes an introduction to the *patchwork student*.

Mind, brain, and education (MBE) research includes the belief that students and instructors in the Fischerian classroom interact to produce questions and experiments linked to relevant social, commoditized, discipline-specific, and instructional problems (Fischer, 2009). Rawson et al. (2005) provided a simple example of MBE research in which writing skills sets and publications provide the dialectical medium upon which important medical communications and decisions rest. The union of MBE and Rawson et al. (2005) illustrates the development of writing skill sets as phenomenological acts subject to Fischerian assumptions. Such a blending of empiricism, pragmatism, and phenomenology demands the student experience development as intersubjective acts mediated by measurable skill set demonstrations. This study assumes such events mimic examples like graduate students and professors communicating in a classroom or medical personnel engaged in dialectical processes.

The MBE approach and the graduate physics student. The study utilized the MBE approach in constructing a Fischerian environment in response to the journal articles cited. Because only a few papers exist on this subject, the literature review will

borrow heavily from the works of Ferguson and Fischer by integrating phenomenological sociology and skill theory (Ferguson, 2006; Fischer, 1980, 2006, 2009) in preparation for the inclusion of the life course.

Fischer (2009) rejected the notion that learning is the simple transmission of information between people, but rather modeled by neural nets evolving within a contextualized environment allowing free agency. Such belief implies that the brain is not the sole mechanism of learning, as dictated by belief revision and information processing theories (IPT) described by Lakemeyer and Nebel (2003), but is part of a more complex system dedicated to a free agent choosing to learn. For example, consider when a student driver and driving instructor interact during driving classes. According to IPT and other theories in Bertrand's (1995) overview of contemporary education praxes, the student should be able to learn how to drive given the ability of the instructor to behave as a conduit of knowledge. Thus, the student should be able to steer the car, use the brake, and follow the rules of driving after exchanging intersubjective gifts with the instructor. However, perhaps comically, few instructors will confirm this understanding to be true.

Meissner (2006) confirmed such an observation by recognizing that IPT is insufficient. Meissner (2006) confirmed that the physical involvement of an individual provides the feedback responsible for adopting neural nets during experiential education such as the driving class example. Thus, Meissner (2006) concluded that learning does not strictly occur in the brain, but is a blending of environment and communication via intersubjective gifts, emotion, and choice. Such conclusions are naturally extendable to

graduate writers engaged in the publication process. Curiously Meissner (2006) implies that previously published graduate students in physics possess the skill sets necessary to publish within their respective experiential Fischerian environment while the unpublished lack such skill sets due to a lack of experiential education

Despite the concerns noted above, the review failed to uncover studies supporting these implications for graduate-aged student development. Nonetheless, indirect evidence exists from epileptic children supporting similar implications (Fischer, 1980, 2004, 2006a, 2006b, 2009; Fischer & Pare-Blagoev, 2000). According to Fischer's research, some children suffer from extreme epileptic seizures requiring a hemispherectomy. Although the procedures leave young learners with only a half a brain, the learners manifest skills traditionally attributed to the removed hemisphere. Fischer (2009) offered the case of Nico, a young boy subject to a hemispherectomy considered detrimental to motor control of one side of his body, visual-spatial skills, and tonally moderated speech patterns. After the hemispherectomy, Nico received an extensive experiential education emphasizing physical activities, art, speech, and other subjects that classical neuroscience attributes with the removed hemisphere. As he progressed, Fischer's research team gauged Nico's progress in these areas and discovered that the experiential education enhanced the remaining hemisphere's plasticity. Although the example of Nico is not that of a graduate student, Nico's story and Meissner's (2006) implication illustrate that an MBE approach might be a suitable methodology for understanding the generic learner subject to neurological development.

What remains to be determined is to what degree the scant evidence supports the graduate student of physics as a Fischerian learner. An extensive search of the literature revealed no known relevant research. Despite the gap in the literature, the story of Nico might parallel that of a publishing student of physics. Parallelism emerges from the belief that early-stage graduate students of physics wish to publish their future research despite an initial inability to publish in a respected journal. Thus, the graduate student influences their development by determining which classes, skills, and topics they pursue while at university. If the university and students interact as a highly contextualized and supportive Fischerian environment such as experienced by Nico, then the physics students might learn the skills necessary to publish. Thus, while Nico overcame a biological deficit to achieve, graduate students of physics must overcome a lesser biological plasticity deficit to acquire and demonstrate desired skill sets for publication.

A graduate student as a Fischerian learner is the *patchwork student* described by this study. Although the term patchwork student (often simply referred to as a graduate student in this study) might appear as a quip, its meaning is precise because skill development might be seen as an unfinished quilt subject to many potential outcomes that chosen by the student. The student creates an experientially derived quilt of embodied skills and skill sets – leading to the patchwork analogy. Current literature does not support a theoretical construct of such a student, nor does the literature provide survey-based studies given such a theoretical lens.

Placing the patchwork student into Elder's theory. The literature review depends upon the scant evidence and conceptual writing involving adult students,

Fischerian theories of development, and scientific findings to place a patchwork student into a phenomenological world. Although known literature focuses upon generic adult learners, this portion of the review unifies elements of Elder's life course, phenomenology of the Self, and commoditized learning environments into the patchwork student. The result will be a rudimentary theory of development motivating the surveys, their statistical interpretations, and commentaries forming the remainder of the study involving the patchwork student.

Elder's (1994) revised theory of the life course, later refined by Mortimer (2004), provides the skeleton theory extending the patchwork student into a realistic world. Elder's theory is useful for peering into the mechanisms of societal change and educational trajectories for the patchwork student while providing a principles-based construction placing the patchwork student into a lifespan. Further, the five principles of life course theory will provide the groundwork from which to understand educational trajectories variations of survey data in the study. Thus, Mortimer's (2004) five principles will demonstrate the suitability of the life course as a means to extend the patchwork student and describe the patchwork student's educational trajectories.

The first principle of the life course is that human development (educational and otherwise) and aging are lifelong processes. Carpenter (2008), Herubel (2008), Fischer (2009), and Labouvie-Vief, Chiodo, Diehl, and Orwoll (1995) noted that self-representations, skill development, and intellectual artifacts appear dependent upon the passage of time; therefore, the developmental processes must be time dependent. The first principle acknowledges that the patchwork student embodies time-dependent

emotions, educational goals, mental artifacts, and skills throughout his or her lifespan while embedded in Fischerian environments. Despite such an abstract claim, the personal experiences of Teramoto and Mickan (2008) realized a temporally extended self-directed journey overcoming difficultly in written expression weakly confirms the principle. Thus, the first principle does not apply strictly to abstraction and is applicable to individuals and experiences; and hence the patchwork student.

Although researchers such as Anaya-Prado et al. (2006), Brown et al. (2008), Carpenter (2008), Ferguson (2006), Herubel (2008), Labouvie-Vief et al. (1995), Rawson et al. (2005), and Teramoto & Mickan (2008) avoided writing in physics, Teramoto and Mickan's (2008) deeply personal account indicated that education researchers should pursue such a gap in the literature because the principle could be applied to the experiences of a graduate physics student. Furthermore, such gaps undermine the current literature because it neglects to address a highly commoditized and evidence-based science with an ability to provide longitudinal studies, interventions, and evaluations to track the impact of the first principle upon the student of physics. Despite the gap and historical unwillingness of the education research community, current literature supports the role of the first principle in the life and development of the graduate student of physics. The undermining of the literature by the first principle leads to an induced statement manifesting as the second principle: free agents choose their own life course through the available choices and given sociological, economic, and other constraints provided by the environment. The second principle is consistent with phenomenological

sociology described by Ferguson (2006) and the requirement that the patchwork student embodies emotions and skill sets.

Kuhn (1962/1996), Herubel (2008), and Paulos (1998/2001) provided strong socioeducational and philosophical arguments for the second principle by implementing a weak Whorfianism. Their philosophical arguments restrict all aspects of development to the linguistic structures realized in the environment. This argument demands that phenomenological actions of the patchwork student are strictly the function of the dialectical structure within one's contextualized environment (Fischer, 2006b; Mortimer, 2004; Paulos, 1998/2001). Although none of the known literature illustrates the second principle as applied to the graduate physics student, there exists literature and observations supporting the validity of the principle in other disciplines (Hyland, 2008; Qinh et al., 2008; Xia, 2006). Nonetheless the second principle extends to the graduate student of physics due to the existence of facilities like the socially constructed arXiv physics preprint archive housed by the Cornell University Library. Thus the second principle manifests in graduate physics and might directly affect the patchwork student.

Despite the lack of literature on the second principle and the writing skills of graduate physics students, Hyland's (2008) quantitative study exploring text clustering patterns in academic publications may point at the gap in the literature. Hyland's (2008) quantitative study demonstrated that the life course of a student progressing through the ranks of higher education tends to reflect upon the student's phraseology as a function of skill sets and educational history. Thus, the writing skills of graduate students and publications are direct reflection of their lifespan and embodied linguistic constraints –

consistent with the previous principles of the life course. There is no known reason why the same analysis could not apply to the publications of graduate physics students.

The third principle of the life course is the realization that the life course is an embedded derivative of the historical times and places experienced by an individual. Although Kuhn (1962/1996) presented the initial thoughts about periodization in academic publishing and science, Herubel (2008) realized the third principle is present throughout the history of academic publishing. Teramoto and Mickan (2008) transferred the effects of the third principle from abstract history to personal experience by discussing an English as a Second Language student's ability to produce a critical review while learning a second language at a postgraduate environment in Australia. Teramoto and Mickan (2008) humanized Herubel's realization by revealing the reflective thoughts and inner struggles applicable to any discipline involving socially constructed artifacts.

Although social sciences and educational research outside of graduate physics research have provided numerous narrations and studies outlining the experience of collaborative efforts, there is no known educational research utilizing the third principle for graduate physics other than storytellers like Feynman. Despite Feynman's historical accounts, anecdotal stories, and philosophical contributions on education for the masses, the gap in the current literature indicates the need to initiate interest. For the purposes of this study, the third principle remains intact because Teramoto and Mickan (2008) humanized their experiences to a point where nearly any graduate student may understand similar experiences.

The fourth principle generalizes the third principle by imposing a noncausal condition upon the third principle. Mortimer (2004) noted the fourth principle implies shared histories will manifest as variations in development for different individuals. Usher and Barnacle (2003) illustrated the principle in practice by exploring variations in research quality by individuals who experienced equivalent educational programs. Although the individuals experienced similar educational programs suitable for entering the information economy, Usher and Barnacle (2003) realized that their writing, communications, and research skills varied upon entering the workforce. The MBE perspective confirms the principle because the life course allows for variable neurological development in the context of personal experience not unlike Nico's contradiction of classical neuroscience. Thus, the study included the fourth principle as an expectation for variations in the survey responses despite participants' shared educational histories.

Butler (2003) provided the only indirect evidence linking the fourth principle to graduate physics students' publication rates given funding formulas commoditizing higher education. Butler's (2003) study explored the impacts social demands coupling to publication rates by realizing the effects of funding formulas upon the publication rates of disciplines including the physical sciences, mathematics, and medicine. Although Bok (2004) demonstrated that all three disciplines of academic publishing experienced similar commoditization in their respective fields, the disciplines had varying responses in their publication rates across tiers of respected journals. Variations manifested amongst the physical sciences in which publishing counts rose in the highest tier and decreased in the lowest tier while mathematical publications exhibited the opposite response given the

same period. Thus, despite graduate mathematics and physics students pursuing higher degrees in respected universities, the data illustrated the fourth principle in action by showing the variation in publishing skills and output. Unlike the previous principles, the fourth principle appears to be valid for graduate students of physics and supported by evidence found in current publications.

The simplest form of the fifth principle states that individuals link their progressions during the life course with each other and that sociohistorical information propagates along such linkages. This principle is an old notion acknowledging the social construction of knowledge during the 20th century (Adorno, 2001; Bok, 2004; Coser, 1956; Elder, 1994; Ferguson, 2006; Kuhn, 1962/1996; Marx, 1956; T. Parsons, 1940, 1952; Paulos, 1998/2001). Recent studies such as Kearns, Gardiner, and Marshall (2008) and Robertson (2004) extended the fifth principle into education research and established its validity for nearly all students. Furthermore, Lakemeyer and Nebel (2003) illustrate generalized arguments showing that belief propagation occurs along such links manifested in generic artificial intelligence and social models.

Graduate education involves the production of jointly authored papers, symposiums, and other activities requiring linked lives as to accomplish tasks. Although current literature lacks studies examining the practices of graduate physics groups, Mayrath (2008) presented the qualities of effective journal publishers. Mayrath's study and graduate physics departments share the following qualities: (a) collaboration as a means to refine a written document, (b) sharing common interests to encourage collaboration, (c) studying the latest developments in physics, (d) compiling potential

future research projects, and (e) teaching time-management skills to complete group projects. All of the above qualities reflect the collaborative efforts leading to publication as described by Butler (2003) while following the socioeconomic commodification arguments of Bok (2004) and Butler (2003). Thus, the graduate student of physics follows the linked lives principle and Mayrath (2008) indirectly demonstrated physics publication as a socially constructed artifact – thereby confirming the role of linked lives in this study.

The five principles of the life yields a patchwork student able to develop in a contextualized environment involving linked lives, role playing, and the embodiment of social contexts. Blending the principles with the patchwork student provides the student, environment, developmental theory, and crude dynamical theory necessary to understand the educational trajectories responsible for possible variations of survey data in this study while retaining an abstract concept of the learner. (The previous statement is simply the Fischerian compounding of the patchwork student and the life course into a system.) Thus, Mortimer's (2004) five principles in the context of the patchwork student provide the means to understand the patchwork student able to choose their own developmental trajectories.

Patchwork Wanderings: Trajectories and Development

The literature review has constructed a theoretical lens incorporating the purpose of the study, Fischer's theories of development, and Elder's life course theory. The result was an individual possessing free agency and the ability to refine the skills leading to desired educational, developmental, and professional outcomes. Although the theoretical

lens affords insight into skill development, there appears to be no theory discussing the trajectories of patchwork students. This portion of the literature review discusses the trajectories of patchwork students.

Phenomenological patchwork students experience strife as their life path moves across social strata (Coser, 1956; Ferguson, 2006; Marx, 1956; Noble, 2000). Such movements across strata, known as trajectories, manifest as the embodiment of social roles necessary for participation in a desired activity within labor markets, educational institutions, and social groups (Adorno, 2001; Coser, 1956; Elder, 1994; Ellis et al., 2007; Marx, 1956; Mortimer, 2004; Noble, 2000; Parsons, 1952). Often trajectories and the free agency guiding them rely upon the skill sets developed during educational, personal, and professional experiences as a means to achieve in accordance with embodied emotions of the patchwork student.

Despite the apparent utility of trajectories, they remain difficult to define since no generalized model exists. According to Mortimer (2004), the manifestation of a trajectory and their observed variations are sequences of events guided by the principles of the life course. Trajectories might take many forms including kinship interactions, socioeconomic transitions, educational roadmaps with milestones, and many other evolutionary developmental processes responsible for strata traversal; thus, there may be no generalized model but only the definition of a trajectory as a guiding principle. Nonetheless, projections of ill-described trajectories lend to an understanding of educational trajectories in graduate education.

Educational trajectories are the extension of generic trajectories when combined with an experiential education as a means of crossing educational, personal, and professional strata. Mortimer (2004) presented a simple example in which trajectories subject to the Wisconsin model of status attainment indicated that family influence, professional status, and social participation affect academic performance leading to higher paying jobs. Curiously this implies Bok's (2004) contention that such mobility also obeys the pressure of commodification in higher education. Thus one can compose an educational trajectory as sequences of events involving at least socioeconomic pressures affecting the experiential classroom, funding formulas linked to publishing, commodification, familial pressures, and societal expectation grounded in cultural contexts (Butler, 2003). This is the functional definition of an education trajectory in this study since there are no known generalized models at this time.

The projection of stratification, mobility, and trajectories into such a definition is neither fair nor complete because the wording glosses over dynamic variables of age, gender, family, marital status, and countless potential parameters. Femlee (1988) extended studies into trajectories by including age, gender, family, and marital status as elements affecting the life course, and hence, the educational trajectories of women in the labor force seeking higher education. Her expanded definition of an educational trajectory facilitated the conclusion that education provided the means to cross economic, professional, sociocultural, familial, and gender strata beyond the socioeconomic roles of Bok (2004) and Merton (1968). Although the functional definition in this study is

limited, it remains extensible as to support Femlee's (1988) analyses while providing the initial insight into the trajectories of the patchwork student.

The Fischerian view of educational trajectories. Thus far, chapter 2 has remained abstract and required the use of vague phenomenological terminology. Although this afforded a sketch of education trajectories, the result has yet to be integrated into the patchwork student as a blending of Fischer's skill theory and Elder's life course theory. Although the integration of skill theory, life course theory, and educational trajectories is nearly nonexistent in the literature, Fischer (2004) provided hints allowing integration and the completion of a theoretical lens pursued in this chapter. The integration process is two-fold via a discussion on how microdevelopmental processes lead to skill acquisition and how their results emerge into observable educational trajectories. Upon concluding this segment, the analysis afforded by the resultant lens will illustrate the forging of an approximate Fischerian educational trajectory (FET) and closure of the theoretical lens.

The underlying assumption of FET emerges from Fischer's skill theory: the manifestation of skills and skill sets indicate milestones forming a rough representation of a trajectory. The endpoint of a trajectory is the demonstration of targeted skill mastery although some dynamical quantities determining the trajectory may remain unknown. Although the description of a FET may frustrate educators and their attempts to observe trajectories, the statement is consistent with the principles of the life course because the FET is inherently noncausal. It may seem strange that causality may be lacking in a FET, but the lack of causality ensures that individuals exhibit variation in skill set

development. Further, Bertrand (1995) and Bloland (2005) found that shared educational experiences lead to variations in intellectual achievements consistent with the noncausal assumption of FET.

The crude mapping of a FET begins with the idea that microdevelopmental processes contain the immediate compounding, differentiation, and other manipulations responsible for skill set development (Bertrand, 1995; Fischer, 1980, 2004, 2006a, 2006b, 2009; Fischer & Pare-Blagoev, 2000; Moll, 1990; Reardon & Wright, 1999). In phenomenological terms suited for patchwork students, microdevelopment is an embodied phenomenon responsible for belief revision occurring over timescales commonly observed in the classroom. Although microdevelopment appears abstract, it occurs when a graduate physics student tackles a novel quantum mechanics problem. If one transfers Fischer's simplified bridge building physics lab experiments into their suitable QM counterparts, then one may observe microdevelopment in the graduate physics classroom when considering a simple exercise provided by Shankar (1994).

