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Factors in the Admissions Process Influencing Persistence in a Master's of Science Program in Marine Science

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This applied dissertation was submitted by Melissa L. Dore under the direction of the persons listed below. It was submitted to the Abraham S. Fischler College of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova Southeastern University.

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Abstract

Factors in the Admissions Process Influencing Persistence in a Master's of Science Program in Marine Science. Melissa L. Dore, 2017: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler College of Education. Keywords: academic persistence, admission counseling, graduate students, marine science education, examinations

This applied dissertation was conducted to provide the graduate program in marine sciences a valid predictor for success in the admissions scoring systems that include the general Graduate Record Exam. The dependent variable was persistence: successfully graduating from the marine sciences master's programs. This dissertation evaluated other values including the applicant's age, gender, undergraduate GPA, letters of recommendation, and acceptance level (Accepted with Academic Requirement (probation) or Full Acceptance).

The writer statistically showed that two values proved most significant in defining a student's persistence: undergraduate major GPA and age when entering the program. An analysis of the data allowed the marine science master's programs to develop an index to assist students to succeed in the program as well as reduce the time to completion.

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Chapter 1: Introduction

As master's degrees in various disciplines are continuing to increase in popularity, the admission process falls under greater scrutiny by institutions, accrediting bodies, and the public consumer. A master's degree signifies a high understanding overview and demonstrates an excellence in a particular area (Glazer, 1986; Wakeham, 2016). Many jobs require a master's degree, such as undergraduate lecturers, financial advisors, school counselors, and program directors (Lockard & Wolf, 2012). Society, and especially the sciences, still deems the master's degree as a significant milestone in one's career. While some admissions criteria may be common across disciplines, each discipline requires the applicant to demonstrate mastery in a specific area. In the marine sciences, students must demonstrate mastery in the full understanding of the scientific method, a generalized knowledge of current environmental problems (both natural and human-driven), and an in-depth knowledge in a specific aspect in marine science (Gilman, Hitt, & Gilman, 2015).

Currently in the United States there are 49 graduate schools that focus on the marine sciences. These programs require specific courses or other points of interest, and the general admission criteria for graduate admissions of the majority these universities include an application, application fee, all undergraduate transcripts, letters of recommendation, and the general GRE (Burmeister et al., 2014). At the start of the admissions process, graduate admissions officers look at the diversity of their applicant pool. This pool consists of all potential students qualified to enter graduate programs. Potential students can apply directly from their undergraduate degrees, return to school from the workforce (and need the master's degree to advance their employment), or want to enhance their knowledge base for a myriad of other reasons (Gilman et al, 2015). It is necessary to evaluate the effectiveness of the entire application as the basis for students' admission to the master's of science degree program to create a standard for admissions.

Students that are applying to the master's of science in marine biology degrees are usually skilled in the natural sciences, majoring in degrees such as biology, geology, and the environmental sciences. Their coursework includes general and organic chemistry, zoology, ecology, and statistics (Garrison, 2015). It is important to recruit and successfully retain students in master's of science programs to continue promoting research in science, technology, engineering, and math (STEM) (Foltz, Gannon, & Kirschmann, 2014). The development of a successful graduate admissions program is the continuation of the STEM pipeline first created by sparking a student's interest in high school, expanding their knowledge base during their undergraduate education, and finally focusing their skills in the creation of a successful graduate student. During their time as an undergraduate, a student must complete a base set of STEM skills that will be used throughout their career. These skills are mandatory for a student to be admitted to a graduate program and persist through to conferral (Hazari, Potvin, Tai, & Almarode, 2012). Basic skills for a STEM major in the marine sciences include knowledge of biology, chemistry, ecology, and other natural sciences. Working knowledge of computer programming and statistics is also important for the success of a STEM graduate student. The admissions requirements to a graduate school must be related to the university's belief that the applicant has the ability to successfully complete the program and allow the student to continue down the pipeline towards a successful career in a STEM field (Schwager, Hülsheger, Bridgeman, & Lang, 2015).

Maintaining a continuous flow down the STEM pipeline is vital to future economic and technological development in the United States (Hout, 2012). Part of this flow requires university administrators to make informed decisions regarding service and support that are responsive to a broad spectrum of student needs. Awareness of previous STEM education and its components reviewed in support of admission requirements directly relate to the persistence rates of students. Success of the student relies not only on the education received at the graduate level, but also on what foundation has been created in their previous education. Failure to capture these gaps in the admissions process can hamper completion of the STEM graduate degree. Without an in-depth graduate admissions process, persistence through the pipeline will become blocked (Husbands Fealing & Myers, 2012). This persistence is important to both the student and the university. For the student, it signifies the completion of a long list of requirements and training, allowing them to enter the STEM workforce. For the university, a high level of persistence indicates that the graduate admissions and education processes are working synchronously to produce the STEM researcher, and not losing time, effort, and money on admitting graduate students who lack the strong background to successfully complete a graduate degree (Habley, Bloom, & Robbins, 2012).

According to the National Science Foundation (NSF) (2014), over 608,000 students entered graduate STEM fields between 2000 and 2011. In 2011, underrepresented minorities (blacks, Hispanics, American Indians, and Alaska Natives) made up 12% of the student body, 47% were white, and 6% were Asian. During this time over 151,000 master's degrees were conferred. Persistence in the STEM fields ranks at 52% in the biological sciences. Between 2000 and 2011 the master's degrees awarded to

Asians decreased, while that of the other ethnicities remained flat (NSF, 2014). NSF did not sort the conferred students by age or degree track.

In 2011, NSF sorted the degrees by levels of research activity as well as institutional type. NSF reported just 1,789 students received master's degrees in the Earth, atmospheric, and ocean sciences field. This is less than 3% of the 64,961 STEM field master's degrees awarded that year (Table 1). More than 89% of these marine science master's degrees were received from doctorate/research universities. More than 85% came from high or very high research activity universities.

Table 1

STEM Field Master's Degrees Awarded in 2011 (NSF, 2014)

Institution Type	Biological sciences	Earth, atmospheric, and ocean sciences	Mathematics	Physical sciences	Engineering
Master's Total	11,214	1,789	6,203	4,473	41,282
Doctorate-granting universities—very high research activity	5,244	1,097	3,476	2,672	22,626
Doctorate-granting universities–-high research activity	1,996	457	1,288	831	10,559
Doctoral/research universities	570	44	303	241	1,563
Master's colleges and universities	2,395	168	1,124	676	6,051
Baccalaureate colleges	45	12	5	34	166
Associate's colleges	39	0	0	0	0
Medical schools and medical centers	888	1	0	12	27
Schools of engineering	0	10	0	2	272
Other specialized institutions	17	0	1	2	15
Tribal colleges	0	0	0	0	0
Not classified	20	0	6	3	3

This is a potential link with the requirement of a major professor as part of the application process and persistence in the degree program (NSF, 2014). As many university leaders confront the changing dynamics within education, evaluation of graduate admissions becomes a critical component of program effectiveness (Gayle, Tewarie, & White, 2011).

Background and justification. When developing the admissions process for a STEM graduate program, and specifically a marine science STEM program, administrators look for a relationship between valid predictors and performance outcomes. These predictors are an important part of the process, as they help to ensure the success of the students within the program. Institutions have a responsibility to admit those students that are able to complete the program; otherwise, students are placed at a disadvantage and will waste time and money. In 2014, U.S. federal student loan debt exceeded $1.2 trillion with over 7 million debtors in default (Gross, 2014). With these ever increasing student debt ratios, institutions have an even greater responsibility to ensure that students are prepared for the rigor of the program that they are admitted to. This is aided by the proper admissions criteria that identify students that will be able to complete the program.

Although this can vary by discipline, typically, the admission criteria for a master's degree include an application, application fee, all undergraduate transcripts, letters of recommendation, and the general GRE. Within the master's of science program in marine biology, the admission criteria generally consist of all the aforementioned requirements as well as a baccalaureate major in a natural science (Gilman et al., 2015). As of 2015, there are 49 U.S. universities that offer master's of science degrees majoring in the marine sciences (Integrated Postecondary Education Data System, 2015). These universities and their degrees are listed in Appendix B. All of the universities have an application fee ranging from $30 to $53 (Integrated Postecondary Education Data System, 2015). All 49 universities require a baccalaureate degree with a major in a related science as a primary admissions requirement (Integrated Postecondary Education Data System, 2015). This means an applicant must have a baccalaureate majoring in biology, zoology, ecology, or other natural science to apply to the master's degrees (Integrated Postecondary Education Data System, 2015). This is an important component for the STEM pipeline.

The most common admission requirements among the 49 programs are undergraduate cumulative grade point average (UGPA), the Graduate Record Examination (GRE), writing statements, and letters of recommendation (Integrated Postecondary Education Data System, 2015). The UGPA is an average of all grades received while obtaining the baccalaureate (Integrated Postecondary Education Data System, 2015). The UGPA is a vital part of the graduate application as it allows the admissions committee to review the STEM courses required in the marine science graduate programs. Failure in completion of these STEM requirements could lead to the failure of a student for completing the graduate program (Bailey, Rosenthal, & Yoon, 2014). In general, a university's admissions offices require the submission of official baccalaureate transcripts to provide the UGPA. Eighteen of the 49 universities require a minimum UGPA score of 3.0 for admissions. Ten of the universities require a UGPA of 3.0 in the last 60 units, major, or upper division courses. The remaining 21 universities require the submission of a baccalaureate transcript but do not post the UGPA requirement. Two universities also require applicants to have a year of chemistry and a year of physics. Setting a minimum UGPA of 3.0 is necessary because it shows that the applicant has the scholarly aptitude for an advanced degree (Gilman et al., 2015).

The GRE is still considered the standard requirement for STEM graduate schools. However, there is increasing speculation as to how admissions administrators view this examination. Some admissions experts believe that the emphasis on the GRE (Graduate Record Exam) scores reduces other measures, such as drive and diligence. Other admissions groups use the GRE to quickly filter applicants by discarding scores under 700. Research has shown that doing so can adversely affect underrepresented minority and women applicants (Colarelli, Monnot, Ronan, & Roscoe, 2012; Miller & Stassun, 2014). Of all 49 universities, only nine do not require the general GRE. One university does not require the GRE if the applicant has a previous post-baccalaureate degree, such as a master's degree in another field. Of the remaining 39 universities, eight use the percentile scoring for each component of the exam. Six use the raw scores for each component of the exam. The remaining 25 universities require the GRE but do not post their required scores. The percentile and raw scores are provided by the Educational Testing Service (ETS) directly to the universities' admissions offices. The 14 universities that post their GRE scores go into great detail about the three GRE components in their application processes. These three components consist of the quantitative (GREQ), verbal (GREV), and analytical writing sections (GREW). The GREQ is designed to measure ''problem-solving ability, focusing on basic concepts of arithmetic, algebra, geometry and data analysis'', while the GREV is designed to measure an applicant's ''ability to analyze and evaluate written material and synthesize information obtained from it, analyze relationships among component parts of sentences and recognize relationships among words and concepts''. The GREW measures ''critical thinking and analytical writing skills, specifically your ability to articulate and support complex ideas clearly and effectively'' (ETS, 2014).

Another section of the application process is the statement of career goals, also known as a career statement or writing example. Writing is the primary communication in the STEM fields. Most information between researchers occurs in journals, abstracts, and posters. The inability to communicate succinctly leads to the lack of advancement in the STEM workforce (Husbands Fealing & Myers, 2012). Thirty-eight of the 49 universities require such a sample. The length of the statement ranges from 500 words to three pages. The other 11 universities had no equivalent requirement. Eighteen universities require the applicant to submit a resume. The same 18 universities also required the writing example (IPEDS, 2015). The writing sample allows the graduate admissions office to review the overall writing skills for a potential master's degree student. The process reviews the applicant's preparation for communicating in a basic academic style, which includes organization, grammar, style, and depth of language (Swales & Feak, 2004).

Letters of recommendation is another criterion for the admissions process. Letters of recommendation allow the graduate admissions office to see a personal view of an applicant's academic success. These letters are regarded as providing a guide to the applicant's performance and giving a qualitative review to balance the quantitative view of the UGPA and GRE (Kuncel, Kochevar, & Ones, 2014). Letters of recommendation were required by all 49 of the universities (IPEDS, 2015). Six universities required two letters, 38 required three letters, and one required a minimum of three letters with a maximum of four. Twenty-five universities provided forms for the recommenders. The remaining 24 required official letters on letterhead. Three stated that a supervisor's letter would be sufficient. The remaining 46 required the letters of recommendation to come from faculty in the related field of science. These letters of recommendation are an important part of the admission process, especially for STEM students, because they allow the graduate admission committee an insight into an evaluation of laboratory teamwork and research skills not seen in the GRE or transcripts (Dasgupta & Stout, 2014).

Interviews are another criterion that are often used in the graduate admissions process; however, this varies widely from institution to institution, as well as from program to program. These interviews, like the degrees themselves, can be conducted in a hybridized environment. While some schools require a physical presence for the interview, others allow the interviews by phone (Willey, 2012). An interview of a graduate applicant allows the admissions committee to assess what the social sciences call "grit". Grit is defined as a predisposition for achieving long term goals. Grit is rated by measuring passion and perseverance (Peterson, 2015). These interviews allow an applicant to shine in a personal context. Applicants are asked questions that show their ambition, determination, what brought them into the various STEM fields depending on their application, how they have dealt with challenging experiences, and what they did to overcome them (Powell, 2013). While interviews are considered a basic requirement in undergraduate programs (Henson & Eller, 2012), only four of the 49 universities required an interview as part of the application requirements. Two would allow phone interviews.