Shankar (1994) presented the discussion about uncertainty in measurement using Dirac notation, wavefunctions, differential operators, eigenvalues, and commutation rules. Consider a crude outline of the processes utilized in Shankar's presentation before discussing the FET implications:

1. Defines a nonvanishing commutation rule between the generalized operators such that the resulting eigenvalues possess an imaginary component.

2. Defines the variance as the square of the uncertainty equation and then uses the generalized operators and commutation rule to simplify the result.

3. Utilizes intricate mathematical processes including substitutions of operator identities, use of theorems, and inequalities to manufacture the uncertainty of measurement inherent in the pair of operators (measurements) given a particular commutation rule. This yields an uncertainty relation for complementary pairs of observables represented by operators.

4. Extends the result of the previous steps into the energy-time and position-momentum uncertainty relations forming the postulates of QM and transitions the dialectical presentation into abstraction and principles tiers of development.

This process allows the educator and student to observe whether a student might manifest particular skill sets as direct measure of microdevelopmental processes indicating whether a student is approaching the exhibition of optimal skill levels. If a student fails to exhibit adequate mastery of a skill at Step 3, then the educator might view the functional skill sets concerning the use of compounding, substitution, and differentiation involving operator algebra as too distant from an optimal skill. Thus the educator may intervene and assist with the construction of a proper representation of operators and operations in operator algebra (Moll, 1990). Likewise, if the student falters during the transition to the final step, the educator can address how to transition the patchwork student's knowledge from an abstraction tier of skill development into a principled systems approach similar to the final tier of skill theory. Thus the ethnomethodological nature of graduate instruction and problem solving might afford an indirect, or inferred, observation of microdevelopment and the construction of a FET.

The QM example above requires a Fischerian understanding of development and an accompanying FET because one must be able to differentiate between two differential operators. Such differentiation is a skill indicative of operating in final levels of a representational tier and signals a milestone in a FET (Fischer, 1980). During the embodiment of the generalized operators as knowledge, the student must vary along a tangible dimension allowing the operators to obtain distinct yet similar properties in the mind (Mellor & Oliver, 2004). Such an ability to distinguish allows people to retain similarities between differential operators while allowing their representations to compound more complex mappings and assist with the exhibition of skill sets outlining a FET.

Although compounding helps students develop skills necessary for progressing though an uncertainty calculation, such compounding does not offer a pathway to solving novel problems or understanding the meanings embedded in the calculation. For example, a graduate student might acquire the skills to perform technically complex calculations and yet not understand the principles and methodologies allowing the application of such skills. Thus, students must bundle various mappings into a coordinated representational system to create the skills leading to success in attempting to solve novel problems (Fischer, 1980, 2004, 2006a, 2006b, 2009). Such a new skill, the coordination of a representational system, affords the opportunity to combine the skills associated with the use of operator algebra with physical concepts as to generate an observable mastery of uncertainty simply coded into a FET.

The problem solving process offers the potential of failure (observed as a failed or insufficient skill) and interventions. As graduate students learn that the ordering of quantum operators follows strict commutation rules, they run the risk of failing to perform due to the embodiment of a faulty representational system. Such failures emerge from several potential problems, including incompatible mappings conflicting within the representational system indicating inconsistent understandings of the dimensions contained in the system, unrealized mappings necessary for completing the bundled representational system indicating a lack of compounding, and other problems spanning contextualized learning presented by Bertrand (1995). When graduate students fail to allow the functional and optimal manifestation of skills to converge, then they resort to introspective processes promoting the embodiment of new or refined skills. Whether or not intervention or personal choice triggers the introspective process, failure is a motivation for skill refinement and observable macrodevelopment events forming a FET.

The next step from representational systems to the abstract tier provides the transition from weakly observed microdevelopmental processes to directly observable macrodevelopmental behaviors mimicking traditional learning (Bertrand, 1995; Bloland, 2005; Brown et al., 2008; Carpenter, 2008; Diezmann, 2005; Ferguson, 2006; Fischer, 1980; Moll, 1990; Mortimer, 2004). As graduate physics students compound and coordinate multiple (and potentially conflicting) representational systems, the abstract and principle tiers emerge in the artifacts produced while transitioning into the abstract and principle tiers. Prime examples of demonstrated integrated abstract and principle tiers are von Bertalanffy's (1969) and Zeh's (1989) works attempting to unify

representational systems spanning numerous disciplines into systems of abstractions obeying principles. In the case of the QM calculation, transition occurs when the graduate student of physics compounds the representational system learned from the calculation with those found in thermodynamics and stumbles upon statistical field theories. Whether or not the student exhibits such skills determines their progress along a FET.

Although the microdevelopment of the graduate physics student might remain obscured by phenomenological restrictions upon observing an individual, the glimpses of microdevelopment are an easily observed synthesis of macroscopic intellectual artifacts dependent upon abstract and principles tiers. After interventions upon observed failures between transitions and evaluations of intellectual artifacts, educators can assemble crude generalized FETs leading to successful patchwork student achievement and curriculum development. Although the above could be useful in higher institutions of education, current literature lacks any research on FETs, definition of FETs, or the extension of FETs into other disciplines.

Synopsis and criticisms upon an incomplete effort. This chapter collected insights from scarce literature as to begin a literature review. The resulting text integrated concepts from Fischerian and MBE concepts, the underpinnings of phenomenological sociology, life course theory, and several journal articles to produce an incomplete theoretical lens. Problems with the lens range from the philosophical to the questioning of assumptions that permeated this study. Thus what follows, before analysis

of the only journal article directly related to this study, is a critique of this chapter, its products, and assumptions.

The fundamental flaw in the construction of the lens is the reliance upon scant literature compounding education research, graduate physics publication methods, and writing skill sets. Despite the lack of journal-quality publications describing such a compounding, there exist extensive studies in childhood writing skill development linking education research, student performance, and writing skill interventions as a means to improve elementary education. Thus, this study assumed an extension of such studies without precedence to develop the survey and interpretation of the results. Although Quible and Griffin (2007) and others expressed their disdain of writing quality in academic journals, there is no publicly known response in demands within the publishing segment of the physics community outside of a desire to publish quality papers. Thus, one must ask if there is an audience for this research within the physics community and if an audience will accept the extension of elementary education research as a valid premise for researching graduate physics departments.

Although the potential lack of an audience is disconcerting and may cast the theoretical lens into the shadows, concern arises from the metaphysical underpinnings borrowed from phenomenological sociology. There is no reason to believe that skill theory and phenomenological sociology are compatible theories despite Ferguson's (2006) outstanding exposition linking phenomenology to personal choice and social roles touched upon by skill theory. This concern manifests when one realizes that Phenomenological sociology relies upon metaphysical concepts such as embodiment

while Fischerian thinking defines embodiment as a physical process involving neural nets and scientific measurement. Such concerns lead to whether or not the theoretical lens suffers from the mind-body duality fallacy. Future research should remain vigilant of this potential problem while developing this study into a mature theory.

Just as Coser (1956) demonstrated the elements of social conflict within a functionalist sociology, neurobiologists realize that not all neurological development is cooperative. Biological conflicts such as disease and irregular development might trigger the acquisition of frustrated skill sets leading to a sense of conflict in the graduate student. A simple example of such frustration occurs when dyslexic students attempt to reconcile a medically based learning condition with the goal of mastering principled physical thought and mathematical expression. Furthermore, the construction of the lens assumes there is an unknown biological definition of skill sets not hampered by the notion of phenomenological embodiment allowing skills to exist in the mind. Thus, this leaves the education researcher in a precarious position of sorting out potentially frustrated skills and how they should manipulated as to produce an experiential education via conflict-motivated emotional distress.

The use of functionalist thought tends to skew a theory toward a Western ethnocentric bias because its categorization schemes tend to reflect Western perspectives of sociological systems. The theoretical lens suffers the same bias because the literature building the study admitted to using samples favoring U.S. and European children (Fischer, 1980, 2004, 2006, 2009). Although ethnocentricity was undesirable the a study, this study focused upon students in Western institutions of higher education reflecting the

categorization schemes once demonstrated by Parsonian functionalists. Thus, there is a risk that future research along such lines will suffer ethnocentric biases – requiring the redefinition of skills to a generalizable concept across all cultures given an appropriate understanding of life course theories across multiple cultures.

Although ethnocentric biases and philosophical inconsistencies force the researcher to appeal to pragmatism as to allow a flawed theoretical lens, there is yet another complication because Fischer's skill theory tends to end about the age of graduate students. Although Fischer does believe skill development occurs beyond 20-30 years of age, consistent with the Vygotskian view of development and Elder's life course theory, there is little evidence or description of such extended skill development (Fischer, 1980, 2004, 2006, 2009). Graduate physics students tend to vary in age, which places the construction of the patchwork student in question because it relies upon the validity of Fischerian development during the life course and ages beyond which MBE theorists commonly consider valid. Thus, this brings into question whether the abstraction and principle tiers of development applied to the participants of the study. In addition, if the assumption of development beyond 20 years of age is problematic, this study risked potentially projecting development into an incorrect tier leading to faulty analysis. In either case, whether Fischerian development remains extensible or not across the life course, this study assumed extensibility because the resulting theoretical lens might prove valuable in understanding the survey data.

Bok (2004) revealed another weakness in the theoretical lens by stating that corporate interests, joint ventures between commercial and educational institutions, and

associated cash flows affect student body composition and research opportunities. This association indicates that the skill sets favored by the commodification of higher education might receive special attention in the classroom and research environment (Adorno, 2001; Anaya-Prado et al., 2006; Biser et al., 2007; Bok, 2004; Brown et al., 2008; Butler, 2003; Ellis et al., 2007; Gjerding et al., 2006; Glazer, 2004; Shumar, 1997; Vidovic & Bjelis, 2006). Since the journal articles cited do not directly address coupling between commodification and potentially externally selected skill development, an open question exists concerning how trajectories of graduate physics students involved in commoditized projects develop writing skill sets demanded by business. Thus, future researchers must ask how commodification of graduate physics affects enrollment in writing courses and skill development across cultures and segments of the global economy. Currently there are no answers to such questions and they should warrant significant education research.

However, the previous problem extends beyond academic experiences since the patchwork student must enter a workforce utilizing professional skill sets. Upon entering a workforce, the former patchwork student discards their previously experienced scaffoldings and FETs in favor of ones supported by their new professional environment. Although the transition is commonplace, the literature review and theoretical lens ignores the transition despite the invocation of Elder's life course. This gap presents a critical problem since the endpoint of FETs are supposed to serve the emotional, professional, and personal needs of the patchwork student. If the transition occurs and the endpoint is confused, then the recommendations from the study may provide a disservice to students.

If such an event occurs, then it is the case that curriculum revisions grounded in this study may be unethical.

In addition to the ethical dilemmas emerging from uncertainties in FETs, this study conjectured how professional services and journal editors assist with professional writing skill set development (Bertrand, 1995; Bloland, 2005; Bok, 2004; Femlee, 1988; Gilbert et al., 2004; Gjerding et al., 2006; Glazer, 2004; Le Roux & Galloway, 2008; Vidovic & Bjelis, 2006). Although this study focused upon graduate students, the lens used should offer hints concerning the coupling of professional FETs to professional writing services. Ideally such insight could assist with the planning of skill set refinement given professional goals and smoother transitions between educational and professional FETs. Yet no known publications compatible with this theoretical lens explore the planning of skill refinement in professional settings outside of a few remarks by Fischer (1980). This forced the study to remain questionable on whether or not it can fit into an embedding theory or remain little more than an exercise in phenomenology.

The final problem of concern in the study was whether life course theory provides a compact support for Fischerian development. Elder's theory of the life course has inspired a vast field of research primarily ignoring the work of Fischer. Currently there is no supporting evidence encouraging the integration of Fischerian development and Elder's theory of the life course outside of an educated guess injected into this study. Such a guess brought into question the validity, consistency, applicability, and value of this study, for better or worse. Nonetheless, this study emphasized that research into such an overlap be a target of future researchers to break down the life course into units

suitable for innovating educational praxes and research. Hopefully this study illustrated the need for future research to integrate Fischerian thinking and life course theory into a coherent lifelong theory of skill development while allowing this study evolve into a proper form lacking the phenomenological and metaphysical implications discussed earlier.

The critique above provides the groundwork for an antithetical study and the construction of a conflicting theory with the potential for contradicting research into the patchwork student and FETs. Despite such weaknesses and potential for a fertile argument, the literature review presents a tool for the pragmatist and curriculum administrator because it provides a framework in which to model graduate physics student publication skill sets. If one accepts the pragmatic nature of this study, then the reasons for the problems in this study are acceptable yet demand further research. Whether resolved or not by future research, all the above problems may be unified into a single root philosophical cause for their existence – the projection of complex ethnomethodological data and personal experiences into reductionist theoretical concepts forming a nearly mechanistic theoretical lens.

Despite the weakness cited above and scarce literature, there exists a single known paper attempting to illuminate the socioeconomic and cultural dynamics involving publication rates despite the ignorance of the concepts presented in this literature review. The conclusion of this chapter will provide a review of the paper while interpreting its results given the theoretical lens presented. Its results provided a rudimentary exercise in interpreting the survey data in this study while extending known literature into this study.

Despite the depressed tone of this paragraph, the single known paper does offer some insight into the problems with FETs discussed in this section. Ideally such a discussion establishes the pragmatic tone of the study while compounding it with known research.

A Curious Article: Laying the Foundation of This Study

Butler (2003) presented the only reference in this study directly addressing publication counts involving graduate physics departments. After a statistical study of Australian physics, chemistry, earth sciences, mathematics, biology, engineering, agriculture, medicine, and social science graduate publications catalogued by the Science Citation Index, Butler revealed that funding formulas utilized during state funding affect the quality, count, and targeted audiences of graduate publications. Thus as funds were issued and allocated among departments, in accordance with funding formulas, the overall quality of publication degraded and the landscape of publications accommodated commodification efforts. Curiously the impact of funding formulas manifested as an increase in publication volume favoring less prestigious journals and magazines because the funding formulas allowed for a decrease in the quality of publication to compensate for an increase in publication volume. Although Butler (2003) did not link publication rates and skill theory in the study, their work inspired this study and laid the groundwork for discussion, analyses, and understanding of her research subject to FETs and the theoretical lens established in this chapter.

Butler's (2003) discovery that the funding formulas leading to an increase in publication favor less prestigious journals is significant in understanding the implications of how educational institutions and commodification efforts influence FETs. The critical

implication of the theoretical lens applied to Butler's (2003) study resides in a paradox she nearly uncovered during statistical analyses. Prima facie that seems obvious if one reads the statistics, but through the theoretical lens such statistics are more meaningful. When Butler's (2003) results are compounded with Quible and Griffin's (2007) push for a workforce with professional publishing skill sets, it becomes apparent the commodification of education using funding formulas linked to external revenues allowed business and educational efforts to produce a workforce lacking proper publishing skill sets.

Ironically such failures occurred despite the presence of commoditized educational experiences guiding skill set acquisition by the patchwork students during their educational trajectory. Thus, the compounding of these two articles within the theoretical lens reveals a subtle irony discussed by Horkheimer and Adorno (1979): that every system, group, complex idea, or composite social structure contains the seeds of its own demise. Quible and Griffin (2007) expounded upon this paradox exposed by the theoretical lens, when applied by the mechanistic pragmatist, and showed that the commodification of education affects publishing skills sets such that they are no longer strictly an academic problem, but reflective of problems involving the manufacture of a labor force.

Transitioning from the social and philosophical to the individualistic experiential edge of the theoretical lens shows another implication buried in Butler's (2003) work: the manipulation of FETs as to violate the composite structure of the patchwork student and render them apathetic toward their own development. The past 30 years have witnessed

an explosion of for-profit institutions of higher education dedicated to student-centered learning, programs, and uniquely structured degrees oriented toward mobility in response to the traditionally rigid institutions of higher education (Smart, 2005). Likewise, traditional universities attempted to accommodate student and sponsor demands by building specialized research programs targeting student interests and sponsor goals given higher education as a globalization effort outlined by Bloland (2005). Despite such efforts, the previous paragraph indicated that the efforts yielded students and professional publishing in the bottom two quartiles of journals and magazines while engaged in commoditized or specialized programs. Thus, such efforts might reinforce FETs reliant upon the representation tier of development over the abstract and principles tier because the lower quarters of the journals target nonacademic audiences focused upon grasping concepts as information workers as outlined by Gray et al. (2005).

The reliance upon the representation tier of development as a road to publication is not the critical concern because there is a market and individuals excelling in teaching utilizing the representation tier of development. Concerns emerge when the coupling of educational and professional FETs restricts the patchwork student to an experiential education focusing upon the representational tier and little else. If it is the case that Butler's (2003) work implies such concerns, then the theoretical lens casts light upon the potential for traditionally academic FETs to abnormally couple to professional or vocational FETs because students might not have enough quality papers to pursue academic or associated careers. (Such restriction indirectly affects publication rates

across quartiles of journals and produces professional publications targeting a potentially undesired career pathway).

Butler's (2003) work, might lead to stagnation in FETs and mobility accompanied by a sense of emotional dissatisfaction responsible for the hampering of skill development because emotions provide the internal driver for skill achievement and phenomenological goal embodiment. One might picture a student as a dichotomy of appreciation for experience and garnishing an education while being disdainful of the fact that his or her social status and mobility was restricted because of such appreciation – the dichotomy leading to the seeds of distrust and frustration as hinted by Bertrand (1995), Femlee (1988), and Marx (1956). If left unaddressed, then higher education might suffer from its own socioeconomic shortcomings while alienating the student and embedding society.

Butler's (2003) work proclaimed a connection between funding formulas describing block grants and productivity via visual inspections of correlations. Despite the lack of proper statistics, all sectors except for the second quartile in chemistry journals manifested significant increases in publication volume across all quartiles upon the introduction of funding formulas during 1989-1993. If productivity couples to FETs via publication experience, then one may deduce that distribution formulas of block grants manipulate observed increases in publications while directing graduate education publication experiences and FETs. Furthermore, Butler (2003) illustrated that publication volume and educational publication experiences supported a shift from publishing in upper quartiles into the lower, which is a behavior common to chemistry, biology,

agricultural, and social science. Thus, productivity and associated experiences contained in FETs follow the adage *follow the money*, forcing one to consider the possibility that productivity, the manufacture of intellectual products, and FETs may be manipulated to favor quantity over quality, appeal over content, and enhancement of selective prestige leading to additional funding.

Butler (2003) indicated that the physical sciences increased publication counts evenly across all quartiles that contradicted publication measurements involving other disciplines. The curious response of publication in the physical sciences indicates that the commodification of journal publications and productivity are not subject to exactly the same forces involved in other disciplines. Although the study offered no insight into why such a condition occurred against the generalized trends, the evidence indicated that the physical sciences suffered the same organizational efforts as other disciplines yet only manifested a roughly even increase across all quartiles demanding finer research. Thus, education research should investigate how the distribution formulas used in the block grants, funding schemes within individual physics departments, and their mingling with external funding sources affect institutional funding policies impacting FETs, productivity, and publication volumes and quality.

The few previous paragraphs illustrated Butler's (2003) work through a phenomenological and social lens highlighting personal and societal conflicts suggested by the data. The paragraphs also showed that publication rates couple to the personal and professional motivations present during experiential higher education subject to systems of external and internal influences. If Bok (2004) and Butler (2003) are correct and a

causal relation between motivation and productivity measured by publications exists, then FETs are a tool in understanding the psychological and developmental processes underpinning successful graduate publishers.

Viewing the findings through the theoretical lens afforded a chance to discover some linkages between known literature and the concepts presented in this chapter. Butler's (2003) investigations revealed that funding formulas utilized during state funding impact the quality, count, and targeted audiences of graduate publications. Thus as funds were issued and reallocated among departments, in accordance with funding formulas, overall quality of publication degraded and altered the associated FETs, productivity measures, and Fischerian skill sets composing the experiential component of graduate physics education. Although this chapter cannot provide proven changes in FETs, the literature and theories of Fischerian development and phenomenological sociology indicate couplings between FETs, student experience, developmental theories, and pragmatic perspectives addressed in the survey portion of this study. Thus, one should consider this segment of the literature review as a preview of the qualitative analyses imposed upon the quantitative data collected via surveys and as the perspective dominating the application of the theoretical lens.

Dualism Unifying Known Research, the Patchwork Student, and Potential for Constructivism

This study extolled an incompatibility with known literature due to the mixing of scientifically grounded Fischerian theories, phenomenological sociology, and emotionally driven conflict responsible for producing a theoretical lens. Prima facie the

claim offers a conflict naturally grounded in the literature utilizing diverse and conflicting epistemologies. Yet the pseudoscientific or metaphysical properties of the lens demonstrate compatibility with a buzzword in education: *constructivism*. This study did not utilize constructivist principles and demands that the pragmatist progressively strip the theoretical lens of such pseudoscientific and phenomenological aspects while progressing to a refined theory. Nonetheless the study cannot ignore the commonalties between itself and current literature. What follows is nearly a formistic examination of the commonalities between the theoretical lens and known research despite the call for the pragmatist to discount the epistemological relativism present in constructivist thought and metaphysical underpinnings of this study.

The roots of constructivism emerged during the early 20th century while Vygotsky and Piaget developed their conflicting early model theories of development given a socially defined contextualized environment (Hua Liu & Matthews, 2005). As elegantly delineated by Hua Liu and Matthews (2005), the Vygotskian tradition produced social/realist constructivism while the Piagetian tradition manufactured cognitive/radical constructivism. Although both camps of constructivism acknowledge the roles of socially derived contexts affecting the development of individuals, those following cognitive/radical constructivism believe that such contexts drive cognitive conflicts leading to development while those adhering to social/realist constructivism believe that learning and development is an enculturation process initiating the individual in a knowledge community.

Despite the conflict between the directional theories, the theories rest upon a single axiom demanding that individuals may only understand reality and knowledge as far as thought allows while invoking a weak form of embodied Whorfianism restricting the mind to its artifacts, intersubjective gifts, and belief revision processes. Curiously such an axiom implies that all dialectical structures conducive to the social construction of knowledge are equivalent and demands that constructivism accepts an unproven primacy to epistemological relativism in education.

It is important to present a harsh criticism about constructivism as to remain somewhat intellectually honest before continuing this literature review. The criticism is simple and direct, without recourse except for accepting the denial of constructivism itself. If individuals may only understand reality and knowledge as far as thought allows, then it is the case that one may violate a weak form of embodied Whorfianism to invalidate constructivism.

The existence of the electron provides an invalidation of constructivism. The electron is a fundamental particle possessing abstract quantities such as spin, charge, mass, interesting phenomenology, and other quantum mechanical properties that as per the Dirac equation. A graduate student of theoretical physics will be able to describe the electron in detail via quantum numbers, spin states, conservation theorems, and a plethora of knowledge responsible for revolutionizing the world. Yet if you ask the student a simple experiential question such as, What is the shape of an electron? Is it a ball? A cube? Flower-shaped? Any shape at all? The student will discuss the nature of zero volume point particles and eventually submit that that electron lacks spatial distribution.

Although the student would be correct in the description, you and the student would be at a loss to construct a linguistically motivated mental model of what an electron is despite the wealth of information derived from abstract expressionism contained within the mathematical formalism. Thus, constructivism fails due to the existence of a branch of knowledge exceeding the grasp of thought while remaining expressible and its acceptance into a socioeducational system. This argument is the realization that knowledge is not subject to dialectical construction.

The primary commonality between this study and constructivism was an emphasis upon experiential education. The story of Nico provides the context demonstrating the importance of experiential education in Fischerian environments while Kearney and Treagust (2000) demonstrated effective constructivist interactive videos guiding small undergraduate mechanics physics groups. Both cases utilized laboratory environment during the group construction of representational, abstract, and principled skills leading to development as a contextualized group effort similar to a Parsonian functionalist AGIL schemes. Just as Nico developed beyond the restrictions of classical neurology due to intense group efforts, Kearney and Treagust utilized the constructivist principles of social knowledge allowing a dialectical construction of an embodied understanding of mechanics. Thus by integrating physical activities and multimedia experience into a group experience, students such as Nico and undergraduate physics groups may adopt to new environments, set targeted goals, integrate the knowledge constructed during group dialectics, and provide the latency systems later emerging in newly manifested skill sets or enhanced exam performance (Parsons, 1952).

Geer and Rudge (2002) generalized the study of small groups within a university setting. While considering the temporal, financial, and other constraints underlying a traditional undergraduate classroom, Geer and Rudge applied constructivist principles allowing the classroom to have a well-defined purpose, specific intents, and a melding of traditional lecture followed by smaller study groups dedicated to particular kinds of information and skills responsible for molding beliefs, skill sets, and mental models embodied during examinations. Geer and Rudge found that larger traditional classes might benefit from similar approaches involving the traditional embodiment and integration of knowledge experienced while participating in taking lecture notes and the collaborative smaller groups targeting student-generated questions. Thus constructivism might have value for larger groups given the micromanagement methods of Kearney and Treagust (2000) targeting student-generated questions and knowledge by simply allowing passive acquisition and integration of knowledge during AGIL–aware lectures. Nonetheless, the undergraduate community, much less than the graduate physics community, knows how to implement a sound technique supporting such methods.

It is curious that AGIL, as described by Bales (1950), appeared to link the theoretical lens in this study to the current trends in constructivism despite the discrediting of Parsonian functionalism and the philosophical roots of constructivism. Although the linkage appears in the above paragraph, the emergence of an AGIL scheme while offering the theoretical lens to constructivism is simply the result of acknowledging the linked lives principle. It may seem odd to invoke the linked lives principle as the means to constructivism in the theory, but it unavoidable since FETs and their

experiences are the result of interconnected lives influencing the socially constructed patchwork student. Such linkages demonstrated necessary weaknesses in the study due to the metaphysical aspects of the theory. Thus acceptance of this study and current research requires primacy for constructivist facets of life course theory.

If constructivism supports the larger traditional classroom environment, then the refinement of skill sets necessarily emerge from constructivism and the Fischerian perspective. Whether such refinement is compatible with MBE methodologies, dualistic organismic theories, or some unknown sociodevelopmental theory, remains unknown. Nonetheless the dualism criticized earlier appears as a norm of developmental theories affording AGIL-aware schemes conducive to learning.

Sadly the known literature lacks understanding regarding how such mechanisms consistently manifest in the biological and metaphysical. Further this forces the education research community to ponder whether we pursue a metaphysical or scientific model of learning since they might be mutually exclusive. Such potential exclusivity places this study and constructivism in opposition while meeting only to show the commonalities deemed by the pragmatist as mutual weaknesses of potential utility. Thus, the commonalities of constructivism and this study provide links to known literature while placing them in an adversarial dialectical system driving future research.

Constructivism and this study share directly observable implications concerning social welfare and justice since commodification efforts allow a Marxist perspective. No matter the philosophical arguments presented, one of the goals of experiential education is to serve personal and social needs to improve standards of living. Vicentini and Sassi

(2008) contended that the constructivist perspective focusing upon social justice, cooperative activities, and the social development of generic skills applicable to science and technology might address problems involving communicative interactions, gender inequality, and writing skills responsible for social welfare. Although Vicentini and Sassi cannot provide the mean on how to use constructivism in such a fashion, they indicated that constructivist educators might emphasize social justice as part of their curriculum.

Vicentini and Sassi (2008) also believed that the constructivist classroom would yield individuals able to transfer generic scientifically orientated mental models and skill sets between disciplines. For example, if a constructivist grade school science class teaches generic and associated Fischerian skills involving group reporting and time management, then such skills may be transferred to complex novel environments requiring time management skill sets; examples are science labs, legal proceedings, and medical procedures dependent upon the notion of cooperative time management focused upon providing for society. Thus, the generic skill debate is alive and well in constructivism and the Fischerian perspective, and perhaps with good reason if generic skills can lead to an educated populace striving for various socioeconomic equalities.

Although constructivism and this study are rarely explored dynamic quantities in promoting social equality, there explorations provide insight into graduate education while addressing equality from differing perspectives. While constructivism originates social problems in viewpoints embodied by a society, Fischerian thinkers tend to ground social problems in an ecological system involving an external reality (i.e., the society embedded in an externalized and scientifically described world). Such grounding might

appear foreign to many, but it is simply the realization that social problems are not strictly a function of society. Social problems are multivariate concepts grounded in biological constraints such as medical issues, geography and resource issues, environmental pressures, genetic selection, and assumptions of the life courses subject to a histories not strictly defined by societies (Anaya-Prado et al., 2006; Brown et al., 2008; Carpenter, 2008; Ellis et al., 2007; Glazer, 2004; Gray et al., 2005; Le Roux & Galloway, 2008; Marx, 1956; Merton, 1968; Mortimer, 2004; Paulos, 1998/2001; Sall & Ndjaye, 2007; Stewart & Waight, 2008). Despite such differences, constructivists and Fischerians attempt to provide instructional guidelines, tools, and examples to address the problems confronting societies through innovation in higher education.

Thus, in a phenomenological sense of societal problems, it does not matter which perspective is correct, only that one, or both, provide resolution to the problems facing students, scientists, and educators because technological societies are dependent upon their intellectual products. But, it might matter because the mechanisms derived from both views need to acknowledge the existence of an external reality subject to description, and wandering too far from that during instruction might provide a disservice to society by educating scientists not aware of such a condition. Thus, the tie that binds this study to constructivist education is craving for a desirable future and not just educational or philosophical considerations.

The final commonality of concern emerges from the appearance that Fischerian perspectives and constructivism favor empiricism over rationalism. Unlike rationalists favoring the generation of knowledge from previously established knowledge, a position

weakly invoked by scientifically oriented MBE supporters, both favor the use of empirical observation as an organizing principle of development. Neither party may claim innate knowledge due to Locke's rebuttal that one cannot embody what one might never have conceived, or hold representations without experience. Thus, rationalism cannot apply as a means to examine the development of the self given a social context.

The failure of rationalism forces Fischerian and constructivist thinkers to appeal to empiricism to guide them in their quest for knowledge and understanding all of which both thinkers encompass. Yet empiricism offers little solace since it depends on the ability to observe given incomplete data using biological systems honed by reductionist evolutionary processes and similarly affected machinery. The picture provided by the rationalist and empiricist is inherently incomplete and requires both to abandon their respective camps; denying Fischerian and constructivist thinkers their intellectual dominance.

Such a philosophical failure is the great unifier of this study and known literature. Both approaches are necessarily pragmatic due to such failures yielding studies like Wilhelm, Thacker, and Wilhelm (2007), who emphasized results over methodologies. Wilhelm et al.'s reversal of such denial into success attributes to pragmatism and emphasized outcomes rather than theoretical constructions. Although Wilhelm et al. (2007) realized this analyzing a small group, their research demonstrated that the pragmatist is the guide indicating what remains effective in the classroom environment. Thus, just as the Fischerian assumptions of this paper and constructivism emphasize the

use of metaphysical dualism, both approaches indicate one must adapt a *seeing is believing* stance when innovating higher education in light of the above commentary.

Final Conflicting Thoughts Before the Survey

Usually the conclusion of a chapter offers the unification of its contents by tying together the imperfect theoretical lens, the contextualized patchwork student obeying Fischerian development, the underlying and unspoken pragmatism reconciling manifest conflicts, and the numerous concepts that occupied the previous pages. Yet the imperfect lens and conflicting metaphysical and scientific underpinnings ill-afford resolution and must appeal to a Coserian attitude utilizing pragmatism as a means to dissolve the conflicting metaphysical-scientific dualism in the lens. Although the pragmatist cannot clearly partition the practical from the theoretic, there is a sense of closure for this chapter given the following relating theory to practical measures derived from survey portion of the study. Thus, what follows is a conclusion, neither adequate nor complete, signaling the need for future research and debate.

The first crux of the conclusion focuses upon whether a flawed theoretical lens used in interpreting Butler (2003) and the impending survey remains valid. Although one may cite the dualistic nature of the lens as a damning quality invaliding its use in serious research, the pragmatic undertones of this study accepted such flaws in the hopes that future research will slowly erode the metaphysical aspects from the lens while yielding generations of increasingly scientific theoretical lenses. The flaws remain within the lens utilized in this study without appealing to an excessively narrow perspective focusing strictly upon a mechanistic, organismic, or contextualized perspective.

Such focus may reconcile many of the flaws while negating the phenomenological aspects of emotion, introspection, and the richness offered by life course theory. Thus reconciliation may render the patchwork student devoid of emotion, free will, and the ability to develop as discussed earlier in this chapter. Nonetheless, the inclusion introduces intellectual dishonesty into the study by undermining the pragmatic approach while accepting the problem: dishonesty acknowledging the learner as a composite of metaphysical and organic components. Thus, the crux of validity must remain unaddressed in the hopes of future research enforcing the pragmatic maxim.

Despite doubt in the validity of the theoretical lens and potential intellectual dishonesty in the study, they provide the means for the pending survey data and its inferences involving the patchwork student. If analysis adheres to the lens, despite its ramifications involving the mind–body duality argued by philosophy, the lens allows researchers to grapple with complex and unknown biological systems involved in Fischerian development and graduate education.

It may be the case that the uncertain grappling with unknown quantities affords insight into graduate education by extending known quantities such as skills, human development, and language of education research into novel explorations involving graduate institutions. The interplay between metaphysical and Fischerian languages affords a conflicting dialectic striving for a scientific resolution and dissolution of the metaphysical components, yielding a publication-worthy effort responsible for extending education research. Nonetheless, the problems in the lens, literature reviews, and this study remained and must be acknowledged as to analyze Butler (2003) and related

research while reaching beyond statistics and into the experiential nature of publishing as a graduate student of physics.

The dialectic approach motivated the brief discussion of Butler (2003) while introducing the application of a highly abstract and conflicting theoretical lens to a practical study. Since the utilitarian benefits of the lens emerged from a conflicting dialectic questioning the choice of a lens, then there may be the possibility that the lens contributes to the survey. Survey benefits begin in the mind-body duality assumed by the lens since the duality allowed this study to incorporate the embodied beliefs of graduate physics students concerning writing skill sets. Thus the lens supports a quantitative survey incorporating a brief segment of open-ended questions intended to enrich data analysis and extending Butler's (2003) commentary. Thus, the dualistic nature of the lens expounded upon by the pragmatic perspective provides strength for this study while it enhanced the data collected during the survey – albeit not a justification that resolves questions surrounding the theoretical lens.

The theoretical lens presented in this chapter mimics the transition from empiricism to science during the early 20th century in an attempt to establish a new direction for education research. Such an effort places the study on sociological footing exceeding its assumed roots in human development. The theoretical lens presented in this chapter transitions the patchwork student into a self-defined Luhmannian participant in communicative contextualized learning environments via the implementation of self-directed FETs. The transition is simple to realize once the patchwork student transitions from an anonymous assimilator of knowledge and into a socially manufactured artifact

blending neurological development, the principle of linked lives, skill set acquisition and demonstration, free agency, emotion, and other factors into a FET defined unit able to differentiate itself from its learning environment. In essence this study ceases to be an exploration of human development and transitions into a sociology study of a learner, a patchwork student, actively constructing their development via revision of skill sets and the establishment of an identity distinguishing them from their educational community.

Because this final segment of the chapter cannot resolve the nature of the lens into a sound and self-consistent concept, one must ask if this study was empirical, scientific, or another methodology as the lens appeals to a conflicting selection of literature involving science, medicine, opinions, metaphysics, sociology, and business. Despite using the tools and languages of science and empiricism, the study was neither strictly scientific nor empirical despite the use of survey data and well-documented conflicting literary sources. Nor was the study strictly pragmatic due to the propensity for research to incorporate emotion into human development. The key to understanding the carefully constructed theoretical lens and its application lies in a rarely considered intersection of learner, Fischerian development, philosophy, and systems thinking: autopoietic systems and epistemological constructivism commonly attributed to Luhmann's sociology. Thus, this study was not simply a theory of development applied to graduate physics students nor a quantitative study, but rather a difficult and open-ended sociological study of a highly contextualized discipline utilizing information, utterance, and phenomenological understandings leading to the publication skill set development and FET milestones of the patchwork student and graduate physics student.

Chapter 3: Research Method

Brown et al. (2008), Butler (2003), Gilbert et al. (2004), and Usher and Barnacle (2003) noted growing apprehension regarding the lack of substantial scientific publications. Their concerns necessitate the need to determine the relationships between experienced university level composition and English classes and the publication rates of physics graduate students. The primary data collection instrument was a researcher-designed survey grounded in Fischer's skill set theoretical constructs. This chapter explicates the appropriateness of design in addressing the problem delineated and includes a restatement of the hypotheses as stated in chapter 1, pilot testing goals, and the data analysis process. This chapter also includes the rationale behind the population selection and sampling critical to the online data collection and survey process. Further, this chapter covers validity, reliability, and significance, along with a brief on practical social change as a summary of the previous chapter.

Research Design

Creswell (2007), Litwin (1995), and Smith (1987) offered potential design methods and the roadmap to a correlational study design via process of elimination. The process allowed me to select a suitable design compatible with the survey. For this study, I rejected other quantitative and mixed methodologies before accepting the correlational study design.