The other universities required applicants to travel to their respective campuses (IPEDS, 2015).

In addition to the four common admissions criteria (1) UGPA, (2) GRE, (3) Writing Sample, and (4) Letters of Recommendation, and the less common criterion of an interview, some master's of science programs in the marine sciences traditionally require a faculty member to support an applicant prior to starting the application process (Willey, 2012). Unlike undergraduate science programs, graduate students in the marine sciences focus on specific areas of the field. This requires a strong connection to a faculty member that will be an important contact throughout the graduate's career. The marine sciences field is a small community. A positive connection with the faculty may lead to positive employment, grants, and publications for years to come. So while research has shown that the criteria ranking potential graduate students is important, the fit with faculty interests ranks as the predominant reason a student chooses a specific graduate school (Colarelli et al., 2012). Slightly more than half of the universities required an applicant to have prior approval from a major professor. Twenty-five of these universities require that an applicant communicate with a member of their research faculty to receive full acceptance into a research laboratory prior to beginning the application process. The primary reason for this requirement is funding of the graduate degree. Universities that require a major professor during the application process expect the funding of the student to arise from that laboratory's funding, albeit from sources external (grants and contracts) or internal (allocations) from the university. Only three universities suggest the applicant provide evidence of funding during the application process (IPEDS, 2015).

Once all of the requirements are submitted to the admissions office, the applicant's information is packaged and sent to the admissions committee. Traditionally, the admissions committee consists of five to ten faculty from the marine science major (IPEDS, 2015). Standard practice with science graduate universities is use the "top-down" selection process in which a scoring system consisting of all the admissions requirements combined to a single score (Dasgupta & Stout, 2014).

Prior to presenting the application packets, a baseline for Full Acceptance is created by the graduate admissions committee. It is here that the STEM pipeline can potentially break; for example, if the applicant has a 3.0 UGPA and rating of 50% for the GREV, GREQ, and GREW, then the committee might rate them at a 75%. The assumption has been that applicants with higher predictor scores will have a better success rate than those with lower scores (Wendler et al., 2012). It is assumed that the Full Acceptance student will then attend the program (Carnevale, Rose, & Cheah, 2011). This first filter could remove a large number of potentially successful applicants. These lost applicants are predominately women or minorities (Maltese & Tai, 2011). For example, an applicant with a score of 75 would be in the accept range while another applicant with a score of 60 might be an Acceptance with Academic Requirement. These applicants might have the grit needed to persist in the graduate program, but are lost in the scoring requirements (Powell, 2013). Only 20 of the universities offer an Acceptance with Academic Requirement or other non-standard acceptance to their program. The remainder of the universities offers Full Acceptance or Rejection as their only choices (IPEDS, 2015). This numerical model of acceptance can inhibit the potential of STEM pipeline by taking only those students who perform well in testing but may not have the grit required to persist into completing the degree.

There needs to be a correlation between entry into a university and success in the marine science field, allowing an applicant to bridge the gap between their undergraduate education and entry in the STEM fields of research. Of the 20 universities that offer more than the Full Acceptance or Rejection in their admissions process, 15 offer a non-thesis (capstone) track for their students (including the focus of this study). This capstone track is designed for students wishing to enter a workforce outside of the research environment. Some universities consider the non-research track to be a terminal degree (Henson & Eller, 2012).

The graduate admissions office is the control valve for the STEM pipeline leading from undergraduate to graduate STEM research. Without the ability to regulate the flow, marine science graduate programs would not be able to produce a viable and productive STEM workforce. Time and effort spent evaluating the admission process will create a robust administrative procedure that will influence selection and decision making strategies (Colarelli et al., 2012).

Statement of the Problem

The research problem. Neither universities nor their students want to expend time, effort, and financial support/aid on an applicant who fails to complete the marine sciences program. University administration needs to further define the criteria to develop a successful correlation between the admissions process and persistence in the master's of science program. The university and its marine science department (Oceanographic Center) are committed to providing students with a quality education by the constant review, evaluation, and evolution of the admission and program components.

The current admission criteria for the marine sciences master's of science majors consist of two classifications: Full Acceptance or Acceptance with Academic Requirement. There are three majors in the in the marine sciences M.S. program: marine biology, marine environmental sciences, and coastal zone management.

All of the marine sciences master's of science degree programs require a $50 application fee, the official application, baccalaureate transcripts (UGPA), the GRE, three letters of recommendation, and a statement of career goals. No major professor, interview, or financial backing is required. The statement of career goals is used as the writing example. It has a minimum of 500 words. While Full Acceptance and Acceptance with Academic Requirement have the same basic requirements for GPA, GRE, letters of recommendation, and the statement of career goals for all marine science majors, each major has a slightly different requirement for the baccalaureate major (Nova Southeastern University [NSU] Oceanographic Center, 2014).

To qualify for Full Acceptance, the applicant must have an undergraduate cumulative GPA of 2.9 and a major GPA of 3.0. The GRE requirements for Full Acceptance are listed in percentages. The score must be a minimum of 55% on the verbal section, 55% on the quantitative section, and a raw score of 4.0 on the analytical writing portion. Acceptance with Academic Requirement for the marine science program's M.S. majors of marine biology, marine environmental sciences, and coastal zone management may be awarded to someone who has shown that they may succeed in the program but have not satisfied all the application criteria. The applicant should have a minimum of 40% on the verbal section, 40% on the quantitative section, and 3.5 on the analytical writing portion. The Acceptance with Academic Requirement requires that the student must maintain a GPA of 3.0 or better for the first four courses in the program. Failure to maintain the GPA of 3.0 results in immediate dismissal from the program (NSU Oceanographic Center, 2014).

Each of the Oceanographic Center's majors has a slightly different admissions requirement for the undergraduate baccalaureate major. The marine biology major requires a baccalaureate's degree with a major in biology or a closely related field. The majors of marine environmental sciences and coastal zone management require a baccalaureate's degree with a strong background in a natural sciences field, but not necessarily a major in the field. The equivalent of a minor in a natural science (15 credits) is preferred for these two majors (NSU Oceanographic Center, 2014).

The Oceanographic Center's master's degree programs are designed to be well-rounded and multidisciplinary programs, which have been carefully designed to take full advantage of the unique variety of marine environments available for study in the southeast region of the United States. Both the university's administration and faculty believe that the current and perspective students should take lecture and laboratory courses in the marine environmental sciences, coastal zone management, and marine biology. These courses are followed by intermediate-level courses in marine ecology, marine monitoring techniques, and statistical applications in marine science.The student would receive fundamental knowledge and comprehensive competencies, and skills and the appropriate assessing scores (NSU Oceanographic Center, 2014). Failure to complete these levels of knowledge would impact the STEM pipeline and persistence into the STEM workforce (Foltz et al., 2014).

The researcher is employed in the Oceanographic Center with the primary responsibility being to ensure adequate admission standards and provide research opportunities for students. In support of the university's vision the researcher was charged with reviewing the admissions criteria to determine the quality of students for the master's of science majors of marine biology, coastal zone management, and marine environmental sciences and the rate of success (NSU, 2015).

Vision 20/20 was created by the president of Nova Southeastern University (NSU) in collaboration with faculty members, staff, alumni, student leaders, community members, and the board of trustees to create a single vision based on eight core values to be implemented by the year 2020. Through excellence and innovation of teaching, research, service, and learning, these core values: academic excellence, student centered, integrity, innovation, opportunity, scholarship & research, diversity, and community are to provide NSU with the recognition of being a premier, not-for-profit university of quality and distinction that engages all students and produces alumni who serve with integrity in their lives, fields of study, and resulting careers (NSU, 2015).

In response to *Vision 20/20*, the STEM educators, and the university's enrollment (currently declining), reviewing student data from the admission criteria through the duration of the degree programs at the Oceanographic Center will assist program administration in determining the most effective admission criteria as predictors of student success. It is anticipated that these criteria will maintain and enhance the program's quality, as well as increase student retention and persistence (NSU, 2015).

As part of the admissions process, the Oceanographic Center graduate program office collects UGPA, undergraduate major GPA (UMGPA), and the general scores on the GRE, which include verbal, quantitative, and analytical writing. Other information collected includes the student's graduate GPA (GGPA) at the Oceanographic Center and if the student graduated or withdrew from the program. Although the Oceanographic Center started its master's programs in 1978, it was discovered that student data were not adequately catalogued to be useful for evaluative purposes until 1992. Therefore, in support of *Vision 20/20*, the Oceanographic Center deemed it important to review student data from 1992 forward (NSU, 2016; Nova Southeastern University Oceanographic Center, 2014). This is the basic information used in this correlated study.

From 1992-1999 there was very little marketing of the marine science programs. In 2000, the new director increased marketing, but also initiated an almost open enrollment. Open enrollment consisted of still requiring all the standard admissions protocols but waived any minimum entrance requirements. Unless the applicant's GPA was below 2.0 and the GRE scores were below 25% the applicant was admitted to the program. In 2006, the marketing was more targeted and admissions standards were enforced. From 2000-2011, academic probation (a GGPA of less than 3.0) was enforced and students who dropped below that level were placed on probation for two terms. If students did not raise their GGPA to the required 3.0, they were dismissed from the program (NSU Oceanographic Center, 2014). For this initial charge the analytical portion of the GRE was not used. Only the verbal (GREV) and quantitative (GREQ) scores were used since the analytical test was changed to the analytical writing section (GREW) in October 2002 (Educational Testing Service, 2014).

When compiling a preliminary sketch of the student population from September 1992 until December 2013, there were distinct differences in the data. For all three marine sciences master's programs (marine biology, marine environmental sciences, and coastal zone management) from 1992-1999, there were a total of 69 entering students.

The average UGPA was 2.97, the average UMGPA was 3.04. The average GREV was 490 (54 percentile) and the average GREQ was 571 (50 percentile). The GPA at the Oceanographic Center was an average of 3.55. Fifty-nine percent were women. The retention rate was 77%.

For all three marine sciences master's programs (marine biology, marine environmental sciences, and coastal zone management) from 2000-2005, there were a total of 211 entering students, which was a 206% increase in enrollment from 1992-1999. The average UGPA was 3.14, the average UMGPA was 3.14. The average GREV was 478 (52 percentile) and the average GREQ was 604 (52 percentile). The GPA at the Oceanographic Center was an average of 3.51. Sixty-four percent were women. The retention rate was 71%.

For all three marine sciences master's programs (marine biology, marine environmental sciences, and coastal zone management) from 2006-2013, there were a total of 767 entering students, a 347% increase from 2000-2005. The average UGPA was 3.02, the average UMGPA was 3.15. The average GREV was 452 (50 percentile) and the average GREQ was 525 (46 percentile). The GPA at the Oceanographic Center was an average of 3.38. Sixty-nine percent were women. The retention rate was 79%. For these years 61% of the applicants were Full Acceptance. The remaining 39% were accepted with an academic requirement.

With these large jumps in the size of the incoming classes, it is very important to allow the correct student to enter the program. While applicants trend towards women, it is important to note other characteristics of applicants, including nontraditional, ethnicity, and race. While the literature suggests that both GPA and GRE scores are a predictor of graduate success, including retention/persistence (Enright & Gitomer, 1989; Grehan, Flanagan, & Malgady, 2011), the oceanographic data indicated that while the GPA and GRE scores were higher during the years 2000-2005 than in either the 1992-1999 or 2006-2013 periods, that period had the lowest retention/persistence rate. It was during this time that the center had an open door admissions policy and only evaluated the basic admissions criteria. The increase in incoming students requires the center to critically assess the applicant pool to prevent facility and faculty expenditures on students that will not complete the program. While student enrollment grew unexpectedly, the faculty population has only increased by 5%.

By viewing only the combined data for all three marine sciences master's programs (i.e. marine biology, coastal zone management, and marine environmental sciences) admission criteria of the Oceanographic Center masked the predictors of persistence. Administrators were unable to determine if the current admission criteria were appropriate to the master's of science program. Other factors, including gender, age, and ethnicity, must be included in the review. In an effort to enhance the admissions pool and guide the admissions committee into creating a more informed incoming student body and thus achieving the research and scholarship component of *Vision 20/20*, further exploration of admission criteria for each degree major is warranted (NSU, 2016). It is anticipated that examining admission criteria among each of the three majors in science (i.e. marine biology, coastal zone management, and marine environmental sciences), specifically the data compiled for applications from 2006-2013, would benefit college administrators. Gaining insight into what factors can determine student success would allow administrators to make complete informed decisions about program revisions and use of current admission criteria.

Deficiencies in the Evidence

The STEM pipeline needs to be continually examined. With the strong need of a STEM workforce, graduate school administrators need to bridge the gap between the admissions process and persistence to degree conferral. A strong review of all factors in maintaining a continual stream of STEM students is vital. In the literature reviewed for this project, many authors cited the need for the development of a well-rounded STEM workforce in the United States (National Academy of Sciences, 2011). This STEM workforce does not include professional degrees such as nursing. Various studies on post-baccalaureate STEM programs focus independently on persistence, reviewing ethnicity, age, and gender (Bielby, Posselt, Jaquette, & Bastedo, 2014). Other studies review recruitment and the admissions process to reverse underrepresentation and enhance the connection of baccalaureate students into the graduate school required for a STEM workforce (Appleyard et al, 2013; Husbands Fealing & Myers, 2012). Yet others discuss the STEM pipeline and how to successfully transition students through high school, undergraduate, and graduate levels of education; however there seems to be no research that combines all of these points of interest (Maltese & Tai, 2011).