Ethical inquiry, an intellectual analysis of ethical problems, considers the ethical obligations of scientists to produce written works benefiting societies. However, I rejected this method due to a lack of ethical consensus on how physicists should

contribute and function within a technological society. I rejected foundational and historical due to a lack of recorded histories involving graduate physics students. Grounded theory methodologies were excluded due to a lack of existing observational data involving the research questions while remaining compatible with the hypotheses presented later in this chapter. The common forms of qualitative research are incompatible with the research questions and hypotheses, thus ruling qualitative investigations as inappropriate.

I rejected several quantitative methods before selecting a correlational approach. Experimental and quasi-experimental methodologies failed since they could not reveal causal relationships between publication rates and dependent variables. Although presenting a study incorporating causal their definitive results would benefit education research into graduate physics writing skill development, the unwillingness for local universities to permit experiments in their graduate physics departments disallowed experimental methodologies. Thus I ignored the experimental and quasi-experimental methodologies.

Causal-comparative studies illuminate relationships between variables when independent variables lacking adequate controls. Although the ability to conduct a study with lesser controls upon independent variables was appealing, the known scant literature lacks enough information to produce temporally ordered cause-and-effect variables suitable for the study. Further there are questions if the scant literature supports research quality between group designs and time series analyses. The final blow to the causal-comparative method is the potential for a student to manifest obscured synchronous

development of writing skills and publication rates—triggering questions on whether or not causality is mandatory for their development. Thus I cannot utilize the causal-comparative methodologies.

The correlational methodology was an appropriate choice because it allows for understanding the patterns between variables while affording prediction (Smith, 1987). The structure of the hypotheses and questions demands the derivation of a predictive model from the data along with the testing of hypotheses. I utilized the correlational methodology by coupling the correlations linking variables to statistical prediction. The results from the correlational methodology may allow insight into the study while other methods may obscure its resolution. In addition, I allowed for survey-based free-response questions subject to open-coding techniques. Such an approach would be the beginning of a systems theory approach to generalizations of this study.

The purpose of correlational studies is to understand relations between independent variables and observables (Smith, 1987). I sought to understand such relationships while improving writing in graduate physics by utilizing the study as a catalyst for curriculum development. The intent of the free-response question was to obtain data complementing the study while revealing participant beliefs about writing skills in their environment, suppressor variables, interesting opinions and insights, and comments affecting the conclusions of the study.

The participants formed a sample of convenience involving public, private, and commercial institutions of higher learning supporting graduate physics departments. Since it may have been illegal to flood departments with unsolicited emails for survey

purposes, each department representative received an email explaining the nature of the study while seeking permission to use graduate student email listings. Upon the approval of each department, their email listings and mass email services triggered the survey software. Afterward, the survey software sent out invitations to the survey as a mass email to prospective participants on two separate occasions. This method ensured a sample of convenience and the chance to inquire across disciplines, institution type, and publishing experience levels necessary for sound statistical analyses and hypothesis testing.

Procedure

After participants completed the consent portion of the survey, they were directed to a researcher created web-based survey comprised of multiple choice and ordinal responses using a Likert-type scale including the phrases *very important, important, neutral, unimportant, very unimportant,* and free-response questions (see Appendix A). The inclusion of open-ended questions led to open coding was necessary to include perspectives and beliefs held by the participants.

Smith (1987) warned that a sample of convenience might lack diversity, thus demanding range restriction and possible skewness in the moments because empirical observations are not necessarily Gaussian. These problems arise from uneven stratification in the sample (i.e., an abnormal count of a particular specialization or institution type present in the sample). Potential skewness in moments were monitored using a visual inspection of scatter plots for nonlinear effects along with power series expansions (including linear regression as a truncated power series) intended to manifest

nonlinear effects. Cross-validation ensured the stability of the data and fitting of ensuing models.

Despite the nonGaussian complications, as noted above, the advantages of the correlational approach resided in the ability to understand potential relationships between variables while building predictive insights. The intrinsic value of the correlational approach was the ability to negate capitalization upon chance while building models of statistical significance involving nonGaussian samples. Given such strengths, I explored the potential for nonlinear, functional, attenuation, and higher order relationships between variables. Thus, the advantages and weaknesses of the approach are primarily a matter of statistical nature.

The correlational approach had the additional advantage of removing concerns about internal validity due to a lack of causal claims. The lack of causal claims was important because anonymous survey methods were subject to the post hoc fallacy and the self-selection of groups. I avoided such issues due to controlled selection of participants and undirected relationships between concepts or variables. Interaction between participants was minimal as to minimize biases, if any, and barred the need for participants to conform to a consensus.

Appropriateness of Design

Although the roots of the correlational study reside in the historical accounts of formistic thinking as described by Pepper (1942/1970), the 20th century witnessed the formistic correlational understanding of the world transform into a statistical model of covariation in naturally occurring systems. After such growth into statistical physics and

economics, the correlational study of Smith (1987) emerged and became a tool for the quantitative researcher wishing to understand ensembles. Thus, correlational studies are the successor of philosophical formism and allow the researcher to understand the dynamics of ensembles – not unlike this study intended to understand an ensemble of graduate physics students. The correlational methodology revealed structures and relationships in the data because they served to organize the data into simple relationships affording graphical and numerical analyses. Exposing the simple relationships between variables in this study allowed me to address the hypotheses presented in chapter 1.

The Role of the Researcher

I was responsible for all aspects of implementing this correlational study. This included recruiting all participants, composing the survey questions, analyzing the results, constructing subsequent surveys, and interpreting the findings. A correlational study is of the quantitative paradigm and required that I perform statistical inferences. The careful interpretations of participant responses were essential to the success of this study.

Pilot Study Justification

Pilot studies allowed for the refinement of the survey instrument and ensure the ease of use for participants forming a sample of convenience (Litwin, 1995). The pilot study included participants who met the criteria for the study. The pilot study functioned as a "small scale version or trial run in preparation for the major study" (Polit, Beck, & Hungler, 2001, p. 467).

The pilot tests were simple and involved the survey with additional open-ended free responses linked to honest feedback about the format and content of the survey. All responses were confidential during the pilot tests. In addition, the pilot survey participants obtained an e-mail address allowing them to contact me with suggestions and comments.

Research Questions

The research questions were:

1. What is the relationship between the number and types of university level composition and English classes taken by the graduate physics students and their publication rates in peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year?
2. What is the perspective of graduate physics students on how their writing classes affected their publications and publication rates?

Hypotheses

The following hypotheses were tested:

$H\mathrm{a}_1$: A relationship exists between the number of English and composition classes taken by the participant and publication rates.

$H0_1$: No relationship exists between the number of English and composition classes taken by the participant and publication rates.

$H\mathrm{a}_2$: A relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

$H0_2$: No relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

Ha_3: A relationship exists between publication rates and institution type currently attended for graduate studies.

$H0_3$: No relationship exists between publication rates and institution type currently attended for graduate studies.

Ha_4: A relationship exists between publication rates and specialization in physics.

$H0_4$: No relationship exists between publication rates and specialization in physics.

Ha_5: A relationship exists relationship exists between English and composition classes taken by the participant and publication rates.

$H0_5$: No relationship exists between English and composition classes taken by the participant and publication rates.

Ha_6: A relationship between a linear combination of independent variables and publication rates exist.

$H0_6$: No relationship between a linear combination of independent variables and publication rates exist.

Sampling Frame

E-mailed survey introductions and requests recruited 143 participants for this study. The participating universities and institutions included private, public, and for-profit institutions supporting graduate physics throughout the United States. This approach ensured that potential graduate physics students may participate while casting a

wide net to ensure enough participants. A sample size of about 100 participants from an estimated 14,000 graduate physics students would yield a 90% confidence with 10% error (Mulvey & Nicholson, 2008).

Informed Consent

All participants received an online informed consent form in the preface of the survey. The use of online signatures, in the form of an e-mail address, removed the need for a separate consent form while ensuring each survey corresponds to an easily completed consent form. All participants obtained the proper e-mail and a phone number allowing them to ask questions at any time during the survey process and to view the results of the survey.

Confidentiality

Responses from the pilot study and final survey utilizing the e-mail functionality of Survey Monkey remained anonymous, contained no identifying marks related to the participant, and could not be linked to institutions, participants, or collaborative efforts. Each survey form received a random number from a table of random numbers associated with a participant-submitted e-mail address as part of the consent form. All representations of the data were referenced by the associated random number as to maintain privacy. No contact information, name, e-mail address, or other identification marks remained in a publicly accessible format. Likewise, no identifying phrases or terminologies from the surveys remained in the data to ensure privacy during the feedback process.

Geographic Location

The participating universities and institutions included private, public, and, if possible, for-profit institutions supporting graduate physics throughout the United States. The solicitation of participants was via e-mailing graduate students on e-mail lists. The graduate students, although living in the United States at the time of the survey, might have been educated and raised in other countries despite the focus upon U.S. institutions of higher education.

Instrumentation

I utilized Survey Monkey, an anonymous online survey software package, which ensured privacy and the efficient collection and import of data (see Appendix B). The use of anonymous online surveys facilitates the type of data (ordinal, Likert-scale, and free response) required by the correlational approach. Thus the selection of Survey Monkey as the instrument was an effective tool for the solicitation and collection of data.

Proposed Pilot Tests

Pilot testing removed errors, ambiguities, and confusing aspects from the survey. The pilot tests considered the problems with the survey such as font size, jargon, culturally sensitive language, survey length, monotonous language, and suitable use of language. Information about these problems in the survey were gathered during two serial pilot runs at universities not included in the general survey, an exclusion ensuring practice biases will be minimized while refining the survey. The refining process occurred after both pilots to afford an iterative approach.

Data Collection

Upon receipt of IRB approval number 12-03-10-0337442, the data collection process commenced using the online survey. Because the survey was web-hosted, there are no required downloads and no cost to the participant. The free-response portion of the survey complementing the quantitative questions warranted qualitative analyses. NVivo 8.0 managed the qualitative data and employ coding schemes presented by Auerbach and Silverstein (2003). Further, the qualitative coding of the free response in the general survey data afforded the chance to analyze previously unknown dimensions of the study revealed by the participants. Likewise, the qualitative portion of the pilot surveys served to make the survey user friendly.

Data Analysis

Hypothesis testing utilized the R Statistics Package. The following is a brief outline of the nonparametric statistical tests for each hypothesis requiring $p < .10$ for rejection of the null hypotheses:

Ha_1: A relationship exists between the number of English and composition classes taken by the participant and publication rates.

$H0_1$: No relationship exists between the number of English and composition classes taken by the participant and publication rates.

The first hypothesis involved continuous variables and unknown distributions subject Pearson's and Spearman's correlations. Although calculating both coefficients was unnecessary, comparing them ensures a verifiable measure of strength of the linear relationship linking number of English and composition classes taken by the participant

and publication rates. The associated p-values of both tests determined whether to reject the null hypothesis stating no correlation exists.

Ha_2: A relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

$H0_2$: No relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

The second hypothesis utilized a chi-square test of independence coupled to a Cramer's V test given the nominal variables listed in the hypothesis. The purpose of the chi-square test was to determine whether distributions of categorical variables differ from one another while Cramer's V determined the strengths of association between the variables. In the case of the second hypothesis, the coupling of chi-square and Cramer's V allowed me to determine if a significant relationship existed between the English and composition classes taken by the participant and the last year of good standing.

Ha_3: A relationship exists between publication rates and institution type currently attended for graduate studies.

$H0_3$: No relationship exists between publication rates and institution type currently attended for graduate studies.

The third hypothesis required the use of ANOVA coupled to a Scheffe Test. Since institutional types spanned several categories, I appealed to ANOVA as to determine if categories denoting institution type produces variations in publications rates. Coupling a Scheffe Test to the ANOVA provided insight into potential differences between the three calculated during ANOVA. The coupled tests allowed the

determination of potential variations across institutional type and magnitude of such variations.

Ha_4: A relationship exists between publication rates and specialization in physics.

$H0_4$: No relationship exists between publication rates and specialization in physics.

Ha_5: A relationship exists relationship exists between English and composition classes taken by the participant and publication rates.

$H0_5$: No relationship exists between English and composition classes taken by the participant and publication rates.

The fourth and fifth hypotheses required the use of ANOVA coupled to a Scheffe Test and observation of the correlation ratio (eta coefficient). An ANOVA approach determined if the categories produced variations in publications rates given the numerous categories spanning English and composition classes taken by the participant and specialization in physics. Since no linearity assumption is justified, given the known literature, I utilized the correlation coefficient responsible for detecting nonlinear relationships between the categories and publication rates. If the relationships were linear between the categories and publication rates, then the correlation equaled the coefficient of determination; otherwise the relationship was nonlinear. The combination of above statistical methods afforded the possibility of rejecting the null hypothesis while potentially revealing nonlinear phenomena in the study.

Ha_6: A relationship between a linear combination of independent variables and publication rates exist.

$H0_6$: No relationship between a linear combination of independent variables and publication rates exist.

The final hypothesis required multiple regression analysis as to determine if there existed at least one relationship between a linear combination of independent variables and publication rates. Since multiple regression allows the compilation of linear sums intended to predict the dependent variable, I explored numerous linear equations and their associated coefficients of multiple determination. The coefficient of multiple determination indicates the proportion of total variation in the dependent variable explained by the terms in the linear model. Thus if at least one linear sum produces an extraordinary high coefficient of multiple determination, then the variation in the dependent variable can be explained while rejecting the null hypothesis.

Further Information on Hypothesis Testing

It is naïve to believe that hypothesis tests are enough to build convincing cases for the relationships mentioned above. Thus the hypothesis tests reinforced their validity by including intergroup statistical measures, cross-classification tables, contingency coefficients, shrinkage controls as to properly measure R^2, and potentially suitable nonparametric regressions. The data allowed qualitative analyses and the results were included into a brief mixed methods commentary in chapters 4 and 5.

Validity, Reliability, and Statistical Significance

Unlike experimental, quasi-experimental, and causal comparative studies, internal validity is not essential for correlational methods. Smith (1987) posited that it is important to ensure the survey is easy to use, appeals to participants, and will not confuse

the participants. Discussions with an appropriate panel ensured content validity. There are no known surveys-based studies affording tests for concurrent validity. Since the I implemented a search for relationships and model building, I ignored predictive validity. The lack of previous experience with the survey instrument disallowed consideration of construct, divergent and convergent validity measures.

The reliability of the study depended upon gathering an adequate sample using a controlled asynchronous survey environment equally experienced by all participants. No trained observers were necessary, which eliminated scoring reliability problems while keeping guidelines to a minimum. Thus, there was no significant interference with reliability for this study due to limited online distractions and lack of social interactions, practice effects, and anonymity concerns. The size of the sample ensured that the correlational analyses were sound, assured a 10% margin of error, and denied of the correlation-causation fallacy rendering poor statistical interpretations.

Contribution to Social Change

The contributions of writing, publishing, and generic skills spanning disciplines defines a workforce and survival of a technologically dependent society driven by information brokerage (Adorno, 2001; Biser et al., 2007; Bok, 2004; Brown et al., 2008; Butler, 2003; Carpenter, 2008; Femlee, 1988; Gilbert et al., 2004; Gray et al., 2005; Rawson et al., 2005; Sall & Ndjaye, 2007; Teramoto & Mickan, 2008; Xia, 2006). Due to the breadth of such a statement, I focused upon the graduate physics student and modified Fischerian development as to illuminate how individuals acquire publishing skill sets leading to an information articulate publishing workforce. The inclusion of skill

theory into professional and higher education research can assist with creating interventions targeting the representation, abstraction, and principle tiers of writing skill set development.

In turn, the individuals educated in the above context can form the foundation for the workforce of a technologically dependent society driven by information brokerage while achieving socioeconomic equality (Anaya-Prado et al., 2006; Biser et al., 2007; Femlee, 1988). Although the previous paragraph gives a grand view of societal change, individuals involved in a skill-theory-aware curriculum would realize the greatest immediate impact. Not unlike the case of Nico, skill-theory-aware educational experiences can help individuals to obtain social mobility and traverse biologically and socioeconomically stratified societies. This point is more apparent by combining Femlee (1988) with the writings of Marx (1956), Coser (1956), and Williams and Stockdale (2003), a compounding illustrating Western society as a socioeconomic medium requiring that individuals seek intellectual means of social mobility. Thus education might utilize skill theory to empower individuals and help them succeed in a particular economic climate dependent upon communications and information brokerage.

The final generalized social impact is philosophical and personal – the notion that skill-theory-driven education research defines the free agent learner within a social system while appealing to personal interests. The social significance, the ability to educate about emotional interests and passions, of this study emerges when strips the theory presented in the previous two chapters devoid of jargon, excess concepts, and experimental evidence. Thus this study allows development of the emotion agent while

society provides scaffolding for development and integration of the learner into technologically dependent and high-mass-consumption societies.

Future research grounded in this study could alter curriculum development regarding writing skill seta and expression in the academic and professional worlds. If successful, future research along the lines presented in this study can alter expression in the social constructions of scientific and professional publications responsible for maintaining an evolving a technological society. If members of society adhere to empiricism and science as the mode of societal evolution, then the grand societal contribution of this study resides in the resulting changes to social systems mimicking the epistemological constructivism of Luhmann's sociology.

Summary

Chapter 3 outlined the correlational methodology and basic procedures underlying this study. The methodology selected served to determine the relationships between educational experience in university level composition and English classes and the publication rates of physics graduate students, controlling for the number of years in a graduate physics program, type of institution (private, public, other), and specialization. Furthermore, this chapter included a discussion on the appropriateness of the correlational design in addressing the above relationships, hypotheses stated in chapter 1, pilot testing, validity, reliability, and statistical significance, and data analysis forming the conclusions of this study.

In addition to the above, this chapter contained a discussion of the role of two pilot tests serving to make the online survey more user friendly. The exclusion of the

pilot test participants and inclusion of random number identifications removed practice bias and confidentiality issues from the study. Integrated consent forms, as part of the survey, utilized digital signatures as to provide proper consent agreements and confidentiality.

The chapter closed on the social relevance of the study, albeit not in the classical educational research framework. Although the methodology and theoretical lens mimics traditional education research, the impact of the research remained as a sociological insight into systems responsible for the maintenance of a technologically dependent educated society.

Chapter 4: Findings and Results

The purpose of this quantitative correlational study was to determine the relationships between the number and type of college level writing classes experienced by the graduate physics students and their reported publications per calendar year. The secondary purpose was to reveal the perspectives of graduate physics students concerning their experiences in college level writing classes and their perception on their publication rates. Students from several graduate physics institutions and universities across the United States participated in the study. I analyzed data obtained from a researcher designed and pilot tested survey instrument. Overall, 143 participants, from an estimated population of 14,000 individuals, completed the survey in the time allotted and the statistical results were verified using the R Statistical Package.