Applicants have more than one facet to bring to graduate admissions. They are not just a GRE score, an underrepresented minority, a GPA, or an older student. A STEM researcher would look at the unified field theory developed by James Clerk Maxwell to know that various interactions effect the outcomes of the whole (Soos, 1998). The literature shows that educational research needs to create a composite evaluation of all these areas to create an authentic view of the STEM pipeline applicant who will successfully complete a graduate program and enter the workforce.

The U.S. workforce is in great need of a thriving and sustainable STEM workforce (Gilman et al., 2015). Various hypotheses have tried to explain why there is such a minority gap in U.S. STEM pipeline. Potential reasons include the lack of same gender/ethnicity in faculty role models, negative peer effects in STEM courses, and the perception that a higher GPA will outweigh the knowledge gained from a tougher science course. Even grade inflation at the high school level has been implicated in the breakdown of the STEM pipeline (Imose & Barber, 2015).

Traditional marine science graduate programs work with students that have gone the traditional academic route: undergraduate directly into graduate schools. These students do not take a “gap” year and the population trends towards non-minority men. This filter has inhibited the number of people entering and succeeding in the ever growing STEM workforce. Master’s degree programs and their graduate admission departments are struggling to find a strategy to enhance the U.S. workforce while training underrepresented minorities and reducing the gender gap (Allen-Ramdial & Campbell, 2014).

Many research projects have looked at individual issues in the breakdown of the STEM pipeline. Evaluations of various pipeline breaks have focused on single issues such as underrepresented students, gender, non-traditional students, GPA or GRE scores, or combinations of two of these foci (Espinosa, 2011; Allen-Ramdial & Campbell, 2014; Bielby et al., 2014). While this information is important, it does not bridge the gap of looking at the entire breadth of the STEM pipeline.

Audience

Several groups at the university will benefit from this research study. The university's upper administration will be able to tighten the focus of recruitment and admissions targets. In an increasingly competitive recruiting field this will yield a greater result for budget dollars spent in the admissions process. The university needs to have students that will complete the degree, not only to maintain a successful retention rate, but also to maintain the income needed to maintain the Oceanographic Center (Hawleyet al. 2014).

The Oceanographic Center faculty will also benefit from this study. Currently the 16 members of the faculty are responsible for reviewing each master's application. An admissions decision cannot be made without a faculty quorum. The admissions process is in addition to the standard faculty load. Currently Oceanographic Center admissions review falls into the "other items as required" portion of a faculty member's contract. The greater majority of their workload consists of conducting research projects, writing grants, mentoring current students, and teaching graduate classes. With this prescribed workload, reviewing applications is not of primary importance to the faculty. Some faculty simply review one portion of the application and make a decision based on a single point of data. With this model as a standard review practice of the admission process, potentially successful applicants can be overlooked. In creating a standard admissions profile of the successful student, the pressure of intensively reviewing hundreds of applicants a year will be diminish as part of their faculty load. The majority of admissions decisions would be determined by the Associate Dean. Only applications with crucial decisions would be routed to the faculty, lessening their workload.

The third audience group to benefit will be the enrolled student. The updated application process will allow the Associate Dean to recommend Full Acceptance or Acceptance with Academic Requirement. Those applicants that receive Acceptance with Academic Requirement will be assigned various requirements (such as requiring an English writing course within the two terms of enrollment) that will be easily tracked. With the Oceanographic Center faculty admissions workload reduced, the faculty would receive reports of high end applicants to review for funded graduate research assistant positions.

Definition of Terms

GREV. GRE Verbal Reasoning Percentile. This section is designed to measure an applicant's ''ability to analyze and evaluate written material and synthesize information obtained from it, analyze relationships among component parts of sentences and recognize relationships among words and concepts''. (ETS, 2014, p. 4)

GREQ. GRE Quantitative Reasoning Percentile. This section is designed to measure ''problem-solving ability, focusing on basic concepts of arithmetic, algebra, geometry and data analysis'' (ETS, 2014, p. 5)

GREW. GRE Analytical Writing. This section is designed to measure ''critical thinking and analytical writing skills, specifically your ability to articulate and support complex ideas clearly and effectively'' (ETS, 2014, p. 6)

UGPA. Undergraduate GPA. The grade point averages for this study were based on cumulative GPA reported by the undergraduate university transcripts where the baccalaureate degree was completed and based on a 4.0 scale. This study did not define the number of credit hours within each transcript.

UMGPA. Undergraduate Major GPA. As part of the Oceanographic Center admission process the last eight courses in the applicant's major are calculated to represent the understanding of the area of study. The UMGPA is calculated in the Oceanographic Center program office.

GGPA. Graduate Grade Point Average. The program requires a minimum of 39 credit hours, of which a minimum of 30 hours are coursework. There are 5 core classes for all degree programs: biostatistics, marine chemistry, marine ecosystems, marine geology, and physical oceanography. There are two tracks: thesis and capstone. Once the coursework has been completed all thesis and capstone credits are given a pass or fail.

YTG. Years to Graduation. This is the number of years from entry to the master's program to its completion. YTG is defined from the entry term to the final conferral. The length of time to completion may not represent the entire time spent in the program. Leaves of absence, be they unofficial or official, are included in this time frame.

Persistence. Defined as the successful completion of a master's degree in the marine sciences (Tinto, 2012).

Purpose of the Study

The purpose of this study is to determine the correlation between admission criteria and persistence of students in the Oceanographic Center's master's of science programs. Persistence is defined as a successful completion of the program. In the admission process there are two levels of acceptance: Full Acceptance and Acceptance with Academic Requirement. This study will review admissions information, including the factors GREV, GREQ, GREW, UMGPA, UGPA, age, and ethnicity/race, with the acceptance level of the applicant. This will be correlated with the time taken to complete the degree and determine which attributes define a successful master's of science student (Habley et al., 2012; Tinto, 2012).

Chapter 2: Literature Review

The master's of science degrees in the natural sciences are the continuation of the pipeline of personnel from undergraduate degrees into contributing members of the STEM fields. To create a successful master's program in STEM, it is important to review the history of STEM, the admissions process into natural science graduate programs, and persistence, which will lead into a successful entrance into the STEM workforce. With the globalization of the STEM fields, simply looking at basic admissions requirements is not sufficient. Understanding how ethnicity, gender, and age groups learn and persist is also a part of the successful STEM master's degrees.

Post-Graduate Education

Adopted into the United States' education system in the 19th century, the master's degree was considered an intermediate degree for those on the doctoral path, and a terminal degree for those in need of certification in their professional fields. Since the 1990s, the paradigm has shifted, with the M.S. degree becoming a requirement for scientists and other professions. It has replaced the baccalaureate as the lowest degree required for professional placement and career advancement (Stewart, 2010). Because of these new requirements, the population of master's students has grown dramatically over the past decade. In the academic year 2009-2010, over 600,000 students earned a master's degree (Snyder & Dillow, 2012). There has also been a shift in the population that is seeking a post-graduate degree. Research has shown that the traditional graduate applicant pool has shifted to include students who are older, maybe married or in a long-term relationship, and who may have children (Gardner & Gopaul, 2012). There has also been an increase in ethnic, racial, and gender diversity of those seeking a postgraduate degree (Stewart, 2010; Allum, Bell, & Sowell, 2012).

Scientific Research and Education at United States Universities

Scientific research in the United States has constantly shifted between private industry and the educational sector. Prior to World War II the industrial sector was responsible for almost all scientific research in the United States. In 1940, universities spent $31 million on research (approximately $513 in today's money). This is less than 1% of today's nationwide university research budget (Stephan, 2012).

The U.S. government did not directly support research in universities until the 1950 U.S. Congress created the National Science Foundation (NSF) (NSF, 1950). This legislation charged the NSF with the support of education in mathematics, science, and engineering. In 1968, the U.S. Congress amended this act to grant NSF the authority to award universities grants with the objective of enhancing education in the sciences and mathematics fields (Graham & Diamond, 1997). While the NSF act created the research university as it is known today, in 1970 the Carnegie Commission on Higher Education devised a classification system to rank research performance at each United States university (Carnegie, 2015). Top ranked U.S. research universities routinely claim the lion's share of federal funding (Graham & Diamond, 1997).

External funding (non-tuition income) is important to a research university. Prestige and rank depend on the amount and type of funding. It allows for universities to compete for "star scientists", releases the economic burden of faculty salaries from the "hard money" bottom line, and allows researchers to hire people in "soft money" (externally funded) positions. Faculty principal investigators (PI) use external funding to staff their laboratories with graduate students as they are (a) young, (b) full of ideas, and

(c) cheap. The average graduate student costs about $15 per hour including fringes and indirect. A staff scientist costs about $32 per hour (Stephan, 2012). To gain this external funding to relieve the financial impact of supporting a research program, a university needs to attract a pool of successful applicants to its graduate programs.

Academic Competition

Growing competition in scientific higher education has resulted in a renewed focus on providing opportunities for research efforts in assessing the performance of the graduate students at many colleges and universities in the United States. Institutions of higher education can "augment their competitiveness and prestige" (Sá, 2007, p. 18) through development of research centers that share resources and support by the highest levels of university administration. Academic leaders continue to focus on research and how it impacts general society as well as enhancing a university's position in academia (Sá, Li, & Faubert, 2011).

The administrators and the faculty have the role of creating standards of academic excellence for their department and the university as a whole. They are responsible for attracting promising applicants and creating curriculum content and the learning objectives to evaluate the success in engaging the student and instruction. Faculty and departmental administration are responsible for creating new educational programs and degrees to enhance students' learning outcomes. Eventually these proposals and other academic decisions reside in the Council of Deans, chaired by the university Provost, and must comply with the rules of accreditation set forth by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) (2014). In order for these programs to be a success, the application process currently used must bring these points into focus to attract and keep the students at the university (Eaton, 2012).

Science, Technology, Engineering, and Mathematics (STEM)

In today's global economy, the paradigm of employment has shifted from the unskilled position to more technically savvy positions requiring advanced knowledge of science and mathematics (Lacey & Wright, 2009). While the workforce is looking for individuals trained in the sciences, technology, engineering, and mathematics (STEM), the United States is continually suffering a shortage of trained STEM professionals (National Academy of Sciences, 2011). This trend is not expected to improve in the coming years (Scott, Toulson, & Huang, 2009).

The retention of STEM students has been found to be a primary problem. Researchers investigating this situation cite a lack of connection between the student and instructor. There is a continuous debate regarding how to acquire, enroll, and retain students in the STEM disciplines (Scott et al., 2012; Seymour & Hewitt, 1997). In fact, only 35% of PhDs granted in the United States are awarded to United States citizens (Cummings & Finkelstein, 2012; Gonzalez & Kuenzi, 2012). As the United States migrates into a science and technological era, it is important for U.S. society to provide employees with the cognitive abilities and motivation to engage in STEM research (National Research Council, 2011). This is especially important when looking at ethnic diversity in awarding STEM degrees.

Diversity. South Florida, the location of four marine science programs, is one of the most ethnically and racially diverse areas of the United States. Population statisticians have determined that by 2025 (Santiago, 2010), the Latino/Hispanic population of South Florida will be greater than the White, non-Hispanic/Latino population. While the face of the population is changing, there is an underrepresentation of minorities in STEM education (Santiago, 2010). In 2008, only 23% of South Florida's Latino/Hispanic population have a baccalaureate degree or higher. By 2025, researchers predict that 90% of all college age South Floridians will be of Latino/Hispanic or other underrepresented groups (Santiago, 2010; U.S. Department of Education, 2007).

Statistics on minorities in STEM graduate programs show that in 2005 less than 10% of all degrees awarded went to underrepresented minorities (Committee on Science, Engineering, and Public Policy, 2006). As a result of this and many other similar statistics, and the desire to maintain a competitive edge in the STEM fields, United States government agencies on all levels, as well as universities, industries, and non-profit organizations have developed multiple solutions to resolve the low STEM performance by United States citizens. Some of the most notable include the America COMPETES Act (Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act), which was established with support from the U.S. government based on a report entitled *Rising Above the Gathering Storm* (Augustine et al, 2010). Another source of funding for STEM education is the American Recovery and Reinvestment Act (2009) which includes the directive that science and technical education is required for the United States' long term economic recovery. In order for Nova Southeastern University's Oceanographic Center to have a successful marine science graduate program, it must enhance its education of underrepresented minorities.

One result of the STEM and Preparing Future Faculty (PFF) research shows that with a slight change in emphasis, a traditional part of graduate programs in science creates a best practice scenario that supports the student-faculty interaction and enhances the learner's academic outcome. This practice of mentorship is especially important in first-generation graduate students, most of who are from underrepresented minorities. Mentorship between a student and faculty member dates back to the beginning of educational history (Johnson, Subak, Brown, Lee, & Feldman, 2010). While early literature did not delve into this relationship, modern reviews have shown mentoring provides a core component of graduate student development. Being a mentor is not just advising a student or being a role model. A mentorship involves a close personal relationship between the faculty member and the student. Mentorships should contain a bond where the faculty member facilitates the student's personal and professional development, creating a viable and productive new member of the research field (Johnson, Rose, & Schlosser, 2007. Mentorship and professional development are areas that can be observed when reviewing a graduate science program. It is important to understand the history of science research and education to understand the link between STEM and educational output in the United States. With these STEM points in mind, the area of admissions information needs to be reviewed.

United States Universities Graduate Admissions Process

The Van Nelson, Malone, and Nelson (2001) study collected the departmental admissions data for students in graduate studies, continuing the work of Thornell and McCoy (1985). Researchers continually looking at admissions procedures are finding a growing need to look into localized comprehensive reviews of the use of all admissions requirements, including the GRE, letters of recommendation, undergraduate transcripts, and interviews at the university and post graduate degree levels (Rubio, Rubin, & Brennan, 2003; Johnson-Motoyama, Petr, & Mitchell, 2014).

While all admissions requirements are subject to continual review, universities around the country continue to analyze admissions data to focus recruitment on potential students that will succeed in their master's programs (Powers, 2004; Katz, Chow, Motzer, & Woods, 2009; Reis, 2012; Wheeler & Arena, 2009).

The quality of the applicant pool is vital to the development and quality of a STEM master's program. Research has shown how funding agencies believe that lower quality students diminish the reputation of a research facility and ultimately the amount of the school's external funding (Stephan, 2012). In reviewing the United States universities with marine science master's degree programs (Appendix B), there were multiple choices regarding the various levels of entry (Full Acceptance and Acceptance with Academic Requirement). It is important to understand the history of the master's of science programs as well as the development of university research funding to understand the significance of a successful admission pool.

Academic Challenges and Student Effort

In today's educational environment, faculty are finding students are increasingly passive in the learning process. More and more faculty are reporting students expecting their entire education path will be laid out with minimal effort on the student's side (Harris & Cullen, 2010). Research has shown that in today's digitally driven economy, at least a baccalaureate and, in the natural sciences, a master's degree is absolutely required to become economically independent. This has led to an unprecedented influx of students to the realm of higher education, many of whom are not prepared for the academic environment and its challenges (Kuh, Kinzie, Schuh, & Whitt, 2010).

Higher education administrators and faculty have many different definitions of what constitutes academic challenge. Some consider that the more rigorous a program, the greater the academic challenge. An example of this is where courses require extensive reading and writing along with other assignments are considered a great challenge, but classes that have few papers or examinations are considered easy (Kuh et al., 2010). This definition does not take into the account the modern requirements of learning outcomes, which requires the student to employ higher-level thought processes to stretch their levels of effort, understanding, and accomplishment. This requires student effort to become an amalgam of experiences both in and out of the classroom. Administration and faculty need to find ways to make the transition from undergraduate to graduate level education as smooth as possible. This includes mentorship, peer counseling, a strong orientation program, and a wide amount of student support services all of which support the best practices for learners and their interaction with faculty (Kuh et al., 2010).

Factors That Predict Academic Success

In developing the STEM pipeline it is important to assess the graduate admissions process and how it relates to persistence within the pipeline. When reviewing the STEM pipeline from undergraduate, to graduate, to workplace, researchers found that the number of STEM graduates have declined in the past 10 years (Maltese & Tai, 2011). Analysis in persistence requires tracing the students through various factors, including familial factors, classroom interactions, experiential learning opportunities, and out of class engagement. Other areas reviewed looked at anti-deficit areas and how students not normally considered STEM student prospects can be included and succeed. These include sociological factors such as gender, underrepresented minorities, and the non-traditional student (Harper, 2010; Perez-Felkner, McDonald, & Schneider, 2014).

While the literature has shown that both cognitive and non-cognitive evaluations are important for bringing in the most promising applicants for graduate school and allowing for success at the graduate level, it is also important to look at social factors in the pipeline. In graduate admissions, cognitive evaluations of an application include the UGPA, UMGPA, and GRE scores. The non-cognitive evaluations are the letters of recommendation and statement of career goals essay. These non-cognitive evaluations look at personality, attitude, and motivation (Megginson, 2009). Sociological factors are also reviewed in regards to persistence in the STEM pipeline.

STEM admissions review. In conducting a literature review of admissions requirements and information for master's of science in the marine sciences, there are vagaries in the weight of each requirement (Cannady, Greenwald, & Harris, 2014). The first to be reviewed here are the required elements of the application (i.e., GPA, GRE, letters of recommendation). These are the standard requirements for an application. Other important points to review include gender, ethnicity/race, and the adult learner (age). When reviewing an application, there are two distinct sections to define an applicant: qualitative and quantitative. The qualitative sections of the application include the statement of career goals (writing statement), an interview (if required), and letters of recommendation. The quantitative values consist of the UGPA, UMGPA, and the GRE scores (Miller, 2014)

Statement of career goals (writing statement). The graduate application process has many names for the writing statement. Some call it the statement of career goals, others the personal statement. For some admissions processes, the evaluation of the statement relates to the applicant's ability to communicate the understanding of concepts and practices in graduate level education. This is one of the more qualitative portions of the application process. While others review the statement as a simple writing sample (Chiu, 2015), little has been researched on this area of the application and it is considered a minor portion of the application (Kuncel et al., 2014).

What research that was found discusses how the social backgrounds of the applicants can negatively impact this portion of the application process (Morgan & Pullin, 2010). An evaluation of writing samples to research universities in the United States showed that the writing statement needs to be developed as part of a holistic admissions process and register the various socio-economic paths that come to the STEM pipeline. To acknowledge the various entrances to the pipeline in the applicant's writing sample would be to enhance diversity within the application matrix (Malcom & Malcom-Piqueux, 2013).

Interview. While professional schools (e.g., medical, dental, nursing) require interviews as part of the admissions process, it is rare for STEM programs (Eva et al., 2012; Kuncel et al., 2014). The STEM interview process can occur over the phone or in person. The interview process allows the admissions process to humanize the applicant.

One common trait in the interview process now consists of the Multiple Mini Interview (MMI). MMI consists of many short questions with applicants going from interviewer to interviewer in a timed format (Husbands & Dowell, 2013). This has been the final portion of the admissions process. After the applicant has passed the academic requirements, researchers in STEM and medical fields have determined that applicant's scores solely on their MMI promotes diversity in the accepted applicant pool (Terregino, McConnell, & Reiter, 2015). One research project showed that applicants to STEM programs who interview trend towards accepting students who do not meet the higher quantitative requirements. This personal connection seemed to create a positive aspect to the application process (Mack, Rankins, & Woodson, 2013).

Letters of recommendation. The letter of recommendation is the primary qualitative data point for a graduate application. Consistently considered important to the admissions process, the way they are written can impact an applicant. The goal of a letter of recommendation is to have a person, usually a faculty member, discuss an applicant's academic qualifications. It is important that the recommender accurately evaluate not only the academic quality, but also relevant traits of the applicant. However, there are three major issues with evaluating letters of recommendation (Kuncel et al., 2014).

One issue with the letters of recommendation is that the applicant will naturally choose a recommender who writes a positive evaluation. Another is that the letters are not considered reliable (Kuncel et al., 2014). The third is when letters are written by other researchers known to the admissions committee and faculty. There is evidence that letters written by known colleagues will be viewed in greater favor even if the information in the letter is detrimental to the applicant (Nicklin & Roch, 2009). Results have shown that letters of recommendation are considered a predictor of success and persistence only after GPA and GRE scores. When used in conjunction with the GPA and GRE, the letters of recommendation provided a slight improvement in persistence (Kuncel et al., 2014).

Another area of concern in letters of recommendation is the association of gender stereotypes with these letters (Dasgupta & Stout, 2014). Current STEM faculty trend towards baby boomer white men. The letters produced by faculty tend to create a link to the ideal scientist as those that match their gender and ethnicity. Factors within writing these letters include using gendered adjectives. One project found that applicants with gender neutral letters of recommendation linked a positive success rate to women in the STEM pipeline (Sumner, 2013).

GPA. The GPA is a commonplace criterion for the graduate application process. It is considered a measure of academic achievement; graduate recruiters generally believe that the GPA reflects the motivation to understand (learn) as well as general mental ability (Imose & Barber, 2015). The GPA is considered the standard metric for graduate admissions to evaluate a student. When evaluating an applicant, it is considered the second most important criteria (Kuncel et al., 2014).

The UGPA has been considered a proxy for motivational factors as well as general ability. UGPA has demonstrated a validity coefficient ranging from 0.20 to 0.35 depending on the major criteria. Applicants who have taken tests in cognitive ability yield an average of 0.51 (Imose & Barber, 2015). One research project showed the correlation of a high UGPA with conscientiousness. A high UGPA showed an individual exhibiting high professional and academic achievement. High levels of self-motivation correlated with a high GPA (Cheng & Ickes, 2009).

One issue with the GPA is the variability of teaching standards and grading evaluation. Grading systems vary between universities as well as between individual courses. It is difficult to compare GPA from different undergraduate schools as courses and curriculums vary (Bailey, Rosenthal & Yoon, 2014). Undergraduate students quickly learn which courses are considered “easy” to impact their GPA. This results in a student who has had to contribute less to achieve a higher grade (Gershenfeld, Hood, & Zhan, 2015).

A disconnect in the GPA and actual student performance impacts persistence at the graduate level. Glenn (2011) discusses the movement of students into high GPA majors due to their low rigor. In the current society where the highest grade wins, students are abandoning areas of interest, such as the STEM fields, in search of a higher GPA. While researchers have discussed many ways to adjust GPA to predict better performance, none are being used today (Gershenfeld et al., 2015). While other tools have been created to measure achievement, the UGPA is still a valid requirement for graduate admission (Shiyko & Pappas, 2009). One way to offset the skewed GPA is to look at the undergraduate major GPA (UMGPA) in their admissions process (Burmeister et al, 2014). The UMGPA, usually defined as the last 60 hours in major coursework, has shown an even higher correlation to success (Imose & Barber, 2015).

Like the GRE, the UGPA and UMGPA should not be used as the sole indicator of success in a graduate program. In a research project evaluating the UGPA of almost 7,500 students, it was statistically shown that a UGPA can range from 0.35 to 0.50 difference between ethnic groups. Entrance requirements that use a UGPA of 3.0 can potentially cut off underrepresented groups (Imose & Barber, 2015).

GRE revised test. In 2014 ETS announced that it was revising the GRE general test again. The major portion of this revision is the scoring of the GREW. Currently ETS is developing an electronic scorer for the GREW to eliminate human bias in the scoring process (ETS, 2014). ETS offers the GRE in two different delivery formats: computer and paper. The exam is typically three hours long with an optional 10-minute break between the GREQ and GREW sections and one-minute breaks between GREV and GREQ. Test takers are told to plan for at least 4 hours at the testing location. The general

GRE paper-delivered format is now limited to countries or areas where the computer format is not available. Most GRE test takers use the computer delivery format (ETS, 2015a).

The GRE computer delivery format is offered globally in a variety of locations. Test administrators assign seating after verifying the test takers' identification. Scratch paper is provided by the testing facility. There is an on-screen calculator for the GREQ section. For each section there is a countdown clock on the screen (ETS, 2015a). Test takers may see the results of their GREV and GREQ sections immediately after completing the GRE. GREW is reported at a later date (ETS, 2016b).

Scoring. While the GREV and GREQ are scored using scoring technology, as stated above, the GREW section is currently scored by trained readers (Bridgeman, Trapani, & Attali, 2012). In a high-stakes examination such as the GRE, it is vital that the scores' values are not diminished by issues of race, ethnicity, or even country of origin. There has been evidence that the readers are consciously or unconsciously scoring with a bias towards country of origin, race, and first language of the test taker (Bridgeman, Trapani, & Attali, 2012; ETS, 2014).

The GREW component is scored on a scale of 0–6, in half-point increments. Upon completion of the exam, the GREW is sent to two readers hired by ETS. These readers then score each essay on the six-point scale. If the two readers score the essay within one point, the average score is awarded to the test taker. With scores greater than a one-point difference, a third reader is brought in to read the essay and examine the individual readers' responses. It is then a final score is determined (ETS, 2014).

Currently the computer scoring system for the GREV and GREQ are limited to quantifiable scores. The GREW requires understanding a logical argument and at present ETS hires readers with a potential bias to score the GREW (Bridgeman, Trapani, & Attali, 2012). ETS has acknowledged the potential bias and is conducting a feasibility study to implement a scoring engine for the GREW. ETS is calling this scoring engine the "e-rater" (Breyer et al., 2014).

Predictive validity of the GRE. The GRE is considered the primary criteria in a graduate application (Kuncel et al., 2014). During the past decade, using the GRE scores as the indicator of success or failure of graduate students has received a great deal of attention from the national press. Since 2000, the U.S. Department of Education has been actively engaged in efforts to examine the research on the validity of the GRE score as predictor of success or failure of graduates' performance (Schwager et al., 2015). According to Kuncel, Hezlett, and Ones (2004), research shows some correlations in the GRE's scores. The research also indicates that the confidence interval of 90% credibility included zero. In addition, the 1,752 independent samples yielding 6,589 correlations for eight different criteria and 82,659 graduates demonstrate that the GRE's Subject Tests tended to be better prediction than the Verbal Tests, QuantitativeTests, and Analytical Tests.

A recent meta-analysis study (Kuncel, Wee, Sarafin, & Hezlett, 2009) has shown that while the GRE is a predictor of many general aspects of a graduate student's success, it has been found lacking for specific populations and degree levels. A meta-analysis is statistical procedure to combine data from more than one study. So when the effect size is consistent from each study, the meta-analysis is used to find a common effect. There is also the continuing theory that test anxiety can reduce the scores of the GRE and other cognitive ability assessments (Reeve, Heggestad, & Lievens, 2009). This is of great concern to admissions officers as it impacts the potential admission of high ability applicants. This research showed that applicants who have taken the GRE multiple times but had a lower cognitive ability produced higher scores than high ability prospective students with test taking anxieties.