General Description of Participants

The demographics of the participants (see Table 1) included many specializations, research interests, educational backgrounds, and publication targets. Most participants were in doctoral programs, while a few were pursuing a Masters of Science degree. A single postdoctoral candidate participated in the study.

Table 1

Counts of Degree Programs

Degrees	Percent
MA (n = 0)	0.0%
MS (n = 4)	4.6%
Ph.D (n = 82)	94.3%
Professional degree (n = 0)	0.0%
Postdoctoral program (n = 1)	1.1%
Undecided (n = 0)	0.0%

Of the 143 participants, 103 reported whether or not they have published prior to taking the survey. Of the 103, 62% (n = 64) reported previous publishing experience while the remaining 37% (n = 39) reported no publishing experience. Table 2 shows the distribution channels used for past publications and projects. Peer reviewed journals, conference papers, and grant proposals were the most popular publication types.

Table 2

Counts of Publication Types

Publication type	Percent
Textbooks (*n* = 1)	1.2%
Peer reviewed journals (*n* = 42)	51.2%
Nonpeer reviewed journals (*n* = 5)	6.1%
Professional journal or magazine (*n* = 7)	8.5%
Industrial journal or magazine (*n* = 1)	1.2%
Conference papers (*n* = 36)	43.9%
Professional blogs (*n* = 3)	3.7%
Collaborative wiki articles (*n* = 4)	4.9%
Essays (*n* = 2)	2.4%
Magazine articles (*n* = 2)	2.4%
Grant proposals (*n* = 15)	18.3%
Review papers (*n* = 4)	4.9%
Monographs or books (*n* = 1)	1.2%
Not applicable (*n* = 29)	35.4%

Table 3 presents the counts of time passed since initial publication. Most of the published participants were less than 4 years into their publishing lifetime.

Table 3

Counts of Time Passed Since Initial Publication

Time Interval	Percent
Less than 1 year (*n* = 14)	15.9%
Between 1 year and 2 years (*n* = 8)	9.1%
Between 2 years and 3 years (*n* = 12)	13.6%
Between 3 years and 4 years (*n* = 10)	11.4%
Between 4 years and 5 years (*n* = 3)	3.4%
Between 5 years and 6 years (*n* = 1)	1.1%
More than 6 years (*n* = 4)	4.5%
Not applicable (*n* = 36)	40.9%

Participants indicated whether they have published while attending required classes or lectures. Of the responses, 44% (*n* = 39) of the participants indicated they have while 14% (*n* = 12) have not. The remainder stated the question was not applicable. Participants also stated whether they intend to publish in the future. Of the responses, 94% (*n* = 83) expressed a desire for future publication.

Table 4 presents counts of currently attended institution types. The responses illustrate more than fifty percent of participants attended public universities.

Table 4

Counts of Currently Attended Institution Types

Institution Type	Percent
Public university (*n* = 56)	64.4%
Private university (*n* = 26)	29.9%
Vocational school (*n* = 1)	1.1%
Technical school (*n* = 0)	0.0%
Public research institution (*n* = 1)	1.1%
Private research institution (*n* = 3)	3.4%
Corporate research institution (*n* = 0)	0.0%

Participants indicated their employment status. Table 5 indicates that teaching assistants (TA) and research assistants (RA) positions within the department dominated the sample.

Table 5

Counts of Employment Status

Employment Status	Percent
Unemployed (*n* = 2)	2.3%
Part time employment outside the department (*n* = 0)	0.0%
Full time employment outside the department (*n* = 2)	2.3%
Mixture of full or part time employment outside the department (*n* = 1)	1.1%
TA position within department (*n* = 24)	27.3%
RA position within department (*n* = 53)	60.2%
Other (*n* = 4)	4.5%
Does not apply (*n* = 2)	2.3%

I asked whether participants took more than the minimum undergraduate English and composition classes. Of the responses, 75% (*n* = 63) took only the minimum undergraduate requirements while 18% (*n* = 15) exceeded minimum requirements. I also asked whether participants took more than the minimum undergraduate English and composition. Of the responses, 57% (*n* = 48) took only the minimum high school English and composition classes while 32% (*n* = 27) exceeded minimum requirements.

Table 6 presents the counts of reported institution types providing undergraduate English and composition classes.

Table 6

Counts of Institution Type Where Participants Took Undergraduate English and Composition Classes

Institution Type	Percent
Professional or academic writing workshops (*n* = 4)	4.8%
Public university (*n* = 33)	39.8%
Private university (*n* = 39)	47.0%
Vocational school (*n* = 0)	0.0%
Technical school (*n* = 1)	1.2%
Community college (*n* = 4)	4.8%
High school (*n* = 54)	65.1%

I asked participants to recall whether they participated in writing classes or workshops while attending graduate school. The data indicated that 86% (*n* = 72) of participants had not participated in writing classes or workshops while attending graduate school. I inquired whether participants utilized peer-review processes and 53% (*n* = 47) of participants report having their work critiqued. Table B1 presents the counts of participants along specialization.

Table B2 presents the counts of participants along undergraduate English and composition classes experienced. Participants also cited intense writing experiences in classical philosophy, history, religion, public speaking, and Asian literature classes. Table B3 offers the counts of participants along recalled undergraduate English and

composition educational experiences. Participants also cited faulty recall or a lack of organized classes targeting particular skills.

Results of Hypothesis Tests

The research questions that guided this study were:

1. What is the relationship between the number and types of university level composition and English classes taken by the graduate physics students and their publication rates in peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year?
2. What is the perspective of graduate physics students on how their writing classes affected their publications and publication rates?

Hypothesis 1

H_{a_1}: A relationship exists between the number of English and composition classes taken by the participant and publication rates.

There was no assumption of normality of data because of the small sample size and lack of known literature about the population. The potential nonnormality led to the calculation of Spearman and Pearson correlation coefficients. Although using both coefficients is uncommon, their comparison is required for an argument of consistency given nonassurance of Gaussian response distributions.

The *R* Statistical Package helped compute Pearson's correlation coefficient between number of English and composition classes taken by the participant and publication rates. No correlation was found, $r(49) = -0.066$, $p = 0.6458$. *R* helped compute the Spearman's correlation coefficient between number of English and

composition classes taken by the participant and publication rates. No correlation was found, $r(49) = -0.101$, $p = 0.48$.The inability to reject the null hypothesis implies there is no discernable correlation between the number of English and composition classes taken by the participant and publication rates.

Hypothesis 2

Ha_2: A relationship exists between the English and composition classes taken by the participant and the last year of good standing in a graduate physics program.

The initial chi-square independence test determined whether distributions of English and composition classes taken by the participant were independent of the last year of good standing. The first factor was the last year of good standing with two levels (*yes* and *no*). The other factor was English and composition classes taken by the participant with a self-reported number of levels reflecting classes taken by the participant. No association emerged.

The second chi-square independence test of importance tested whether the participant took extra English and composition classes in high school is independent of last year of good standing. The other factor was a two level indicator on whether or not the participant enrolled in additional English and composition classes while in high school. An association emerged as $\chi^2 (12, N = 143) = 145.85$, $p \sim 10^{-16}$, and $V = 0.583$. The test indicates the association is of significant strength.

The next chi-square test determined whether taking extra English and composition classes in undergraduate studies is independent of last year of good standing. The first factor was the last year of good standing with two levels (*yes* and *no*). The other factor

was a two level indicator on whether or not the participant enrolled in additional writing or composition classes while in undergraduate studies. An association emerged as χ^2 (12, N = 143) = 132.77, $p \sim 10^{-16}$, and $V = 0.556$. The test indicates the association is of significant strength.

An association emerged between standing and writing experience as an undergraduate in a private university, χ^2 (3, N = 143) = 35.26, $p \sim 10^{-7}$, and $V = 0.497$. An association emerged between standing and writing experience as an undergraduate in a public university, χ^2 (12, N = 143) = 31.41, $p \sim 10^{-16}$, and $V = 0.469$.

The final tests explored whether the last year of good standing is independent of publication types. An association emerged between standing and having published peer reviewed publications, χ^2 (3, N = 143) = 38.61, $p \sim 10^{-8}$, and $V = 0.520$. Another association emerged between standing and having published conference publications, χ^2 (3, N = 143) = 31.08, $p \sim 10^{-7}$, and $V = 0.466$. A final association emerged between standing and having published grant proposal publications, χ^2 (3, N = 143) = 11.77, p =0.008, and $V = 0.287$. Cramer's V indicates the associations are significant.

Hypothesis 3

Ha_3: A relationship exists between publication rates and institution type currently attended for graduate studies.

An ANOVA evaluated the relationship between publication rates and institution type currently attended. The independent variable, the institutional type factor, included seven levels: *public university*, *private university*, *vocational school, technical school,*

public research institution, private research institution and corporate research institution. The dependent variable was publication rates. The ANOVA (see Table 7) results were not significant.

Table 7

ANOVA for Publication Rates and Institutional Type Currently Attended

Source	x^2	*df*	$\overline{x^2}$	*F*	*p*
Institution type	38.53	3	12.8438	1.366	0.2684
Residual	432.31	49	9.3981		
Total	470.84	52			

Hypothesis 4

*H*a$_4$: A relationship exists between publication rates and specialization in physics.

The fourth hypothesis test coupled ANOVA, Scheffe tests, and the correlation ratio (eta coefficient) to determine possible relationships stated within the hypothesis. The independent variable was specialization while publication rates served as the dependent variable. Table B4 presents the ANOVA results rejecting the equality of means for the following: cosmology, high-energy physics, laser physics, weather physics, nanophysics, optics, quantum field theory, quantum gravity, and general relativity. Scheffe tests yielded no significant results. Correlation ratios failed to detect nonlinear relationships between the ANOVA variables and ruled out nonlinear models involving the ANOVA variables during model building processes of the sixth hypothesis test.

Hypothesis 5

*H*a$_5$: A relationship exists between English and composition classes taken by the participant and publication rates.

The fifth hypothesis test utilized ANOVA, Scheffe tests, and the correlation ratio (eta coefficient) to determine possible relationships stated within the hypothesis. Table B5 presents the ANOVA results rejecting the equality of means for only those taking only the required undergraduate classes. Scheffe tests yielded no significant results. Correlation ratios failed to detect nonlinear relationships between the ANOVA variables and ruled out nonlinear models involving the ANOVA variables during model building processes of the sixth hypothesis test

Hypothesis 6

*H*a$_6$: A relationship between a linear combination of independent variables and publication rates exist.

The sixth hypothesis utilized multiple regression techniques to determine at least one suitable linear model describing the variation of publication rates in terms of undergraduate classes taken, specialization, and publication types reported by the participant. The study included six linear models as to determine a viable linear model because the literature review was unable to recover an applicable model, SEM, casual diagram, or path diagram. Two of the six models were statistically relevant, and one found to be a viable linear model (LM) of publication rates given reported of undergraduate classes taken, specialization, and publication types.

The R package automatically managed the construction of LMs by binning counts of categorical variables into internally defined variables and then utilizing them within a reduced LM. The minimization of the LM resulted from the construction of a general linear model restricted to weighted linear systems involving singularity elimination routines minimizing the number of regressors. The R package automatically detected and removed singularities via exact multicollinearity tests included with the R package. The resultant minimal models exhibited properly adjusted R-squared values and inflation controlled R-squared values suited for discussing the population during the final chapter. The upper value for adjusted R-squares remained bounded by the [0,1] interval utilized by R-squared values within the R package. This methodology helped detect statistically significant LMs containing acceptable *p*-values accompanied by R-squared values approaching the upper bound. Thus, the higher value for the adjusted R-squared along with a smaller *p*-value, the more desirable the LM.

The first LM, and fullest LM possible given the data, attempted to relate publication rates to undergraduate classes taken, specialization, and publication types reported by the participant. The model failed due to over determination and vanishing degrees of freedom attributed to more equations then unknowns in the system constructed by *R*. Such failure implies are no solutions to the LM except when guessing at error terms leading to an approximated result. Although the first model failed, this failure indicated simpler relationships might explain variations in publication rates.

The second model used only undergraduate English and composition classes taken by participants as factors. The model reported 24 degrees of freedom and multiple

R-squared of 0.1872. The R Statistical Package reported that variance of error dominated the model and yielded -0.4901 for the adjusted R-squared. Thus, the LM was unfeasible and required more statistical information than it can infer.

Table B6 presents the third model using only specialization. The LM successfully reported 16 degrees of freedom and adjusted R-squared of 0.6868 accompanying a significant *p*-value of 0.001429. Further, 12 regressors were removed due to their contributions of singularities to the LM. Thus, the third model provides a statistically significant LM of publication rates given specializations.

Table B7 presents the fourth model using only publication types. The model successfully reported 32 degrees of freedom and adjusted R-squared of 0.3123 accompanying a significant *p*-value of 0.01335. Further, one regressor was removed due to their contributions of singularities to the LM. Thus, the fourth model provides a statistically significant LM of publication rates given publication types.

Table B8 presents the fifth model using publication type and specialization as factors in a LM. The model successfully reported 5 degrees of freedom and adjusted R-squared of 0.7863 accompanying a significant *p*-value of 0.03702. Further, 14 regressors were removed due to their contributions of singularities to the LM. The significant regressors were mathematical physics, quantum electrodynamics, quantum gravity, blog publishing, and peer-reviewed journal publishing. Of the significant regressors, quantum electrodynamics strongly affected predictions, $b = -0.7250$, $p < 0.1$. Other significant regressors possessed small beta coefficients. The fifth model provides a statistically significant LM of publication rates given publication type and specializations.

Table B9 summarizes the sixth model using publication type and undergraduate writing classes experienced as factors of in a LM. The model successfully reported 13 degrees of freedom and adjusted R-squared of 0.4021 accompanying a significant *p*-value of 0.099. Further, 13 regressors were removed due to their contributions of singularities to the LM. Thus, the sixth model provides a statistically significant LM given publication type and undergraduate writing classes.

Qualitative Results

The purpose of the qualitative questions presented in the final chapter was to gain insight into the participants's personal opinions, and desires about communications and publishing skill sets. The intent of the inclusion was to provide the phenomenological depth to responses and help triangulate the findings and guide recommendations presented in chapter 5.

Open-Ended Question 1

There were 19 responses to the first open-ended question. Of the 19 responses, two cited the need for developing effective verbal skills for use in everyday communications and group meetings, seven mentioned a need for *how to publish* by instructors who have successfully published in peer-reviewed physics journals, six indicated a need for English as a second language aware physics publishing instruction. The remaining responses tended to discuss personal writing experiences and anecdotes not answering the question.

Open-Ended Question 2

There were 22 responses to the second open-ended question. Of the 22 responses, four offered concerns about using a survey to explore writing skills, one requested future research utilize a case study methodology, a physics education research student expressed they wished more surveys existed in physics education research, and two encouraged studies of any type if they help students with their publication aspirations. Three responses commented upon ways to improve the survey technique and use of oral interviews in future research. Eight participants mentioned a desire to integrate peer review of graduate writing as to build kinship and improve their writing skills.

Themes from the Open-Ended Questions

The responses to the open-ended questions were coded and processed in NVivo 8.0. The coding processes uncovered the following themes: (a) need for instruction involving the struggles of nonnative English speakers and writers during the publishing process; (b) desire for future education research involving graduate physics students; and (c) students wanting for writing classes or projects assisting with publishing. These themes will guide the recommendation in chapter 5.

Summary

I assessed the relationship between the number of and type of college level writing classes experienced by the participants given their peer-reviewed journals, nonpeer reviewed journals and specialty magazine publications per calendar year. The independent variable was the number of and type of college level writing classes experienced by the participants while the dependent variable was publication per calendar

year. Data were collected using Survey Monkey web survey software. The first research question explored the relationship between the number and types of university level composition and English classes taken by the graduate physics students and their publication rates in peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year. The first research question was answered by the six hypothesis tests. The second research question explored the perspectives of graduate physics students on how their writing classes affected their publications and publication rates. The open-ended questions and qualitative analyses answered the second research question.

The first hypothesis test did not detect a relationship between the number of English and composition classes taken by the participant and publication rates.

The second hypothesis test utilized several chi-square tests of independence as to determine associations between last year of good standing and several categories. Tests found associations between whether the student satisfied the academic requirement of their department (good standing) and the following:

1. Whether the participant enrolled in additional writing or composition classes while in high school.
2. Whether the participant took extra English or composition classes in undergraduate studies.
3. Whether the participant claimed undergraduate writing experience at private or public institutions.

4. Whether the participant published in a peer reviewed journal, conference publication, or grant proposal.

The third hypothesis test determined the likelihood of equality of group means across institution types given publication rates as the dependent variable. The test detected no significant differences between institutions types.

The fourth hypothesis test sought to determine if there is a likely equality of group means across specializations given publication rates as the dependent variable. The ANOVA results demonstrated the following as significant specializations affecting publication rates: weather physics, astrophysics, cosmology, high-energy physics, laser physics, nanophysics, optics, quantum field theory, and general relativity. Scheffe's test revealed no significant differences amongst the groups.

The fifth hypothesis test determined if there is a likely equality of group means across undergraduate English and composition classes taken by the participants given publication rates as the dependent variable. Statistically significant results occurred after performing an ANOVA and Scheffe test followed by an examination of correlation ratios. Although correlation ratios ruled out nonlinear models involving the ANOVA variables, the test found that participants, which only took required English and composition classes, had statistically significant differing publications rates compared to other groups.

The sixth hypothesis test attempted to provide at least one statistically significant LM explaining variation in publication rates given multiple sets of regressors. The model of interest was a linear combination of categories from publication types and

specializations providing an acceptable R-squared of 0.7863 accompanying a statistically value p-value of 0.03702. This result provides a statistically significant LM of publication rates given publication type and specializations.

Chapter 5: Summary, Conclusions, and Recommendations

Summary of the Study

There is a concern regarding the ability of graduate students' to transfer writing skill sets learned at postsecondary institutions into professional settings. Writing for scientific publication is essential to make a positive contribution to the academic community. The purpose of this quantitative correlational study was to determine the relationship between the number and type of college level writing classes experienced by graduate physics students and publications in peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year. The secondary purpose was to present the perspectives of graduate physics students concerning their experiences in college level writing classes, and reveal how they perceived these experiences affected their publications. Respondents came from 143 participants attending public and private institutions in the United States that support graduate physics programs. The findings could lead to revising curriculum to support transferrable skills to generate scientific publications.