Other research into the use of GRE examinations in graduate universities found that admissions heavily weigh the GRE in the selection process (Bleske-Rechek & Browne, 2014). Educational Testing Service does not support this use of the GRE. However, United States universities continue to excessively weigh the exam during the admissions process. In the large aggregate data reviews available to this researcher (e.g., Kuncel, Wee, Sarafin, & Hezlett, 2010), the results show that the GRE can predict overall success in any graduate school. However, these large banks of data do not show success rates within a single university or department.

According to Bleske-Rechek and Browne (2014), the GRE reflects a long-term learning material related to the graduate performance. The researchers note that on the General Test, the test takers are asked to solve the problems, synthesize information, and resolve sometimes complex relationships between pieces of information. They also specify the following items of the GRE's Verbal, Quantitative, and Analytical Tests: (a) analogy, antonym, sentence completion, and reading comprehension problems for the Verbal Tests; (b) the discrete quantitative, quantitative comparison, and data interpretation problems for the Quantitative Tests; and (c) analytical reasoning and logical reasoning problems for the Analytical Tests. In addition, they identified the Subject Tests as the tests that assess acquired knowledge specific to a field of study.

Because of the GRE being specifically designed to measure the performance in graduate studies, the GRE scores are often used to determine who receives the graduate assistantships, fellowships, or other awards (Bleske-Rechek & Browne, 2014). However, the weight given to this instrument for making decisions varies from university to university. Statistical concerns have frequently been raised about the previous studies of the GRE's validity. A range of restrictions and criteria and measured unreliability attenuate the observed correlations between the GRE scores and graduate performance.

Kuncel et al. (2009) also noted that there has been little research conducted on the degree level, and proposed that admissions officers closely examine the validity of GRE on their specific programs. They propose that research be conducted on specific degree levels. If this localized research is found to contraindicate the meta-analysis, then the local research should be used and the admissions processes altered for that program. A case study at the University of Washington Nursing School and a study of selective universities shows this to be the case.

At the University of Washington, researchers found that the GRE was unable to predict success, but anecdotal evidence recorded from the community showed the GRE as a barrier in the admissions process. The University of Washington started requiring the GRE in 1969, but starting in 1994 allowed individual departments to waive the GRE requirement on an individual basis. Since then, research has shown that the GRE was not providing the necessary information to determine the potential promise of an applicant. In 2007, with this data in hand, the University of Washington's School of Nursing petitioned to remove the GRE as an application requirement. The graduate school approved the petition in the same year (Katz et al., 2009). Another research project showed how the GPA and the GRE scores can be completely independent of each other.

Wheeler and Arena (2009) collected information on over 300 graduate applicants. This included the math/science GPA as well as their cumulative GPA and GRE scores. In addition, they created a rating system for each applicant's undergraduate university based on the U.S. News and World Report Classification System. They concluded that the GRE scores were more significant for students from the less selective universities.

Researchers have spent the past decade examining the admissions procedures for master's degrees specializing in education, psychology, mental health, nursing, and administration (Van Nelson et al., 2001), as well as civil engineering, mechanical engineering, business management, and fine arts (Alias & Zain, 2006). At present, no peer-reviewed publications have been found looking at the natural sciences master's degrees, specifically the marine sciences.

Currently researchers are concerned that the weight given the GRE during the admissions process eliminates potential students and restricts the entrance of women and minorities into the sciences (Miller & Stassun, 2014). Sedlacek (2014) noted that there is little correlation between the GRE score of an applicant and their ultimate success in a STEM program. The GRE scores are skewed towards a certain set of demographics for the test takers (Miller & Stassun, 2014). ETS data have shown that on average women score 80 points lower than men and that African-Americans score an average of 200 points below those who stated they were white on their GRE registrations (Bleske-Rechek & Browne, 2014).

This creates a large problem in the universities with graduate admissions committees. These committees are commonly made up of a rotating group of faculty members that rely on a standard set of requirements to winnow the applicant pool to a manageable level. One way to reduce the application pool is to use a minimum GRE score requirement. One example was of an admissions committee that discarded any application with a score less than 700 on the GREQ exam. This portion of the GRE has a maximum score of 800 (Miller & Stassun, 2014).

This filtering is against ETS policy and is disadvantageous to women and minority applicants. When looking at applicants to the physical sciences, only 26% of women scored above 700 on GREQ. Seventy-three percent of men received a 700 or higher on the GREQ. When looking at race/ethnicity, only 5.2% of minorities (excluding Asians) scored above 700. Eighty-two percent of white and Asian people scored above this GREQ cutoff. This incorrect use of the GRE may be one reason why there is the continual problem of women and minorities underrepresented in the STEM fields (Bleske-Rechek & Browne, 2014).

STEM graduate programs in Fisk-Vanderbilt and the University of South Florida have reduced the weight of the GRE score during the applications process. The admissions committee selects their applicants based on a set of skills and character attributes that align the potential student with their program. The committee conducted personal interviews that delved into the applicant's college and research experiences, leadership experience, service to the community, and life goals. The committee then assessed personal traits such as perseverance, maturity, adaptability and conscientiousness. All of these were scored and combined with the applicant's academic scores. Of the students admitted to the Fisk-Vanderbilt PhD program, 81% of the students who entered the program have successfully completed or are making positive progress on completing their degree. More than 85% of these students are women or underrepresented minorities who would not have been accepted into the program based on an application program which automatically eliminated applicants with scores less than 700 on the GREQ (Miller & Stassun, 2014).

Researchers examining GRE scoring issues in the admissions process are quick to point out that they are not advocating accepting unqualified students into the STEM graduate programs. One point that was continuously made in the literature was the assumption made by graduate admissions committees, upper administration, and research faculty that the GRE test score, an example of a single day's work, is a good measure of an applicant's ability, and therefore success in a graduate program (Miller & Stassun, 2014; Bleske-Rechek & Browne, 2014; Sedlacek, 2014).While the statement of career goals, interview, letters of recommendation, UGPA, UMGPA, and GRE are all part of the admissions requirements, there are other areas that can affect the application process. These include gender, ethnicity and race, and adult learner (non-traditional student). These areas can impact persistence as much as the quantitative and qualitative measures submitted to the admissions committee (Kuncel et al., 2014).

Gender. The issue of gender as regards to STEM degrees continues to garner attention in both academic and public realms (Stoet & Geary, 2012). Women are continually underrepresented in the advanced levels of natural sciences. There have been documented gaps in the GRE scores between men and women that have been perceived as a response to stereotypical threats (Bleske-Rechek & Browne, 2014). Researchers evaluated both genders' performance in core sciences in the undergraduate majors of biology, biochemistry, and physics. Rating final grades and learning gains, there was no significant difference between genders. The results of admissions into a graduate program showed a significant gap between the genders. It was implied the GRE scoring was a strong factor in calculating the gender gap in graduate admissions (Lauer et al., 2013).

While the GRE score has shown a close correlation with the gender gap in STEM graduate programs (Miller & Stassun, 2014), other gender differences have been shown to impact STEM admissions for women. The primary issue is that of a woman's multiple role identity. Current identity theory suggests that the current social structure intimates that science is represented by a white man. Since the 1980s the United States has developed a women's STEM pipeline from the middle school level through to baccalaureate. This has created a STEM enrichment program allowing women to develop a science identity, allowing them to feel comfortable in pursuing a STEM graduate degree (Merolla & Serpe, 2013).

Ethnicity and race. Universities have been charged with creating a diverse student body at all levels of education (Gruenewald & Smith, 2014). The GRE is purported to present a prospective student's intellectual capacity and ability to complete a graduate degree (Bleske-Rechek & Browne, 2014). When determining race and ethnicity ETS refers to the definitions released by the U.S. Census Bureau in 2012 (ETS, 2015a).

> Since 2010, the US Census Bureau gives the following definitions for race; (a) White: a person having origins in any of the original peoples of Europe, Middle East, or North Africa; (b) Black or African American: a person having origins in any of the Black racial groups of Africa; (c) American Indian or Alaska Native: a person having origins in any of the original peoples of North and South America (including Central America) and who maintains tribal affiliation or

> community attachment; (d) Asian: a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam; (e) Native Hawaiian or Other Pacific Islander: a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands. The identification of race for the GRE and for admissions is self-reported. Since 2010 admissions applicants have been able to check multiple races to further define a potential underrepresented minority status as well as a Hispanic origin. (U.S. Census Bureau, 2015, p. 3)

In 2010 the U.S. Office of Management and Budget (OMB) created a subsection to cover Hispanic origin. In a U.S. Census brief (U.S. Census Bureau, 2015), OMB determined that a person of Hispanic origin can also be of one or multiple races and of a specific Hispanic subgroup. Currently graduate applications allow self-reporting for both race and Hispanic/non-Hispanic origin (Cox, Imrie, Miller, & Miller, 2014).

Diversity in gender and ethnicity in STEM fields is still limited when compared to the U.S. general population (Frehill & Ivie, 2013). Since 1999 NSF has created two programs (ADVANCE: Institutional Transformation; the Alliances for Graduate Education and the Professoriate) to encourage the diversity shift within the levels of higher education. Both were created to start a pipeline for both women and underrepresented minorities to continue through graduate school and into advanced STEM positions. As these programs have grown within Hispanic Serving Institutions (HSIs) and other minority majority universities the trend has emerged that the issue of gender must be separated from that of race. The only significant difference in this group is that of women of underrepresented minorities (Frehill & Ivie, 2013).

Adult learners and their assessment. An adult learner is defined by the National Center for Education Statistics (NCES) (2015) as a nontraditional student who meets at least one of seven criteria: (a) student does not enter school in the same calendar year that they finished their baccalaureate; (b) is enrolled part-time for part of an academic year; (c) employed full time (minimum of 35 hours per week) while enrolled in an academic program; (d) qualifies as financially independent when requesting federal financial aid; (e) lists dependents (other than spouse) on federal tax return; (f) is a single parent; (g) does not have a high school diploma or equivalent. These students must balance multiple roles off campus while trying to actively participate and complete their educational goals (Ross-Gordon, 2011).

In 2008, NCES reported that 38% of all students enrolled in U.S. universities were classified as nontraditional students. With the aging and increasing diversity of the U.S. population and the increased use of technology in the workplace and in the classroom, the percentage of nontraditional students is expected to increase over the next quarter century. The definition age of a nontraditional graduate student is from the ages of 25-45 (Shepherd & Nelson, 2012).

For adult learners there are three major deterrents to returning to school. These are defined as situational barriers, dispositional barriers, and institutional barriers (Potter, 2013). Situational barriers are related to home and work responsibilities. Lack of time is the most crucial. Other situational issues may include transportation and child care (Shepherd & Nelson, 2012). Dispositional barriers are defined as self-perception and learner attitude. Derived from the psychological term of dispositional attribution, this barrier refers to the internal characteristics of an adult learner. It may be the adult learner believes they cannot complete a degree because they are too old or lack confidence (Potter, 2013). This is an internal issue to the adult learner, where the institutional barrier is external and can depend on the university's practices for admissions and the pedagogies used to develop degree programs for the adult learner (Knowles, Holton, & Swanson, 2012).

The institutional barriers consist of university requirements that impact or impede an adult learner. Traditional universities with a centralized admission program have found it difficult to recruit and enroll the adult learner (Ellis, 2012). Standard recruiting techniques do not capture these potential students. The standard ebb and flow for the standard applicant (graduation from the baccalaureate in the spring to graduate enrollment in the fall) does not exist for the adult learner (Fu, 2014). These barriers can include admissions procedures that require a potential student spending time and money taking a standardized test such as the GRE (Shepherd & Nelson, 2012).

Graduate programs that work with large numbers of adult learners have found that a hybrid admissions office is a best practice for recruitment (Ellis, 2012). The hybrid admissions office allows both the traditional and nontraditional applicants ease of information and various levels of personal contact required by both applicant populations (Fu, 2014). Adult learners interpret centralized admission offices as overbearing and over controlling, creating a lack of trust between admissions personnel and the nontraditional student. Admissions offices that recruit both types of students must be able to find a workable balance and acknowledge the adult learner requires special attention during the admissions process (Shepherd & Nelson, 2012).

Adult learners are more likely to look for flexible programs which allow a strong balance between education and life events. The preferred formats for the adult learner consist of education at a distance, blended/hybrid courses, and/or compressed courses (Ross-Gordon, 2011). These nontraditional students also look for admissions processes that include prior learning assessment and accessibility to key student services such as the financial aid, program, and advising offices (Paul & Cochran, 2013).

The adult learner returns to the academic environment with a different set of skills and reasons compared to the traditional student. These adult learners are considered "prepackaged" by most admissions committees. The adult learners are highly focused on academics and are considered motivated and serious students (Wyatt, 2011). With that focus, admissions contacts are a priority for the adult learner.

Adult learner applicants require a higher contact ratio than the traditional applicant. Because of their focused goals and restricted time, it is important for the admissions office to invest a significant amount of time with the adult learner (Johnson & Cantrell, 2012). Scheduling, studying, and completing the GRE can impact the entrance timing and can frustrate an adult learner from completing the application (Schwager et al., 2015).

Millennial learners. While adult learners require a high contact ratio compared to the traditional (or millennial) applicant, there are specific differences in ways the students learn. Millennial students are defined as students born between 1982 and 2000 (Howe & Strauss, 2009). The millennial learners tend to be highly structured, spent many hours on the computer/internet, and were left to entertain themselves as their parents/guardians were working (Nikirk, 2012).

The typical millennial is considered self-confident, extremely social, technologically sophisticated, goal oriented, and accustomed to teamwork. They are also impatient, sheltered, overly stressed, materialistic, and self-centered. The millennial considers higher education expensive but required. There is a strong sense of entitlement. Many received high grades for little work in high school, and expect the same at undergraduate and graduate levels. Their knowledge bases tend to be lacking and they are resentful of greater than minimal demands on their time to achieve their goals. The millennial STEM learner prefers a work/life-interaction balance in contrast to current lab managers' work-focused lifestyle (DeFraine, Williams, & Ceci, 2014).

With their tightly structured childhoods, millennials respond well to structure and information, but do not spend time in reflection or fuzzy thought that is required in developing research projects. Millennial STEM students will conduct the minimal amount of work necessary to complete a task given to them. Most will not look beyond the basic requirements of study (Knezek, Mills, Wakefield, & Hopper, 2012).

The millennial learner is testing savvy. Immersed in continuous testing, a millennial is cynical about authority and just wants to pass with a high enough GPA to earn a high-paying job. The continuous testing has led to the millennial memorizing enough material to regurgitate the information required, but not to spend time reflecting on its meaning (Howe & Strauss, 2009).

This generation has an innate comfort working with technology. They prefer mobile technology to email, social media to conventional media, and interaction via electronic media rather than face-to-face. Most prefer texting to talking, limiting human interaction outside of their social group. Research consists of Google searches and basic views on Wikipedia (Eastman, Iyer, Liao-Troth, Williams, & Griffin, 2014).

There is a misconception of what is plagiarism among the millennial learners. This has led to wholesale copying and pasting of online sources for papers which points back to the millennial not looking beyond basic requirements in a course. A result of these transgressions is that earlier generations consider the millennial learner untrustworthy and that leads to a negative environment between the teacher and the student (Evering & Moorman, 2012).

Best practices: Support for learners and faculty-student interaction. Part of the graduate admissions process is to link the applicant to a positive role model in the faculty. Providing a positive learning environment for both the students and faculty is the common goal for all educational programs. Promotion of a best practice environment assures student, faculty, and program success. In the modern educational environment, it is considered a best practice to have a learner-centered campus where faculty and administrators have an open dialog to develop and promote more effective learning and teaching (Saroyan & Frenay, 2010).

Palmer (1998) shows the essential requirements to teaching at any level:

> The growth of any craft depends on shared practice and honest dialogue among the people who do it. We grow by trial and error to be sure – but our willingness to try, and fail, as individuals, is severely limited when we are not supported by a community that encourages such risks. (p. 144)

This call for support of quality higher education teaching can be congruous with the current faculty. A current issue is that most graduate level science faculty have learned their teaching skills through the simple process of watching others teach and have not been through any type of formal training (Bergquist, 2010).

Historically, this simple type of faculty-student interaction was considered enough training for a student to move into the realm of teaching and advising their own students. Almost 30 years of research monitoring graduate students in the research fields has shown this process is devoid of teaching the principles required to gain the most out of the student-faculty interaction needed to develop a top rated researcher/instructor (Border & von Hoene, 2010). This led to the creation of the Preparing Future Faculty (PFF) program through the Pew Charitable Trusts. The goal of this program was to prepare graduate students for faculty membership not only in their area of research, but also in the world of education as well. The PFF, as well as the National Science Foundation-funded STEM program, delved into graduate research programs and determined a basic skill and knowledge set needed by future leaders in research and graduate education (Pollock & Finkelstein, 2008).

Persistence

Persistence in the STEM master's of science programs is defined as the completion of the degree and entrance into the STEM workforce. Persistence throughout the STEM pipeline is vital, especially for underrepresented minorities. It is important that students complete the degrees required and not "leak" out of the pipeline (Allen-Ramdial & Campbell, 2014).

Persistence, like the graduate admissions process, must use the three same predictors to determine a successful outcome within the STEM pipeline. These are ethnicity, gender, and socioeconomic status. An additional area reviewed for persistence is student engagement (D'Souza, Kroen, Stephens, & Kashmar, 2015). Researchers showed that there were three reasons for students to leak out of the STEM pipeline. These were (a) lack of finances, (b) lack of academic ability, and (c) lack of academic preparation (Szelényi, Denson, & Inkelas, 2013). Recommendations for achieving a higher level of persistence included using high impact strategies to increase retention rates (Tinto, 2012).

Persistence has also been linked to satisfaction within the academic processes. Persistence in the STEM pipeline needs to include active student engagement with internships, field opportunities, and active links with professionals outside of academia. These active and engaging projects satisfy the students' idea of what is in a graduate program, not simply lecture courses. Interspersing course, lab, and field work helps plug one of the leaks in the pipeline (Nichols & Chang, 2013).

Another leak in the STEM pipeline is the concept that women are not good in math, a major requirement in any STEM field. There continues to be a stereotype that women cannot comprehend higher level mathematics nor understand or develop statistical formulas. This weakness, or believed weakness, in math, has led to women not persisting in STEM majors (Sax, Kanny, Riggers-Piehl, Whang, & Paulson, 2015).

Research Design

Kuncel, Klieger, Connelly, and Ones (2013) noted that many aspects of the graduate application process have been reviewed and evaluated. Meta-analysis has ranked the various portions of the admissions application and how it relates to persistence. Future research indicates that drilling into admissions and persistence data will develop a finer process in pointing to the success of a STEM graduate applicant.

The literature has demonstrated that the current meta-analysis studies give an overall success predictor, but need information for specific populations. It has been recommended that more research be conducted for specific populations and degree levels, specifically developing a correlation between admissions factors and persistence. Data collection must come from verified and repeatable sources (Mertens, 2009).

Analysis of the admissions process within the STEM pipeline requires a review of the standard application as well as the background of the perspective student. A review of the applicant pool diversity requires additional analysis (Merolla & Serpe, 2013). While developing data for the admissions and persistence factors, it is important to note that ethnicity and race are self-reported during the application process. Applicants of multiracial descent submit both races, and current application software reports the first race listed (Garces, 2013).

No matter what the research, it is still of primary importance to confirm the validity of the method used to answer the research questions. While the research questions might start to focus on which method should be used, it is the purpose of the research that brings the method into focus (Creswell, 2012). Over the past two decades, researchers have experienced a shift in social science methodologies. The result has created a “pragmatic paradigm” in which the mixed method has focused the research into a more data driven environment. This method allows for abduction reasoning in regards to the connections between theory and data. This is different from just the qualitative approach (induction) and quantitative approach (deduction). The inference from data is also method specific. While the qualitative approach looks at context, and quantitative looks at generalities, the mixed approach allows the researcher to bridge that dichotomy (Clark & Creswell, 2008).

Conclusion. The STEM pipeline is an active process that consists of K-12, undergraduate, and graduate education. Creating this funnel into the workforce is vital to the United States. The literature has shown that both large and small scale studies have reviewed that there are various admissions factors to predict success in a marine science graduate program. These factors include ethnicity, race, gender, and age. The time to completion of the master's degree is also important to determine persistence in the graduate programs.

There are leaks in the STEM pipeline. The admissions process needs to focus on not only (a) the academic quality of the prospective student and (b) their diversity, gender, and age; but also (c) the socioeconomic factors that can cause a member of the STEM pipeline to fail in completing the workforce requirements. A statistical evaluation is needed to determine the basic factors for predicting success in a marine master's of science program. Persistence is an institutional issue and must be looked at from admissions through conferral. Admissions factors need to be assessed to retain the correct student who will successfully complete the marine science graduate program. During this assessment, data external to the actual application needs to be reviewed.

In 2012, the president of the United States announced the initiative to increase the number of STEM undergraduates to over 1,000,000 in the next decade. The Department of Commerce has determined that STEM occupations will grow nearly 2% faster than other occupations. The President's Council of Advisors on Science and Technology

(PCAST) is chartered to advise the presidential administration and makes policy recommendations in a wide variety of STEM field. The most recent PCAST was re-charted in 2010 by Exective Order 12539 (White House, 2011). PCAST concluded if the STEM pipeline could retain 50% of its students, the United States would reach 75% of that million-degree target (Olson & Riordan, 2012). This initiative requires a focused approach not only during the educational process, but in the admissions process as well. Without fully understanding where the leaks and successes are, this initiative will fail.

Research Questions

The focus of this dissertation is to understand the admissions process and its impact on persistence in a master's of science program by asking the following questions:

1. What is the best criteria (Using GRE, UGPA, UMGPA, persistence, gender, race, age, ethnicity) to generate a Full Acceptance candidate in the marine science programs?

2. What is the best criteria (Using GRE, UGPA, UMGPA, persistence, gender, race, age, ethnicity) to generate an Accepted with Academic Requirements candidate in the marine science programs?

3. Can one of the criteria (Using GRE, UGPA, UMGPA, gender, race, age, ethnicity) predict persistence better than the others?

4. Can all of the criteria (Using GRE, UGPA, UMGPA, gender, race, age, ethnicity) in the form of a multiple-effects model, describe persistence in a way that can be easily interpreted?

Chapter 3: Methodology

This quantitative research study used correlational research. Correlational research determines the degree of association between quantifiable variables (Mertens, 2009). The particular study focused on the correlation of admissions factors to persistence in a graduate marine sciences master's degree. Research evaluating admissions factors for graduate school persistence can be traced back for decades (Fenster, Markus, Wiedemann, Brackett, & Fernandez, 2001; Madus & Walsh, 1965; Omizo & Michael, 1979; Powers, 2004; Rhodes, Bullough, & Fulton, 1994). This study allowed upper administration and the admissions committee to determine what factors determine the success of the applicant into a master's of science marine sciences program. Research on persistence and graduate admissions factors were performed on tighter levels, specifically admissions levels, looking at race, ethnicity, and other diverse populations as well as standard admissions requirements (Quaye & Harper, 2014).

Participants

This study examined the 767 students that were accepted and enrolled, as well as those enrolled into the university's marine science programs master's of science between January 2006 and December 2013. This population was examined as a whole and then divided into the three master's degree programs: a) marine biology, b) marine environmental sciences, and c) coastal zone management. This population set included the student's master's degree major, age, gender, ethnicity, race (Hispanic or non-Hispanic), GREV percentage score, GREQ percentage score, GREW percentage score, UGPA, UMGPA, and number of years required to complete the degree (persistence).

Race is a separate subset than ethnicity. For example, a student may list themselves as white Hispanic or white non-Hispanic. The maximum time limit to complete a master's degree is nine years (NSUOC, 2014). For students that did not go through the standard application procedures (dual admissions from the undergraduate department), the application information was incomplete, and those accepted as special student status (no GREs required) were eliminated from the study. These students did not go through the complete admissions process which require the UGPA, UMGPA, and GRE scores.

Instruments

All data used for this research was provided by the admissions officers and the assessment coordinator from the marine science's graduate program office. There were five instruments for collecting data. They were the student's master's degree admissions application, the GRE, the student's undergraduate transcript (UGPA and UMGPA), the student's acceptance level, and the student's degree conferral. The admissions application is a signed contract with the university stating that all information included is correct. Information submitted with this application includes age, gender, and race/ethnicity. Once a person migrates from applicant to student, this information is transferred into the student's record.

The general GRE information was gathered by direct reporting from ETS to the university via daily downloads from the ETS reporting service. The scoring was reported by raw number and percentile for the GREV, GREQ, and GREW. The GREV and GREQ percentile scores were used as they were based on the performance of all individuals tested within a three-year period. Percentages for GREV and GREQ above 40 are usually accepted by the marine science program. According to ETS the GRE is designed to be a common measure for comparing an applicant's qualifications (ETS, 2014).

The GREW scores are rated 0-6. A score of 0 shows that the paper is off topic and shows no attempt to respond to the topic assigned the test taker. A score of 1 shows the test taker is fundamentally deficient and typically exhibits incoherence in writing skills (including pervasive errors in grammar and severe problems in sentence structure), little evidence in the ability to understand and analyze the argument put forth in the question, and little proof that the test taker can develop a coherent response. A score of 2 shows that the essay is seriously flawed. This is defined by ETS as an essay showing the writer's own view of the subject and which does not develop any ideas on their own. Again the test taker shows serious errors in grammar, sentence structure, and use of language (ETS, 2014). Applicants with these scores are typically not accepted into the marine sciences program at the university.

A GREW score of 3 shows the test taker is classified as limited. This level shows a lack of clarity in expressing ideas, frequent minor grammatical errors, and limited logical development and organizing of ideas. A score of 4 indicates an applicant shows an adequate understanding and conveys the meaning of their argument competently. The GREW scores of 5 (strong) and 6 (outstanding) show the test taker to have developed a well-articulated critique of the argument and to have made only minor errors (ETS, 2014). Applicants with these levels are typically admitted into the marine sciences program, either at the Acceptance with Academic Requirement or Full Acceptance. This information was gathered from the decision given by the associate dean.

The undergraduate transcript was submitted directly from the applicant's baccalaureate school to the university. Only official transcripts are accepted as part of the application process. The UGPA is calculated by the undergraduate school to show the measure of a student's academic achievement. The formula for this is the total number of grade points earned in a course (in the US this is based on a 4-point scale) divided by the total number of grade points attempted. For this university the UGPA is reported to the hundredth's decimal point.