Ethical Dimensions

The study adhered to strict ethical standards, confidentiality agreements, and institutional review board recommendations. All participants were treated with equality and respect. Participants received an online informed consent form and proper e-mail and a phone number allowing them to ask questions at any time regarding the study. The survey data contained no identifying marks related to the participant, and could not be linked to institutions, participants, or collaborative efforts. Likewise, no identifying

phrases or terminologies from the surveys remained in the data to ensure privacy during the feedback process.

I bracketed researcher biases such that data reflects only participants' opinions and responses. No observations or interviewers were necessary. Thus, there was no significant interference with scoring reliability and ethical standards. Full disclosure of the findings formed a core ethical consideration of the study.

Limitations

Limitations involved the possibility of a flawed survey design and ill-handled results inherent in most surveys. To minimize possible flaws, the survey was pilot tested by small groups meeting the sampling criteria and reviewed by experts in the field. The effects of ill-handled results were unavoidable but controlled by utilizing asynchronous online surveying software to ensure that each potential participant had a chance to complete the survey given their personal schedules. Another limitation emerged from the use of survey instruments: the nonresponse and question and answer biases as unavoidable properties of surveys. An online survey incorporating confidentiality clauses, full disclosure results, and introductions to the researchers minimized the impact of the assumptions while promoting open communications. Further one could not eliminate nonresponse bias since the participant cannot control complications in memory recall except for asking redundant questions verifying recall.

Overview of the Study Population and Sampling Method

E-mailed survey introductions led to the recruitment of 143 participants for this study. The participating universities and institutions included private, public, and for-

profit institutions supporting graduate physics throughout the United States. This approach ensured that potential graduate physics students may participate while obtaining a random sampling of the population. A power analysis indicated that a sample size of 100 participants from an estimated 14,000 graduate physics students would yield a 90% confidence with 10% error. The study exceeded this requirement.

Data Collection Processes

The data collection process utilized Survey Monkey survey software bundling quantitative and qualitative responses into a spreadsheet format suitable for electronic delivery. Further, the qualitative coding of the free response in the general survey data afforded the chance for data triangulation and revealed unknown dimensions of the study. The survey data were stored on a USB flash drive and remains in a small safe.

Synopsis of Data Analysis

The R Statistics Package assisted in all statistical calculations and model building facilities. R is a free software environment for statistical computing and graphics available on the LRZ-Linux cluster and features interactive and batch modes. The package allowed for the implementing of ANOVA analysis, chi square and post hoc tests, correlation analyses, and linear models with R-squared controls. The analyses occurred by applying scripted calculation upon the Survey Monkey spreadsheets. NVivo 8.0 helped managed the qualitative data, organized the responses into themes, and employed coding schemes presented by Auerbach and Silverstein (2003).

Summary of Findings

Research Question 1

What is the relationship between the number and types of university level composition and English classes taken by the graduate physics students and their publication rates in peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year?

The first and fifth hypothesis tests determined the answer to the first research question. The result of both of these hypothesis tests led to failure to reject their null hypotheses and indicated that the number and types of university level composition and English classes taken by the graduate physics students and their publication rates are unrelated. Linear models failed to produce a viable model involving the variables. There were no relationships between the variables in the research question.

Research Question 2

What is the perspective of graduate physics students on how their writing classes affected their publications and publication rates?

The second hypothesis test and first open-ended survey question addressed this research question. The second hypothesis revealed associations between various educational experiences in writing classes and publication rates. Participants expressed beliefs that writing classes or specialized writing seminars would help them with publisher demands and departmental expectations. The combination of the results indicates that experience with specialized writing classes may give graduate physics students an advantage during publication opportunities.

Findings of the Hypothesis Tests

Findings of the first hypothesis. There was no statistically detectable correlation between the number of English and composition classes taken by the participant and publication rates

Findings of the second hypothesis. Results indicated associations between whether participants were in good standing and the following factors : (a) participant enrollment in additional writing or composition classes while in high school, (b) taking extra English or composition classes in undergraduate studies, (c) experience at private or public institutions, and (d) participant published in a peer-reviewed journal, conference publication, or grant proposal.

Findings of the third hypothesis. No relationship was found between publication rates and institutional types.

Findings of the fourth hypothesis. Participants within weather physics, astrophysics, cosmology, high-energy physics, laser physics, nanophysics, optics, quantum field theory, and general relativity had statistically differing publication rates relative to others in the sample.

Findings of the fifth hypothesis. Participants who only took required English and composition classes had differing publication rates relative to others in the sample.

Findings of the sixth hypothesis. Analysis provided a linear model relating publication rates to publication types and specializations. The model reported an adjusted R-squared of 0.7863 accompanying a significant *p*-value of 0.03702.

Definitions Revisted

The remainder of the chapter relies upon the following definitions introduced in prior chapters. Therefore, restating the definitions will assist in the interpretation of the conclusions, inferences, and recommendations for this study.

The patchwork student. The patchwork student is the graduate student framed as a Fischerian learner. Such learners develop skill sets using experience, emotions, and the skill set operations of Fischerian skill theory

Fischerian educational trajectory. Referred to as a *FET*. A Fischerian educational trajectory is a list of milestone skill set developments demonstrating a mastery of a task.

Fischerian skill theory. A theory of human development describing approximately the first 35 years of a lifespan. The theory contains seven developmental levels, each manifesting two tiers of development responsible for skill set development. The representational tiers facilitate the skills allowing the ability to manipulate representations, physical objects, and events. The abstract tiers are responsible for the development of skills supporting rational thought, symbolism, and abstract concepts leading to systems thinking. Upon experiencing all tiers and levels, the individual embodies the necessities for abstract and systems thinking within suitable neurological structures.

Good standing or *standing*. Being in good standing refers to the academic status of a patchwork student upon satisfying the academic requirements of their department. Maintaining good standing avails the patchwork student to publishing opportunities.

The life course. Refers to Elder's (1994) revised theory of the life course, later refined by Mortimer (2004), The life course, composed of five principles, outlines a theory of human development. The five principles of the life course yield a patchwork student able to develop in a contextualized environment involving linked lives, role-playing, and the embodiment of social contexts.

Principles of the life course. The life course theory contains five principles guiding human development:

1. The first principle states human development and aging are lifelong processes.
2. The second principle states actions of the patchwork student are strictly the function of the dialectical structure within one's contextualized environment.
3. The third principle states the life course is an embedded derivative of the historical times and places experienced by an individual.
4. The fourth principle states that shared histories will manifest as variations in development for different individuals.
5. The fifth principle states that individuals link their progressions during the life course with each other and that sociohistorical information propagates along such linkages.

Explanation of Findings

The Fischerian perspective, FETs, commodification, and phenomenological perspectives presented in the literature review, framed the findings for this study. A

thorough search of the literature was unable to reveal any studies that presented a comparative explanation to the findings in this germinal study.

Explanation of the First Hypothesis Test

There was no statistically detectable correlation between the number of English and composition classes taken by the participant and publication rates.

The lack of statistically detectable correlation between the number of English and composition classes taken by the participant and publication rates was significant within the Fischerian perspective. I found that skill developments occurring during undergraduate English and composition classes might not influence publication rates and the publishing orientated skill sets of the patchwork student. This result contradicted the findings of the second research question in which participants expressed interest in doctoral level or professional writing interventions and classes. This conflict is central to educators who erroneously rely on traditional English and composition classes as a means to enhance future publication rates. A FET cannot emerge due to a lack of correlation affording the development of milestone events. The failure to establish a FET supports a lack of corresponding causal system linking the variables in the test.

The third, fourth, and fifth principles of the life course lead to a novel insight: that publication rates appear to remain independent of the participant's educational histories and complex interpersonal interactions. If this is the case, then science educators working to improve publication rates should pay close attention to the emotional drives of the patchwork student. The results call into question the ability for professional networking, shared educational histories, and communicative personal relationships to

facilitate publication efforts. Thus if a curriculum committee or instructor wishes to affect publication rates, the findings indicate that stimulating the passions and emotional free agent within the patchwork student is a viable approach.

Explanation of the Second Hypothesis Test

The test found an association between whether participants were in good standing and the following: (a) participant enrollment in additional writing or composition classes while in high school, (b) taking extra English or composition classes in undergraduate studies, (c) experience at private or public institutions, and (d) participant published in a peer-reviewed journal, conference publication, or grant proposal.

The first association of importance involves whether the participant took extra English and composition classes in high school or undergraduate studies and standing. Although I cannot determine the developmental milestone events enabling the association, this data supports the conjecture that additional classes assisted with compounding preexisting skill sets with sound time management, abstract reasoning, and communication skill sets, into an emotional configuration conducive to retaining standing. Curriculum developers might proffer from this finding when designing classes and achievement exams determining admissions and standing polices.

The next association of importance involves where participant took English and composition classes; at a public or a private institution. This association implies that skill set developments of the participants may differ due to institutionally specific variations in pedagogy, socially constructed environments. Butler's (2003) findings could provide the inroads to explaining this association because the coupling of commoditized interests and

curriculum development may differ across institution type while affecting the ability to remain in good standing. Although such conjecture has no known supporting literature, joint ventures between institutions and businesses might wish to keep the above in mind when designing programs supporting publishable students in good standing.

The final association illustrates skill set and emotional development involved with peer reviewed journal, conference publication, or grant proposal processes. Application of the second principle of the life course implies that the patchwork student's emotional states and passions are altered by social publishing efforts afforded by maintaining good standing. Educators and publishers should remain aware of the emotional drives within such a student as to publish and retain standing.

If the above associations are correct, then educators and students must remain mindful that curriculum design, group publication efforts, and joint ventures depend upon the emotional states of the patchwork student.

Explanation of the Third Hypothesis Test

The third hypothesis indicated no association between publication rates institutional types.

The literature review offers a potential insight into the results. Butler (2003) observed publications as revenue streams coupling the efforts of publishers to realized publications. It appears that the emotions and passions driving publication efforts remain unaffected given commodification activities across institution types. Such indifference signifies that financial incentives differing by institution type may not affect publication rates since they disregard emotional states within the patchwork student. Although the

indifference remains an unknown quantity, educators may be able to study the indifference to commodification interests and devise instructional methods allowing funding to enhance publication rates.

Explanation of the Fourth Hypothesis Test

Participants within weather physics, astrophysics, cosmology, high-energy physics, laser physics, nanophysics, optics, quantum field theory, and general relativity had significantly different publication rates relative to other majors in the sample.

I cannot describe the factors within the effect because I neglected publishing process for the above specializations. Nonetheless there appears to be an exchange of intersubjective gifts meshing the emotional drivers of the patchwork student, the financial welfare of the publisher, editor enforced rubrics, and departmental interests. The mechanism for publishing participants in the above specializations differs from other specializations lacking the same subscribing readership. In turn, the publication rates of the above specializations may differ due to a different kind of publication process influenced by carefully considered financial interests. If this is the case, then future educational research must explore the socioeconomic motivators for the difference. Further studies should determine how the mechanics of publishing differs between the above specializations and other fields.

Explanation of the Fifth Hypothesis Test

Participants who only took required English and composition classes had differing publication rates relative to others in the sample.

Each participant is patchwork student subject to financial and scheduling constraints. Although this statement should be obvious, three participants echoed it and one offered the following: "I did it so I saved money and transferred to a four year college and it wasn't worth the extra time and money." Thus the perspectives of students considering whether to engage in additional courses beyond requirements follow trends in commodification. Another student phrased the phenomena in an honest fashion, "What's in it for me? Nothing, why bother?" Such a candid statement illustrated commodification affecting the emotions of the patchwork student. Since emotions are affected, so will be the embodied passions and decisions making processes concerning class selection.

The commodification perspective issues an interesting conjecture for curriculum developers and universities. The above quotes show that students are looking for value from their tuition and are keenly aware of the law diminishing returns. Despite the wish for educating well-rounded students, educators and curriculum planners must realize that education costs money and costs modulate participation, publishing efforts, and publishing rates

Explanation of the Sixth Hypothesis Test

I described a linear model relating publication rates to publication types and specializations. The model reported an adjusted R-squared of 0.7863 accompanying a significant *p* value of 0.03702.

The final test unveiled a linear model using publication types and specializations. Since no causal factors emerged from the literature review, this segment will focus upon

the linear model. The existence of a linear model is important because it allows explanation of the hypothesis test despite ignorance of the skill sets, embodiment, and FETs involved. Assigning phenomenological meaning and embodiment processes to regressors remained critical to explaining the linear model. Although statistical tests treat them as variables coupled to the variations predicted by the model, the phenomenological perspective of the regressors treated them as the media of intersubjective gifts and facilitators of embodiment for the patchwork student.

The model revealed a flaw in the research question exploring whether experiences in English and composition classes affect publication rates. The statistical significance of the linear model placed the variability of publication rates squarely upon the publication types and specializations. Such significance facilitates a finer control of understanding of variations in publication rates outside the assumptions of the study. Such a reframing of the study also yields an interesting question: *What is different about publishing in mathematically and theory intensive specializations compared to other disciplines within physics?*

Answering this question may provide milestone events indicating successful publishing graduate physics students. Whether the answer to the question involves the emotional, experiential, cognitive, or contextual aspects of the patchwork student, this question allows the model to become a significant source of future education research. The explanation and value of the model is not a simple interpretation, but the contradiction of the premise forming the study and the proposal of a new inquiry.

Open-Ended Questions

The survey issued two questions and the responses frame three comments about the interests of the participants. This segment concludes with suggestions for physics educators and education researchers.

Open-ended Question 1. Participants shared their opinions about scientific writing. Responses reflected a desire for students to take courses on *how to publish* by instructors who have successfully published in peer reviewed physics journals. A few participants cited a need for a course tailored to students who had English as a second language (ESL). These students indicated that they struggled with scientific jargon as part of American English. Two participants cited the need for developing effective verbal skills for use in everyday communications and group meetings because they "felt uncomfortable speaking to groups" and "worried about sounding stupid and letting down their friends [fellow researchers]."

Open-ended Question 2. Participants shared thoughts about the value of this survey and their experiences as a participant in this study. Of 22 responses, four offered concerns about using a survey to explore writing skills, one requested future research utilize a case study methodology, a physics education research student expressed they wished more surveys existed in physics education research, and two encouraged studies of any type if they help students with their publication aspirations. Other responses commented upon ways to improve the survey technique and use of oral interviews in future research.

Participants emphasized a desire to learn how to produce clear and concise scientific writing integrating peer review, real life research experience, the proper use of jargon, and discussions about publishing with professional physicists. Eight participants mentioned a desire to integrate peer review of graduate writing as to build kinship and improve their writing skills. If physics departments accommodated such desires, then curriculum panels could build such a writing series. Implementation of such programs could afford skill development, embodiment of knowledge and abilities, and use the emotional motivation of students and educators as to trigger innovation in teaching scientific writing.

Some participants suggested an experiential physics faculty should design a course on how to publish for academic, industrial, and symposium audiences. The course would integrate real life writing and publishing events as to ensure observable skill developments occurred alongside a sense of achievement.

Six comments reflected on the *publish or perish* environment of academe favors quantity over quality. ESL (and international English) students expressed a feeling at being at a disadvantage in such an environment. Since the patchwork student utilizes emotion as a driver for learning, the demoralizing aspect of struggling with language during the publication process may hamper communicative skill set development. Two quotes from participants illustrated the demoralizing aspect of publishing at such a disadvantage. One participant stated, "My office mates get me published because I don't know English well enough." Another participant stated, "French is my primary language and it's impossible to find cooperative editors." Such candid comments show students

struggling with language barriers as part of the publication process. Their potential as publishers may suffer or become dependent upon unregulated peer review processes hampering publishing opportunities. Curiously, this comment and analysis feeds into the previous comment and encourages the development of a *how to publish* course as to help ESL and international English students of physics.

Recommendations

I recommend that physics departments construct a peer reviewed, group publishing orientated, and faculty guided *how to publish* series of classes. Such a series should integrate real life issues, include peer review processes, introduce paper writing techniques (moderated by physics and English professors), and a review process evaluating the effectiveness of the series. The goal of such a program would be the construction of a yearly departmental publication showcasing the resultant writings, facilitate departmental review of writing skill development, inspire early stage graduate students, give virtual publication experience to participants, build camaraderie, and cast the department as a dynamic entity beyond that of journal publications.

The second recommendation targets curriculum designers and graduate physics educators. The result of the fourth hypothesis test suggested that the decision to major in weather physics, astrophysics, cosmology, high-energy physics, laser physics, nanophysics, optics, quantum field theory, and general relativity is associated with higher publication rates than other specializations. Although I was unable to resolve such phenomena, I recommend that future research, curriculum planners, and instructors

observe such students (and their FETs) in these specializations and compare them to their peers in other specializations.

The third recommendation is that educators abandon the *practice makes perfect* concept of writing because the needs expressed by the participants cannot be addressed using rote memory. Educators and curriculum planners could keep this in mind when determining conditions for acceptance into graduate studies, evaluation of standing, and other academic events affecting the opportunity for publication.

The final recommendation rejects the underlying premises of the study and replaces it with a phenomenological model grounded in publication types and specializations. The predictive power of the simple linear model presented in Table B8 demands educators and researchers to explore the significant regressors in the model as to find out why corresponding students manifest variation in FETs responsible for the predictive power of the linear model.

I recommend that physics departments integrate the educational tools, linear models, and resulting classes into their departments as to support the lifeblood of their science—the publication.

Final Summary

The purpose of this quantitative correlational study was to address the research questions exploring potential relationships between the number of and type of college level writing classes experienced by the participants given their peer-reviewed journals, nonpeer reviewed journals, and specialty magazine publications per calendar year. I presented the construction of the patchwork student and the use of the life course theory

as the means to a passionate free agent representing the graduate physics student. Included in this study were six hypothesis tests, linear model building, and interpretation of the results. The findings indicated that specialization and target publication type could provide a linear model explaining the variation in publication rates, while the number of and type of college level writing classes experienced by the survey participants do not appear to lead to dynamical consideration. Further, based on the study's results, I call for future research investigating the linear model as a starting point into exploiting specialization and publication type as a means to derive FETs useful for curriculum planning, the construction of writing classes within physics departments, and helping students publish within the physics community.

The meaning, and potentially the value, of this study remains unknown since its suggestions are not part of the broader graduate physics education community. Once the results of this study manifest within the community, then building the instructional tools helping graduate physics students publish may commence. If future research can focus upon the above results, then the resulting teaching strategies and publication interventions may contribute to journal publication quality, assist students with building the communication skills to help them in their professions, help develop technologies, and thus positively impact society.

Implications for Social Change

Communicative events contained within journals, monographs, symposiums, and industrial-outlet publications provide the backbone responsible for the global sharing of knowledge. This study considered the academic facets of the communications backbone

underpinning the dissemination of information. The results of the study may facilitate social changes and personal developments.