The UMGPA is calculated by the marine science graduate program office. The official baccalaureate transcript is reviewed and the last eight courses in the student's declared major (retrieved from the application package) are used to calculate the UMGPA. The formula for this is the total number of grade points earned in in the 8 courses (in the US this is based on a 4-point scale) divided by the total number of grade points attempted for these eight courses. For this university the UGPA is reported to the hundredth's decimal point. This score is reported to the graduate admissions committee.

Once the entire application packet is completed, the packets are emailed to the faculty (the admissions committee). The admissions committee then makes one of the following three decisions: Full Acceptance, Acceptance with Academic Requirement, or Rejected. Once a quorum has been reached, the application is submitted to the associate dean for a final decision. For this study, only Full Acceptance and Acceptance with Academic Requirement were used.

Degree conferral occurs monthly. These are recorded by the registrar's office and the information is submitted to the alumni and program offices. With the degree date posted in the report, the program office is able to calculate completion time by subtracting the student's start date from the conferral date. These were calculated in years.

Validity and Reliability of the Instruments

In is vital to confirm that there is a high internal validity of the project. Internal validity refers to an inference where a causal relationship between two or more variables is properly demonstrated. A high internal validity prevents the project from being confounding from more than one independent variable (Mertens, 2009).

In creating the GRE, ETS has developed a formal review process to create fairness and equity in their testing procedures. ETS mandates that all testing materials, including instructions, publications, and individual test items, are evaluated prior to being released to their test sites. This includes reviewing the diversity of backgrounds for both its international and U.S. test taking populations, changing roles and attitudes towards various populations, and the role of language towards various groups within and outside of the US (ETS, 2015a); Schwager et al., 2015).

The transcripts which reflect UGPA and UMGPA must come from accredited colleges and universities (SACSCOC, 2014). The transcripts must also come directly from the institution in a sealed envelope. Unsealed envelopes or transcripts sent by the applicant are not accepted by the graduate program office.

The application form submitted by the applicant contains the applicant's age, gender, ethnicity, and race (Hispanic or non-Hispanic) (NSUOC, 2014). The applicant finishes submitting the form by attesting that the information submitted to the university is truthful and correct. Applications containing errors are removed by the program office.

Procedures

Design. The data were obtained by the Oceanographic Center program office. Before being presented to the researcher, personal identifiers were removed. The following informational raw data were provided: the acceptance level (Full Acceptance or Acceptance with Academic Requirement); students' major (marine biology, coastal zone management, marine environmental sciences); the number of years it took the student to complete the degree (persistence); percentile scores from each of the two sections of the GRE (GREV and GREQ); the raw score from GREW (score = 0-6); UGPA; UMGPA; age; gender; and ethnicity.

The researcher created an Excel file. The admission acceptance was ranked as a 1 (Full Acceptance) or 2 (Acceptance with Academic Requirement). The rest of these data were analyzed using the rank as the dependent variables. The student's major (marine biology, marine environmental sciences, and coastal zone management) was listed to help determine if these data are significant within the majors or only with the master's of science degree. Completion of the degree is defined as conferral from the university. For statistical purposes, the following coding was used: 0 = did not complete, 1= one year for completion, 2 = two years for completion, 3 = three years for completion, 4 = four years for completion, 5 = five years for completion, 5+ = more than five years for completion. Students on extended leave of absence were not included due to lack of data. Age was listed as when the student started the marine science program. Ethnicity and race were collected and submitted to the university using the ethnic and race groupings set by the U.S. Census. For this university, race is listed as Hispanic or non-Hispanic.

Dependent and Independent Variables

There were two dependent variables in this analysis: Full Acceptance and Acceptance with Academic Requirement. The independent variables consisted of various admissions and conferral factors. Admissions factors were gender, age, ethnicity, race, GREV, GREA, GREW, UGPA, and UMGPA. Conferral factors included master's of science major and time to persistence (degree conferral).

Data Analysis

The data analysis was conducted using R, a programming language for statistical computing. This is an interpretive language, allowing the researcher to develop various regression analyses. The level of significance was $p < .05$ (R Core Development Team, 2012; Crawley, 2012).

The following sequence of data was employed: (a) thorough exploratory data analysis to gain insight into the moments of the data (mean, min/max, variance, skewness kurtosis, normal/non-normal). This was a first-cut evaluation of what trends can be expected, (b) depending on data type, comparisons between the data were of the standard parametric type one-way ANOVA; and/or (c) or contingency tables (for count data), (d) if the resolution of data allowed various linear regression models to be applied to the data. The ANOVA one-way was the basis for determining and creating the linear regression model suitable for best-fit. Once the ANOVAwas completed and applicable and data density was sufficient, statistical modelling was applied to find a best-fit statistical model that incorporated all variables (e.g., General Linear Model) (Cohen, Cohen, West, & Aiken, 2013).

The data exploration allowed the researcher to find specific moments that showed potential significance, allowing the linear regression analysis to focus on the salient points of interest. With the determination of normality or non-normality, the choice of the most pertinent analysis and/or model was made possible. The regression analyses and statistical modelling allowed the researcher to determine graduations in the response of the GRE as a persistence indicator in this correlated study

Limitations

The results of this study relate to the numerical portion of the prospective student's application package. This research is quantitative and does not review the qualitative portion of the application package. Because of this there are three limitations to this study. The first is that there is no scoring for the applicant's three letters of recommendation that are part of the application package. While the majority of the letters come from the applicant's former faculty, that is not required. Applicants that have been out of academia for a period of time may choose to have their employment supervisor write the letter. Currently there is no rating of how the admissions committee chooses to review any of the letters in scoring an application for admittance.

The second is there is no scoring of the statement of career goals. This essay was created to show the writing skills of the applicant. There is no rating on the level of writing or skill in conveying the idea of where the applicant wishes to be in their career ten years into the future.

The third is the program faculty that make up the quorum to decide if the applicant is accepted, and if so, at what level. All 16 faculty members are sent the application packets. The quorum is reached when two thirds have responded to a specific application. The issue is that this quorum is usually not the same faculty. This can be due to faculty being out of the office, having an increased teaching load, or just not responding to the email request. Because of this variable an applicant might be accepted with one quorum and rejected or accepted with academic requirement to the M.S. programs in marine science.

Chapter 4: Results

The problem reviewed in this study was that university administration needs to further define the criteria to develop a successful correlation between the admissions process and persistence in the master's of science program. The purpose of this study was to determine if there were specific factors in the admissions process that impacted persistence in the M.S. marine science programs. The researcher gathered data from the program office and reviewed the raw data for completeness for data sorting. One issue was that in August 2011, the Educational Testing Services changed the scoring protocol for the GRE general test. Before August 2011, the GRE scored the verbal and quantitative tests on an 800 point scale. Scores were given in 10-point increments, with 200 being the lowest possible score. After August 2011, the verbal and quantitative tests were scored on a scale of 130-170, using a 1-point increment (ETS, 2016b). Scores received after August 2011 were reverted to the original scoring system using concordance tables provided by ETS and are provided in Appendix C (ETS, 2016a).

Description of the Participants

The data provided for these students were verified complete by the program office. These data providea snapshot in time. This study started with the original number of 767 students enrolled in the master's of sciences marine programs between January 2006 and December 2013. As of March 2016, the final number of students captured for this study was 496. Students not counted included dual admission students from the university's undergraduate department, as they are not required to take the GRE. Students whose undergraduate transcripts were incomplete were also removed from the database.

Demographics of the Participants

The gender of students enrolled during the study period showed a significant trend towards the female student. During this time, over 65% were women (Figure 1). The data for race and ethnicity shows the master's in marine sciences skews towards white, not Hispanic or Latino students. These data are self-reported in the application process and are not verified by the program office. Almost 90% of the students in the study reported themselves as white (Figure 2). Over 90% reported themselves as not Hispanic or Latino (Figure 3).

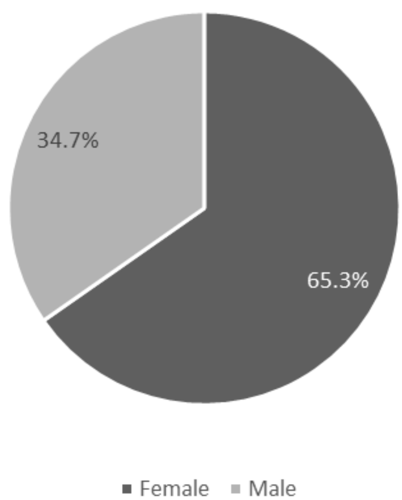

Figure 1. Breakdown by gender for students enrolled 2006-2013.

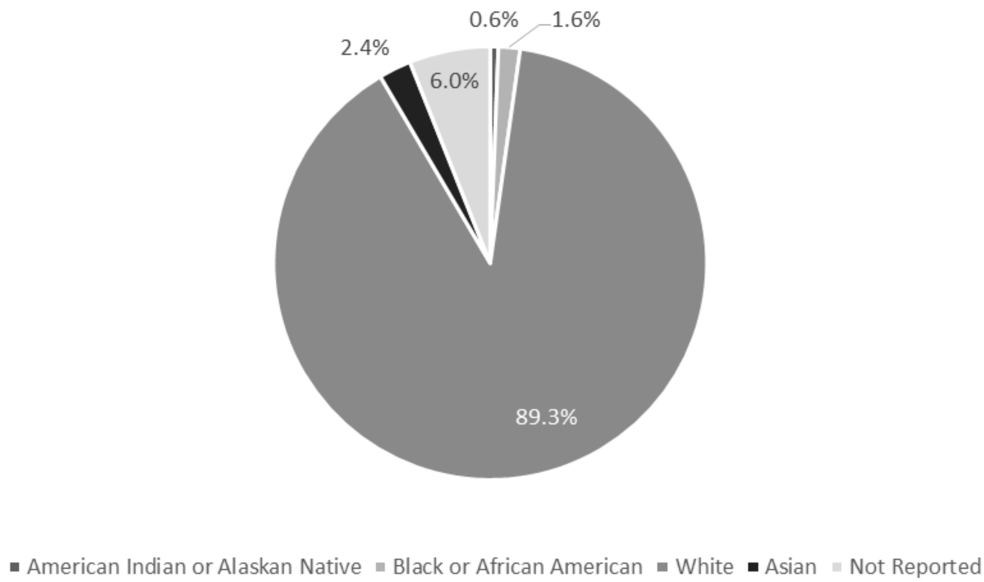

Figure 2. Breakdown by race for students enrolled 2006-2013.

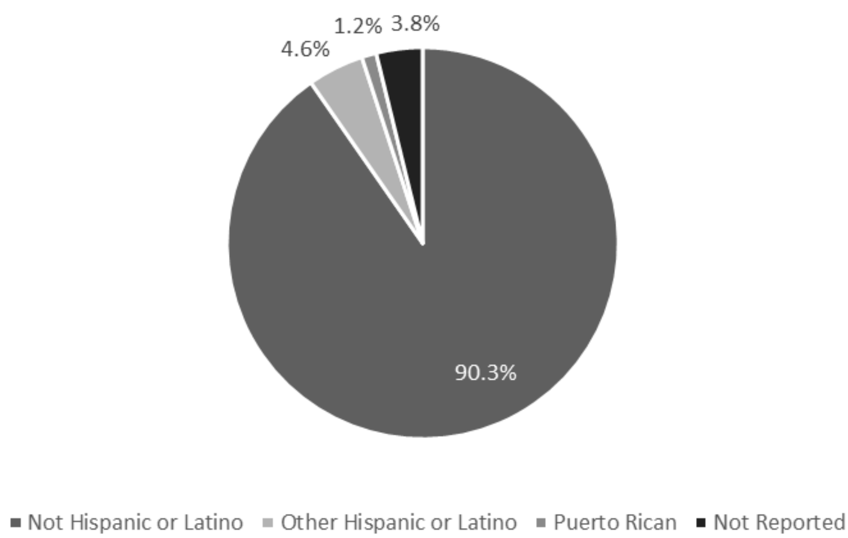

Figure 3. Breakdown by ethnicity for students enrolled 2006-2013.

The age of the students was broken into four categories: The first range is what is considered the standard age of a graduate student: 20-25. Shepherd & Nelson (2012) define the age of a nontraditional graduate student as between the ages of 25-45. The research broke this into three distinct groups: 26-29 years of age, 30-35 years of age, and

36 or greater years of age. While the majority of the students were in the traditional age category, nearly 35% were broken into these three non-traditional age groups (Figure 4).

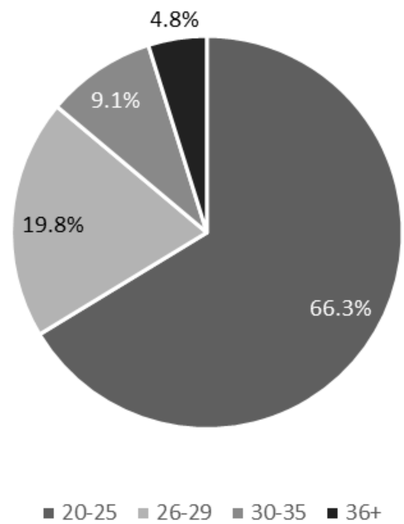

Figure 4. Breakdown by age for students enrolled 2006-2013.