The suggestion of faculty directed graduate writing classes provided an initial insight into producing workers wanting to contribute writings to their respective fields. If such a program emerges, then it may be possible to transform the evolving landscape of current topics and established academic fields into skill sets conducive to writing for scientifically inclined audiences. In turn, the audience may integrate the results into new products, novel production methods, and other technological-orientated research addressing social needs.

Although the above potential for social change appears appealing, the inclusion of this study into the management and development of workforces provides an interesting Marxist perspective. If educational, professional, and industrial institutions included this study into their maintenance of a student body, professional group, or workforce, then such groups could contain individuals possessing the emotional states and intellectual means to make substantial written contributions to their fields. In addition to their contributions, the writers may embody a sense of accomplishment and satisfaction upon observing the fruits of their labor. This study may not only offer social change, it may also appeal to emotions as a way to reinforce writing-skill set development necessary for personal and professional transformation.

The potential for social and personal change remains limited only by future education research responsible for refining this study into practice. Similar studies in other fields may provide the appropriate insights into bridging the gap between engineer,

scientist, and articulate writer able to invest emotional interests into a community maintained body of knowledge.

References

Adorno, T. (2001). *Culture industry.* New York: Routledge.

Anaya-Prado, R., Toledo-Pereyra, L. H., & Toledo, A. H. (2006). The surgeon as a scientific writer. *Journal of Investigative Surgery 19(6),* 19335-19339. doi:10.1080/08941930601025870

Anderson, H., & Bo Kaspersen, L. (Eds.). (1996). *Classical and modern social theory.* Malden, MA: Blackwell Publishers, Inc.

Auerbach, C., & Silverstein, L. (2003). *Qualitative data.* New York: New York University Press.

Bales, R. F. (1950). A set of categories for the analysis of small group interactions. *American Sociological Association, 15*, 257-263. doi:10.2307/2086790

Bertrand, Y. (1995). *Contemporary theories and practice in education.* Madison, WI: Atwood Publishing.

Biser, E., Rubel, L., & Toscano, R. M. (2007). Bending the rules: When deaf writers leave college. *American Annals of the Deaf, 152*(4), 361-367. doi:10.1353/aad.2008.0000

Bloland, H. (2005). Whatever happened to postmodernism in higher education?: No requiem in the new millennium. *Journal of Higher Education, 76*(2), 121-150. doi:10.1353/jhe.2005.0010

Bok, D. (2004). *Universities in the marketplace: The commercialization of higher education.* Princeton, NJ: Princeton University Press.

Brown, C. A., Dickson, R., Humphreys, A., McQuillan, V., & Smears, E. (2008). Promoting academic writing/referencing skills: Outcome of an undergraduate e-learning pilot project. *British Journal of Educational Technology, 39*(1), 140-156. doi:10.1111/j.1467-8535.2007.00735.x

Butler, L. (2003). Modifying publication practices in response to funding formulas. *Research Evaluation, 12*(1), 39-46. doi:10.3152/147154403781776780

Carpenter, S. (2008). A study of graduate student authorship in journalism and mass communication journals: 1997-2006. *Journalism & Mass Communication Educator*, *63*(3), 224-240. doi:10.1177/107769580806300303

Coser, L. (1956). *The functions of social conflict.* New York: The Free Press, a Corporation.

Creswell, J. W. (2007). *Qualitative inquiry and research design* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Diezmann, C. M. (2005). Supervision and scholarly writing: Writing to learn - learning to write. *Reflective Practice, 6*(4), 443-457. doi:10.1080/14623940500300491

Elder, G. H. (1994). Time, human agency, and social change: Perspectives on the life course. *Social Psychology Quarterly, 57*(1), 4-15. Retrieved from http://www.colorado.edu/ibs/pb/thornberry/socy7004/pdfs/Time,%20Human%20Agency,%20and%20Social%20Change%20.pdf

Ellis, R. A., Taylor, C. E., & Drury, H. (2007). Learning science through writing: Associations with prior conceptions of writing and perceptions of a writing

program. *Higher Education Research & Development, 26*(3), 297-311. doi:10.1080/07294360701494310

Femlee, D. (1988). Returning to school and women's occupational attainment. *Sociology of Education, 61*, 29-41. Retrieved from http://www.jstor.org/pss/2112307

Ferguson, H. (2006). *Phenomenological sociology: Experience and insight in modern society.* London: Sage Publications.

Fischer, K. W. (1980). A theory of cognitive development: The control and construction of hierarchies of skills. *Psychological Review, 87*(6), 477-531. doi:10.1037//0033-295X.87.6.477

Fischer, K. W. (2004). Building general knowledge and skill: Cognition and microdevelopment in science learning. Manuscript submitted for publication. Retrieved from http://www.gse.harvard.edu/~ddl/articlesCopy/SchwartzFischerBuildingKnowledge.0205.pdf

Fischer, K. W. (2006a). Dynamic cycles of cognitive and brain development. Unpublished manuscript, Harvard. Retrieved from http://cfans.org/downloads/Dynamics%20cycles%20of%20cognitive%20and%20brain%20development.pdf

Fischer, K. W. (2006b). Dynamic development of action, thought, and emotion. Unpublished manuscript, Harvard. Retrieved from http://www.gse.harvard.edu/~ddl/articlesCopy/FischerBidellProofsCorrected.0706.pdf

Fischer, K. W. (2009). Mind, brain, and education: Building a scientific groundwork for learning and teaching. *International Mind, Brain, and Education Society, 3*(1), 3-16. doi:10.1111/j.1751-228X.2008.01054.x

Fischer, K. W., & Pare-Blagoev, J. (2000). From individual differences to dynamic pathways of development. *Child Development, 71*(4), 850-853. doi:10.1111/1467-8624.00192

Fotopolous, T. (2000). Systems theory and complexity: A potential tool for radical analysis or the emerging social paradigm for the internationalized market economy. *International Journal of Inclusive Democracy, 6*(3), 421-461. Retrieved from http://www.democracynature.org/vol6/takis_complexity.htm

Garfinkel, H. (1996). Ethnomethodology's program. *Social Psychology Quarterly, 59*(1), 5-21. doi:10.2307/2787116

Geer, U., & Rudge, D. (2002). A review of research on constructivist bases strategies for large lecture science classes. *Electronic Journal of Science Education, 7*(2), 1-22. Retrieved from http://wolfweb.unr.edu/homepage/crowther/ejse/geer.pdf

Gilbert, R., Balatti, J., Turner, P., & Whitehouse, H. (2004). The generic skills debate in research higher degrees. *Higher Education Research & Development, 23*(3), 375-388. doi:10.1080/0729436042000235454

Gjerding, A. N., Wilderom, C. P. M., Shona, P. B., & Klaus, S. (2006). Twenty practices of an entrepreneurial university. *Higher Education Management and Policy, 18*(3). doi:10.1787/hemp-v18-art19-en

Glazer, N. (2004). The university for sale. *Public Interest, 154*, 112-118. Retrieved from http://www.nationalaffairs.com/doclib/20080710_20041549theuniversityforsalenathanglazer.pdf

Gray, P. E., Emerson, L., & Mackay, B. (2005). Meeting the demands of the workplace: Science students and written skills. *Journal of Science Education and Technology, 14*(4), 425-435. doi:10.1007/s10956-005-8087-y

Herubel, J. V. M. (2008). Historical scholarship, periodization, themes, and specialization: Implications for research and publication. *Journal of Scholarly Publishing,* 144-155. doi:10.3138/jsp.39.2.144

Horkheimer, M., & Adorno, T. (1979). *The dialectic of enlightenment.* New York: Seabury Press.

Hua Liu, C., & Matthews, R. (2005). Vygotsky's philosophy: Constructivism and its criticism examined. *International Education Journal, 6*(3), 386-399. Retrieved from http://ehlt.flinders.edu.au/education/iej/articles/v6n3/liu/paper.pdf

Hyland, K. (2008). Academic clusters: Text patterning in published and postgraduate writing. *International Journal of Applied Linguistics, 18*(1), 41-62. doi:10.1111/j.1473-4192.2008.00178.x

Kearney, M., & Treagust, D. (2000, December). *Constructivism as a referent in the design and development of a computer program using interactive digital video to enhance learning in physics.* Poster session presented at ASCILITE 2000, Australia: Southern Cross University.

Kearns, H., Gardiner, M., & Marshall, K. (2008). Innovation in PhD completion: The hardy shall succeed (and be happy!). *Higher Education Research & Development, 27*(1), 77-89. doi:10.1080/07294360701658781

Korotkov, R. (2006). On the effectiveness of higher education in Russia. *Russian Education and Society, 48*(1), 28-36. doi:10.2753/RES1060-9393480102

Kuhn, T. S. (1996). *The structure of scientific revolutions.* Chicago: University of Chicago Press. (Original work published 1962)

Labouvie-Vief, G., Chiodo, L. M., Diehl, M., & Orwoll, L. (1995). Representations of self across the life-span. *Psychology and Aging, 10*(3), 404-415. doi:10.1037//0882-7974.10.3.404

Lakemeyer, G., & Nebel, B. (Eds.). (2003). *Exploring artificial intelligence in the new millennium.* San Francisco, CA: Morgan Kaufmann Publishers.

Lambie, G. W., Sias, S. M., & Davis, K. M. (2008). A scholarly writing resource for counselor educators and their students. *Journal of Counseling & Development,* 18-25. doi:10.1002/j.1556-6678.2008.tb00621.x

Le Roux, E., & Galloway, F. (2008). Assessing the demand for scholarly publishing in South Africa. *Journal of Scholarly Publishing,* 110-126. doi:10.3138/jsp.39.2.109

Lerner, V. S. (2004). Introduction to information systems theory: Concepts, formalism, and applications. *International Journal of Systems Science, 35*(7), 405-424. doi:10.1080/00207720410001734183

Litwin, M. (1995). *The survey kit: How to measure survey reliability and validity.* Thousand Oaks, CA: Sage Publications.

Marx, K. (1956). *Karl Marx: Selected writings in sociology and social philosophy.* New York: McGraw-Hill, Inc.

Mayrath, M. C. (2008). Attributions of productive authors in educational psychology journals. *Educational Psychology Review, 20*(1), 41-56. doi:10.1007/s10648-007-9059-y

Meissner, W. W. (2006). The mind-brain and neuroscientific foundations: II. Neurobehavorial integrations. *Bulletin of Menninger Clinic, 70*(2), 120-124. doi:10.1521/bumc.2006.70.2.102

Mellor, D. H., & Oliver, A. (Eds.). (2004). *Oxford readings in philosophy: Properties.* New York: Oxford University Press.

Merton, R. (1968). The Matthew effect in science. *Science, 159*, 56-63. doi:10.1126/science.159.3810.56

Moll, L. C. (1990). *Vygotsky and education.* New York: Cambridge University Press.

Mortimer, J. T. (2004). *Handbook of the life course.* USA: Springer.

Mulvey, P., & Nicholson, S. (2008). *AIP report: Statistical research center.* College Park, MD: American Institute of Physics.

Noble, T. (2000). *Social theory and social change.* New York: St. Martin's Press, Inc.

Parsons, T. (1940). An analytical approach to the theory of social stratification. *American Journal of Sociology, 45*(6), 841-862. doi:10.1086/218489

Parsons, T. (1952). *The social system.* Oxon: Routledge.

Paulos, J. A. (2001). *Innumeracy: Mathematical illiteracy and its consequences.* New York: Hill and Wang. (Original work published 1998)

Pepper, S. C. (1970). *World hypotheses.* London: University of California Press. (Original work published 1942)

Piaget, J. (2005). *The psychology of intelligence* (3rd ed.). New York: Routledge.

Polit, D. F., Beck, C. T., & Hungler, B. P. (2001). *Essentials of nursing research: Methods, appraisals, and utilization* (5th ed.). Philadelphia: Lippincott, Williams, & Wilkins.

Qinh, F., Lifang, X., & Xiaochuan, L. (2008). Peer-review practice and research for academic journals in China. *Journal of Scholarly Publishing, 39(4),* 417-427. doi:10.3138/jsp.39.4.417

Quible, Z. F., & Griffin, F. (2007). Are writing deficiencies creating a lost generation of business writers? *Journal of Education for Business, 83(1),* 32-36. doi:10.3200/JOEB.83.1.32-36

Rawson, R. E., Quinlan, K. M., Cooper, B. J., Fewtrell, C., & Matlow, J. (2005). Writing-skills development in the health professions. *Teaching and Learning in Medicine, 17*(3), 233-239. doi:10.1207/s15328015tlm1703_6

Reardon, R. C., & Wright, L. K. (1999). The case of Mandy: Applying Holland's theory and cognitive information processing theory. *Career Development Quarterly, 47*, 195-202. doi:10.1002/j.2161-0045.1999.tb00730.x

Robertson, I. J. (2004). Assessing the quality of undergraduate education students' writing about learning and teaching science. *Int. J. Sci. Educ.26*(9), 1131-1149. doi:10.1080/0950069042000177244

Sall, H. N., & Ndjaye, B. D. (2007). Higher education in Africa: Between perspectives opened by the Bologna Process and the commodification of education. *European Education, 39*(4), 43-57. doi:10.2753/EUE1056-4934390403

Shankar, R. (1994). *Principles of quantum mechanics* (2nd ed.). New York: Springer.

Shumar, W. (1997). *College for sale: A critique of the commodification of higher education.* Oxon: Routledge.

Smart, J. C. (Ed.). (2005). *Higher education: Handbook of theory and research* (20). Netherlands: Springer. doi:10.1007/1-4020-3279-X

Smith, M. L. (1987). *Research and evaluation in education and the social science.* New Jersey: Prentice-Hall, Inc.

Stewart, B., & Waight, C. (2008). E-Learning teams and the adult learning efforts in corporate settings: A cross analysis of four case studies. *International Journal. on E-Learning, 7*(2), 293-309. Retrieved from http://cop2life.wikispaces.com/file/view/2008+Stewart.pdf

Teramoto, H., & Mickan, P. (2008). Writing a critical review: reflections of literacy practices. *Language Awareness, 17*(1), 44-56. doi:10.2167/la433.0

Usher, R., & Barnacle, R. (2003). Assessing the quality of psychology training: The case of part-time candidates in full-time professional work. *Higher Education Research & Development, 22*(3), 345-358. doi:10.1080/0729436032000145185

Vicentini, M., & Sassi, E. (Eds.). (2008). *Connecting research in physics education with teacher education.* Japan: International Commission on Physics Education.

Vidovic, V. V., & Bjelis, A. (2006). Entrepreneurialism at the university of Zagreb: Managing the stability of change. *Higher Education in Europe, 31*(2). doi:10.1080/03797720600940849

von Bertalanffy, L. (1969). *General system theory.* New York, NY: George Braziller.

Wilhelm, J., Thacker, B., & Wilhelm, R. (2007). Creating constructivist physics for introductory university classes. *Electronic Journal of Science Education, 11*(2), 20-37. Retrieved from ejse.southwestern.edu/article/download/7793/5560

Williams, R., & Stockdale, S. (2003). High-performing students with low critical thinking skills. *Journal of General Education, 52*(3), 200-226. doi:10.1353/jge.2004.0007

Xia, J. (2006). Electronic publishing in archaeology. *Journal of Scholarly Publishing,* 270-287. doi:10.3138/jsp.37.4.270

Zeh, H. D. (1989). The physical basis of the direction of time. Berlin: Springer-Verlag.

Appendix A: Survey Instrument

Graduate Physics Publishers and Academic Writing Expereinces

1. Introduction to the Survey and Confidentiality Pledge

*1.

CONSENT FORM

Graduate Physics Publishers and Academic Writing Experiences

You are invited to take part in a research study to regarding publications in scientific journals. You were chosen for the study because you are currently a graduate student of physics at a recognized institution of higher learning. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Steven T.M. Hess, who is a doctoral student at Walden University.

Background Information:

The study is part of a doctoral dissertation as a requirement for graduation from Walden University. The data collected during this study could advise graduate physics departments and curriculum developers to help future students with publications in scientific journals.

Procedures:

If you agree to be in this study, you will be asked to complete an online survey requiring about 20-30 minutes.

Voluntary Nature of the Study:

Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. No one will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind during the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:

Page 1

Appendix B: Tables

Table B1

Counts of Specialization

Specialization	Percent
Acoustics (*n* = 0)	0.0%
Astronomy (*n* = 5)	5.7%
Astrophysics (*n* = 13)	14.8%
Atomic physics (*n* = 5)	5.7%
Biophysics (*n* = 9)	10.2%
Chaotic systems (*n* = 1)	1.1%
Chemical physics (*n* = 2)	2.3%
Computational physics (*n* = 8)	9.1%
Cosmology (*n* = 3)	3.4%
Low temperature physics (*n* = 5)	5.7%
Crystallography (*n* = 1)	1.1%
Electromagnetism (*n* = 5)	5.7%
Electronics (*n* = 8)	9.1%
Fluid dynamics (*n* = 2)	2.3%
Geophysics (*n* = 2)	2.3%
Grand unified theories (*n* = 0)	0.0%
High energy physics (*n* = 10)	11.4%
High pressure physics (*n* = 0)	0.0%

(table continues)

Specialization	Percent
Laser physics (n = 2)	2.3%
M-Theory (n = 0)	0.0%
Mathematical physics (n = 1)	1.1%
Mechanics (n = 2)	2.3%
Weather physics (n = 2)	2.3%
Molecular physics (n = 2)	2.3%
Nanotechnology (n = 13)	14.8%
Nuclear physics (n = 13)	14.8%
Optics (n = 11)	12.5%
Physics education research(n = 4)	4.5%
Particle physics (n = 14)	15.9%
Plasma physics (n = 7)	8.0%
Quantum electrodynamics (n = 3)	3.4%
Quantum mechanics (n = 6)	6.8%
Quantum optics (n = 3)	3.4%
Quantum field theory (n = 4)	4.5%
Quantum gravity (n = 2)	2.3%
Relativity (n = 2)	2.3%
Statistical mechanics (n = 1)	1.1%
String theory / Superstring theory (n = 1)	1.1%

(table continues)

Specialization	Percent
Thermodynamics (n = 1)	1.1%
Other (n = 15)	17.0%

Table B2

Counts of Undergraduate English and Composition Classes Taken by the Participant

Topic	Percent
African American literature (*n* = 0)	0.0%
African literature (*n* = 0)	0.0%
Autobiographies and biographies (*n* = 1)	1.4%
Chicano/a narrative and social history (*n* = 1)	1.4%
Childhood literature (*n* = 1)	1.4%
Comparative literature (*n* = 5)	6.8%
Creative writing (*n* = 6)	8.1%
Dramatic writing for film or stage (*n* = 1)	1.4%
Editing (*n* = 1)	1.4%
English literature (*n* = 14)	18.9%
Ethnic studies and literature (*n* = 2)	2.7%
European literature (*n* = 7)	9.5%
Independent study in literature (*n* = 0)	0.0%
Linguistics (*n* = 5)	6.8%
Literary criticism (*n* = 3)	4.1%
Medieval European literature (*n* = 4)	5.4%
Mythology (*n* = 6)	8.1%
Poetry (*n* = 3)	4.1%

(table continues)

Topic	Percent
Postmodern writing (*n* = 2)	2.7%
Professional writing (*n* = 1)	1.4%
Russian literature (*n* = 4)	5.4%
Shakespeare (*n* = 1)	1.4%
Technical writing (*n* = 12)	16.2%
Twentieth century literature (*n* = 3)	4.1%
Western literature (*n* = 5)	6.8%
Women in literature (*n* = 3)	4.1%
World literature (*n* = 7)	9.5%
Writing for computer science majors (*n* = 0)	0.0%
Writing for film (*n* = 1)	1.4%
Writing for science majors (*n* = 4)	5.4%
Does not apply/Only took required classes (*n* = 22)	29.7%

Table B3

Counts of Writing Skills or Activities Covered in Undergraduate English and Composition Classes

Topic	Percent
Developing clear and concise writings (*n* = 40)	50.0%
Learning how to organize writings (*n* = 35)	43.8%
Defining purpose for writing (*n* = 29)	36.3%
Evidence based reasoning (*n* = 21)	26.3%
Understanding how to make a writing "flow" properly (*n* = 28)	35.0%
Awareness of a target audience (*n* = 33)	41.3%
Utilizing proper language (*n* = 24)	30.0%
How to handle jargon (*n* = 8)	10.0%
The use of rhetoric (*n* = 15)	18.8%
Scientific or technical writing (*n* = 33)	41.3%
Preparing research papers (*n* = 29)	36.3%
Building confidence as a writer (*n* = 14)	17.5%
Planning complex documents (*n* = 7)	8.8%
Using writing software effectively (*n* = 14)	17.5%
Developing creative writing skills (*n* = 18)	22.5%
Analyzing poetry and its devices (*n* = 22)	27.5%

(table continues)

Topic	Percent
Learning how to develop a topic or theme (*n* = 32)	40.0%
Avoiding plagiarism and citation methods (*n* = 51)	63.8%
Prewriting skills (*n* = 32)	40.0%
Grammar, sentence structure, and mechanics (*n* = 44)	55.0%
Presenting your work to an audience (*n* = 33)	41.3%
Developing editing skills (*n* = 23)	28.8%
Use of MLA, APA, or other writing formats (*n* = 44)	55.0%
Learning critical thinking skills (*n* = 33)	41.3%
How to argue with writing (*n* = 28)	35.0%
Time management and task completion (*n* = 11)	13.8%
Learning how to read carefully (*n* = 28)	35.0%
Assessing your own work (*n* = 31)	38.8%
Developing stamina for writing (*n* = 5)	6.3%
Artistic appreciation of literature (*n* = 17)	21.3%
Linguistics (*n* = 7)	8.8%
Vocabulary building exercises (*n* = 10)	12.5%
Learning how to support an argument or stance (*n* = 42)	52.5%
Transferring writing skills to your major (*n* = 14)	17.5%
Preparing mathematical manuscripts (*n* = 10)	12.5%

Table B4

ANOVA for Publication Rates and Specialization in Physics

Source	x^2	*df*	$\overline{x^2}$	*F*	*p*
Astronomy	11.796	1	11.796	3.1763	0.08 *
Astrophysics	3.109	1	3.109	0.8371	0.37
Atomic physics	8.364	1	8.364	2.2523	0.15
Biophysics	1.879	1	1.879	0.5059	0.48
Chaotic systems	1.469	1	1.469	0.3956	0.54
Chemical physics	0.195	1	0.195	0.0524	0.82
Computational physics	1.597	1	1.597	0.4301	0.52
Cosmology	45.375	1	45.375	12.2183	0.002 *
Low temperature physics	7.218	1	7.218	1.9436	0.18

(table continues)

Source	x^2	*df*	$\overline{x^2}$	*F*	*p*
Crystal physics	1.375	1	1.375	0.3703	0.55
Electromagnetics	0.28	1	0.28	0.0753	0.79
Electronics	3.458	1	3.458	0.9312	0.35
Fluid physics	0.125	1	0.125	0.0337	0.86
Geophysics	0.054	1	0.054	0.0144	0.91
High energy physics	34.851	1	34.851	9.3846	0.006 *
Laser physics	17.839	1	17.839	4.8036	0.04 *
Mathematical physics	0.557	1	0.557	0.1499	0.70
Weather physics	14.953	1	14.953	4.0266	0.06 *
Molecular physics	2.394	1	2.394	0.6445	0.43
Nanophysics	81.854	1	81.854	22.0412	10^{-4} *
Nuclear physics	3.853	1	3.853	1.0374	0.32

(table continues)

Source	x^2	*df*	$\overline{x^2}$	*F*	*p*
Optics	28.762	1	28.762	7.7448	0.01 *
Quantum field theory	18.914	1	18.914	5.0931	0.03 *
Quantum gravity	10.792	1	10.792	2.9061	0.10 *
Quantum mechanics	8.607	1	8.607	2.3177	0.14
Relativity	85.07	1	85.07	22.9073	10^{-5} *
Other	1.128	1	1.128	0.3038	0.58
Particle physics	1.167	1	1.167	0.3142	0.59
Plasma physics	0.221	1	0.221	0.0595	0.81
Residual	77.987	21	3.714		

* $p < 0.10$

Table B5

ANOVA for Publication Rates and Undergraduate English and Composition Classes Experienced

Source	x^2	*df*	$\overline{x^2}$	*F*	*p*
Chicano studies	0.34	1	0.339	0.0273	0.87
Editing	0.17	1	0.173	0.014	0.91
Mythology	3.17	1	3.171	0.2554	0.62
Science writing	0.32	1	0.322	0.0259	0.87
20th C literature	4.74	1	4.744	0.3822	0.54
English literature	3.14	1	3.137	0.2528	0.62
Linguistics	7.84	1	7.836	0.6313	0.43
Poetry	6.03	1	6.033	0.486	0.49
Comparative literature	2.4	1	2.397	0.1931	0.66
Ethnic studies	0.4	1	0.4	0.0322	0.86

(table continues)

Source	x^2	*df*	$\overline{x^2}$	*F*	*p*
Literary critique	2.33	1	2.333	0.1879	0.67
European literature	0.41	1	0.411	0.0331	0.86
Medieval literature	8.74	1	8.738	0.704	0.41
Required classes	49.2	1	49.198	3.9635	0.06*
Western literature	1.15	1	1.152	0.0928	0.76
Creative writing	0	1	0	0	1.00
Modern writings	4.08	1	4.084	0.329	0.57
Russian literature	1.58	1	1.582	0.1275	0.72
Women's literature	1.9	1	1.902	0.1532	0.70
Technical writing	4.92	1	4.915	0.396	0.53
Residuals	372.38	30	12.413		

* $p < 0.10$

Table B6

Multiple Regression Table of the Third Model Utilizing only Specialization

Factor	$\hat{y}$	*SE*	*t*	*p*
Intercept	0.126350	0.994943	0.127	0.900529
Astronomy	-0.072044	1.954446	-0.037	0.971051
Astrophysics	1.445694	1.081534	1.337	0.200016
Atomic physics	0.007541	1.506104	0.005	0.996067
Biophysics	0.873650	2.045537	0.427	0.674998
Chaotic systems	-0.052948	3.279027	-0.016	0.987316
Chemical physics	0.247578	2.420648	0.102	0.919807
Computational physics	0.052948	2.088874	0.025	0.980091
Cosmology	8.500000	2.527572	3.363	0.003958 *

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Electronics	0.038267	1.497436	0.026	0.979928
Electromagnetics	1.666004	1.974376	0.844	0.411213
Fluid physics	-0.713508	2.865334	-0.249	0.806518
Geophysics	1.097507	2.493270	0.440	0.665690
High energy physics	1.158754	1.298002	0.893	0.385237
Laser physics	2.068622	1.626742	1.272	0.221677
Low temperature physics	-0.576630	1.283721	-0.449	0.659322
Mathematical physics	16.833941	3.642808	4.621	0.000283 *
Molecular physics	0.992459	2.942272	0.337	0.740267
Nanophysics	1.154842	1.263277	0.914	0.374202
Nuclear physics	0.059445	0.997638	0.060	0.953223
Optics	1.432963	1.288626	1.112	0.282564

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Other	0.829609	1.220442	0.680	0.506372
Particle physics	1.730488	1.241514	1.394	0.182421
Plasma physics	1.213508	1.349638	0.899	0.381913
Quantum electrodynamics	11.241484	2.545936	4.415	0.000433 *
Quantum gravity	-14.019737	3.108630	-4.510	0.000356 *
Quantum mechanics	2.254748	1.316726	1.712	0.106134
Quantum optics	3.246181	1.555344	2.087	0.053233 *
Crystal physics	0.294632	3.859059	0.076	0.940089

* $p < 0.10$

Table B7

Multiple Regression Table of the Third Model Utilizing only Publication Types

Factor	$\hat{y}$	*SE*	*t*	*p*
Intercept	-2.9199	1.7045	-1.713	0.09637 *
Blogs	5.8493	2.1657	2.701	0.01096 *
Collaborative efforts	-0.2950	1.4615	-0.202	0.84129
Conference papers	1.7545	0.9994	1.756	0.08873 *
Essays	3.5493	3.1633	1.122	0.27020
Grant proposals	1.5463	0.9751	1.586	0.12263
Magazines	2.0509	2.1722	0.944	0.35216
Monographs/Books	-1.0726	2.7459	-0.391	0.69865
Nonpeer reviewed	-1.2008	1.4897	-0.806	0.42613
Peer reviewed	3.5714	1.5787	2.262	0.03060 *

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Professional	5.8456	1.7515	3.337	0.00215 *
Review paper	-0.1181	1.6480	-0.072	0.94331
Textbooks	2.8485	2.7888	1.021	0.31472

* $p < 0.10$

Table B8

Multiple Regression Table of the Third Model Utilizing Specializations and Publication Types

Factor	$\hat{y}$	*SE*	*t*	*p*
Intercept	4.5366	2.5601	1.772	0.13659
Astronomy	1.6541	2.2674	0.730	0.49841
Astrophysics	-0.1099	1.5514	-0.071	0.94625
Atomic physics	-0.3269	2.0789	-0.157	0.88120
Biophysics	0.1645	2.6661	0.062	0.95318
Chaotic systems	-5.6257	3.8445	-1.463	0.20325
Chemical physics	0.9242	3.0808	0.300	0.77625
Computational physics	6.5053	3.5224	1.847	0.12405
Cosmology	6.0867	3.3206	1.833	0.12628
Electronics	-0.3092	2.1302	-0.145	0.89027

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Electromagnetics	3.6873	2.4073	1.532	0.18616
Fluid physics	-0.7328	2.9513	-0.248	0.81379
Geophysics	-5.8015	3.9203	-1.480	0.19899
High energy physics	1.5710	2.1170	0.742	0.49139
Laser physics	0.9817	1.6481	0.596	0.57732
Low temperature physics	-0.1761	1.5308	-0.115	0.91292
Mathematical physics	33.4954	6.9361	4.829	0.00476 *
Molecular physics	2.2066	3.8640	0.571	0.59267
Nanophysics	0.9547	2.5832	0.370	0.72683
Nuclear physics	-0.1469	1.3235	-0.111	0.91595
Optics	0.5948	1.2044	0.494	0.64233
Other	-0.6020	2.9908	-0.201	0.84840

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Particle physics	1.2551	1.2718	0.987	0.36903
Plasma physics	0.7033	1.3962	0.504	0.63584
Quantum electrodynamics	27.4009	6.3084	4.344	0.00740 *
Quantum gravity	-31.5788	7.0228	-4.497	0.00642 *
Quantum mechanics	2.1462	2.1827	0.983	0.37061
Quantum optics	4.7738	3.0531	1.564	0.17868
Crystallography	-7.6385	4.4004	-1.736	0.14311
Blog publication	-11.1274	4.8353	-2.301	0.06966 *
Collaborative publication	0.6667	1.3634	0.489	0.64554
Conference publications	0.8796	1.3989	0.629	0.55707
Grant writing	1.0042	1.6972	0.592	0.57980

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Magazine publication	-3.4154	2.3521	-1.452	0.20620
Monograph or book publication	0.6078	2.7396	0.222	0.83319
Nonpeer reviewed publication	1.2745	2.7396	0.465	0.66134
Peer reviewed publication	-4.5808	1.8824	-2.433	0.05913 *
Professional publication	-4.0514	2.6561	-1.525	0.18770
Review publication	-1.3180	1.7122	-0.770	0.47621
Textbook publication	0.4433	5.3444	0.083	0.93712

* $p < 0.10$

Table B9

Multiple Regression Table of the Third Model Utilizing Publication Types and Undergraduate Writing Experience

Factor	$\hat{y}$	*SE*	*t*	*p*
Intercept	1.42886	4.49114	0.318	0.7554
Blog publication	16.51640	5.57516	2.962	0.0110 *
Collaborative publication	-0.59789	2.24057	-0.267	0.7938
Conference publications	4.23784	1.47528	2.873	0.0131 *
Essay publication	7.82036	7.76015	1.008	0.3320
Grant writing	2.03663	1.13231	1.799	0.0953 *
Magazine publication	0.62029	2.88521	0.215	0.8331
Monograph or book publication	-2.78421	2.73486	-1.018	0.3272

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Nonpeer reviewed publication	-2.11487	2.32661	-0.909	0.3799
Peer reviewed publication	-1.50243	4.33023	-0.347	0.7342
Professional publication	-0.05472	4.58769	-0.012	0.9907
Textbook publication	3.62029	2.88521	1.255	0.2316
Chicano studies	2.07357	2.84994	0.728	0.4798
Comparative literature	1.92415	5.32536	0.361	0.7237
Creative writing	0.08560	2.21933	0.039	0.9698
English literature	2.91524	3.25399	0.896	0.3866
Ethnic studies	-3.61198	3.02827	-1.193	0.2543
European literature	-3.73028	2.47081	-1.510	0.1550
Linguistics	-3.20090	2.97076	-1.077	0.3009

(table continues)

Factor	$\hat{y}$	*SE*	*t*	*p*
Literary critique	-0.70213	3.11126	-0.226	0.8250
Medieval literature	-2.27568	2.39604	-0.950	0.3596
Modern writing	21.04726	7.71085	2.730	0.0172 *
Mythology	0.84000	2.87952	0.292	0.7751
Poetry	-3.66427	2.86104	-1.281	0.2227
Required classes	-0.04672	1.51842	-0.031	0.9759
Russian literature	-0.21337	3.67619	-0.058	0.9546
Scientific writing	0.08733	2.69522	0.032	0.9746
Technical writing	-0.71582	2.36264	-0.303	0.7667
Western literature	-2.96565	2.01455	-1.472	0.1648
Women's literature	-21.18310	9.73081	-2.177	0.0485 *
World literature	2.27569	2.01941	1.127	0.2802

* $p < 0.10$

Curriculum Vitae

Steven Hess

EDUCATION

Walden University
Ph.D. in Education 2012

- Dissertation: "Academic Writing Experience and Academic Publishing Rates for Graduate Physics Students: A Correlational Study"
- Specialized in higher education and novel online teaching methods.

University of California, Davis, CA.
B.S. Physics, B.S. Mathematics, M.S. Theoretical Physics, Ph.D. 1998-2007
Studies in Theoretical Physics

- Studied applied mathematics, classical analysis, discrete mathematics, calculus of variations, string theories, General Relativity, classical and quantum field theories, quantum cosmology, and teaching methodologies.
- Taught various levels of physics classes spanning from basic classical physics for biologists and engineers up to tutoring in graduate level statistical physics classes. Specialized in teaching laboratory in novel fashions and founded the "Invention Lab" at UC Davis.
- Written several mini e-books as interventions for introductory physics.

Chabot Community College, Hayward, CA.
Completed IGETC Certification 1995-1998

- Areas of Concentration: Physics, computer science, philosophy, and mathematics.

TEACHING EXPERIENCE

University of California, Davis, CA. 2001-2007
Lecturer and Assistant

- Developed syllabus and overall course structure, and administered all grades. Managed laboratories and lectured for physics series 7 and 9. Assisted with an assortment of undergraduate and graduate courses.

University of the Pacific, Stockton, CA 2005-2007

- Developed syllabus and overall course structure, and administered all grades. Experimented with novel instruction methods and course material construction for lectures and laboratories.

Chabot Community College, Hayward, CA 1995-1998

- Managed a library computer laboratory, assisted ESL students with assignments, provided technical support for the library, and worked the Reference Desk.

Moreau Catholic High School, Hayward, CA 1995-1997
Provided technical support for a physics laboratory and instructed as needed.

VARIOUS WORK EXPERIENCE

Daytrader and Venture Capitalist
Self Employed 2005-Present
- Technical trader and ETF specialist involved in venture capital sponsoring Pinksheet start-up companies.

On-Demand Computing Consultants
Self Employed Technician 1995-Present
- Built servers for personal, academic, and business uses, consulted on university supercomputing clusters, expert in Windows and Linux operating systems.
- Experienced programmer in Java, C, C++, mono, scripting, FORTRAN, and R.
- Constructed and tested firewalls for select clients.

Independent Scientific Tutors
Freelance Tutor 1999-Present
- Tutored GED students, high school science and math students, provide online algebra help via email and skype, and consult with parents about education.

Drake Anderson Court Apartments
Apartment Complex Manager 2005-2007 (Rough Dates)
- Managed the complex on weekends and nights. Handled conflicts, cited violations of city codes, performed basic repairs, maintained grounds, and handled resident concerns.

PUBLICATIONS AND PAPERS

- Various free mini e-books addressing a spectrum of student concerns and textbook supplements.
- Various solution manuals targeting student needs.
- Editor for the laboratory manuals used at UC Davis.
- Constructed first professor-student classroom textbook built upon lectures and shared laboratory experiences.
- 2001 Luo, Gang, Steven T. Hess, and L. R. Corruccini. Low Temperature Magnetic Properties of the Geometrically Frustrated Pyrochlores Tb2Ti2O7, Gd2Ti2O7, and Gd2Sn2O7. Physics Letters A 291:306.

LANGUAGES

- English

MEMBERSHIPS

- American Mathematical Association
- American Physics Society
- Journal of Educational Practice for Social Change (JEPSC)
- Sourceforge Open Source Development Team
- Second Life Endowment for the Arts and Education