Academic Description of the Participants

The M.S. in marine science has three independent majors: marine biology, coastal zone management, and marine environmental sciences. Of these three majors, marine biology, at an overall 68.1% of the student body, is the largest. Second is coastal zone management (23.8%), and finally marine environmental sciences at 8.1% (Figure 5). When statistical data analysis reviewed the major information, it was determined not to be significant when reviewed with the other admissions data. Therefore majors were not considered when evaluating the remaining data.

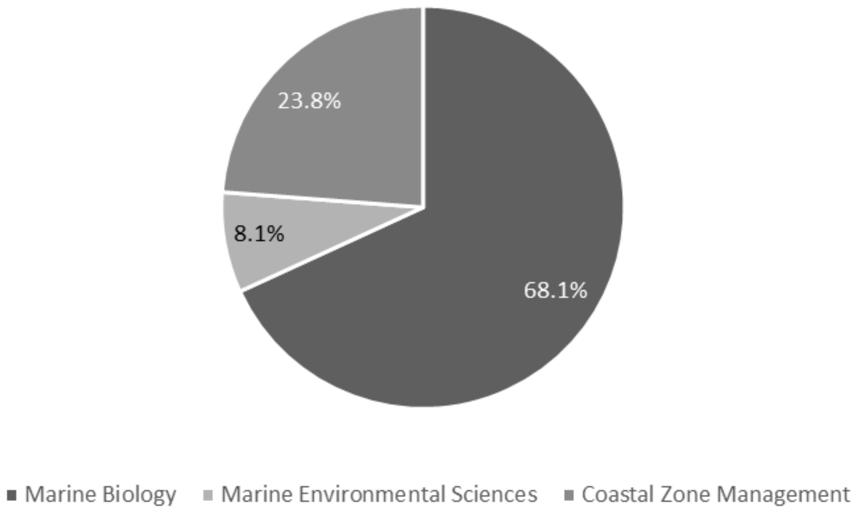

Figure 5. Enrollment breakdown by major of students 2006-2013.

The M.S. marine science program has two levels of acceptance; Full Acceptance and Acceptance with Academic Requirement. Of students enrolled in 2006-2013, 56.5% were fully accepted and 43.5% were accepted with academic requirement (Figure 6). For this study persistence was defined as graduating from the program. Dates for degree conferral were then obtained. Combined with the start date of the student, the number of years to completion was determined. This was broken into seven categories: students who did not complete, students who completed in one year, students who completed in two years, students who completed in three years, students who completed in four years, students who completed in five years, and students who took more than five years to complete (Table 2). Twenty-seven percent of the students enrolled during the study period did not graduate.

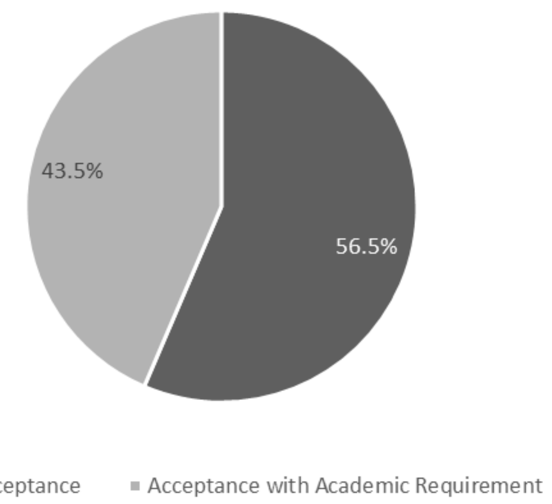

Figure 6. Breakdown by acceptance for students enrolled 2006-2013.

Table 2

Breakdown of M.S. Degree Students' Persistence: 2006-2013

Total M.S. Degree Students 2006-2013	Number	Percent
Students who did not complete M.S. Degree	132	27
Students who completed M.S. Degree in one year	5	1
Students who completed M.S. Degree in two years	64	13
Students who completed M.S. Degree in three years	126	25
Students who completed M.S. Degree in four years	89	18
Students who completed M.S. Degree in five years	69	14
Students who completed M.S. Degree in more than five years	71	14
Total Number of Students in M.S. Degree programs	496	

The UGPA ranged from less than 3.0 to greater than 3.9 (Figure 7) with greater than 35% entering with a less than 3.0. The UMGPA had the same range, but less than 35% entered the program with a lower than 3.0 UMGPA (Figure 8). The students' graduate GPA ranged from less than 3.0 (did not complete) to greater than 3.9 (Figure 9).

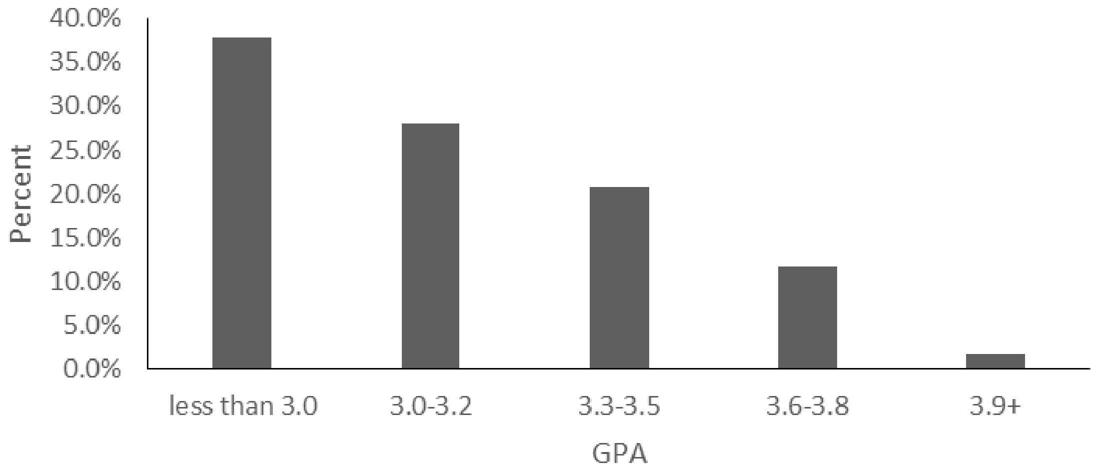

Figure 7. Undergraduate Cumulative GPA for students enrolled 2006-2013.

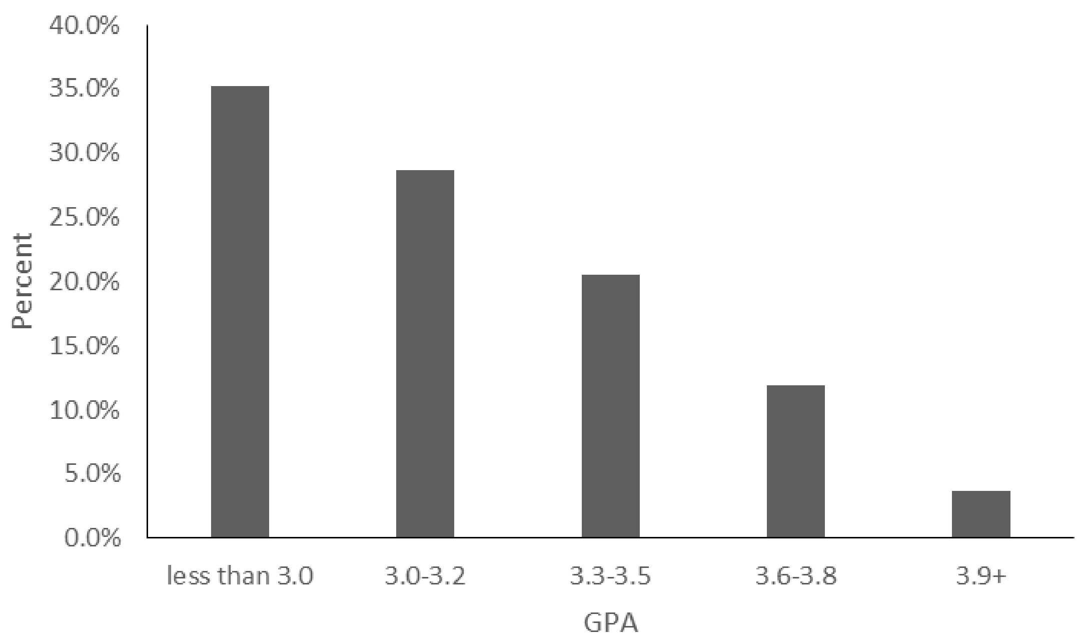

Figure 8. Undergraduate Major GPA for students enrolled 2006-2013.

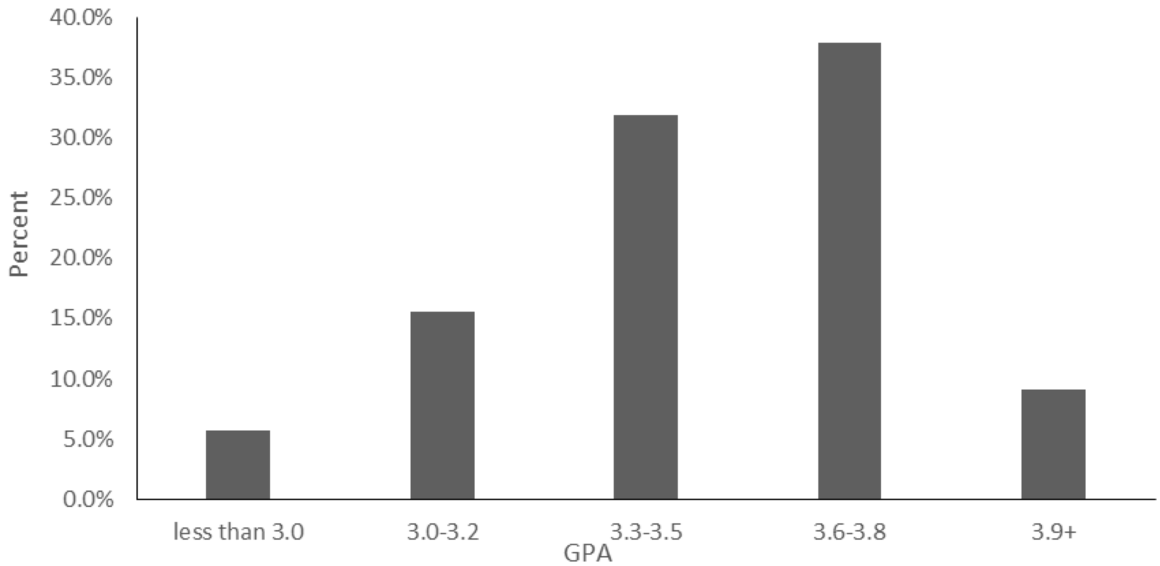

Figure 9. Graduate GPA for students enrolled 2006-2013.

The GRE scores are broken down into the three sections: verbal, quantitative, and analytical writing. Both the raw and percentile scores are recorded. Scores from after August 2011 were matched to the older scores using the concordance table in Appendix C. The raw scores are broken into 40-point increments. The percentile scores are broken into 5-point increments. For all students, the peak scores for the raw GREV were in the 450-490 range (Figure 10). The peak raw GREQ scores were in the 600-640 range (Figure 11). The raw analytical writing (GREW) has a peak at 4 (Figure 12). The percentile scores for all the GRE sections peak with percentile scores less than 40% (Figures 13-15).

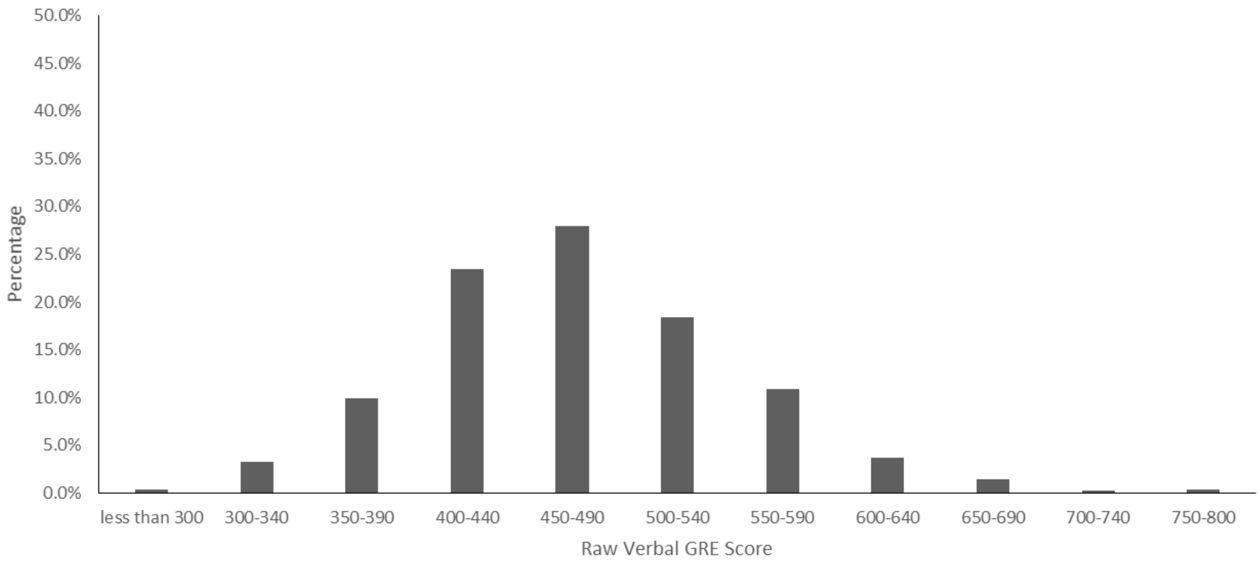

Figure 10. Raw GREV scores for students enrolled 2006-2013.

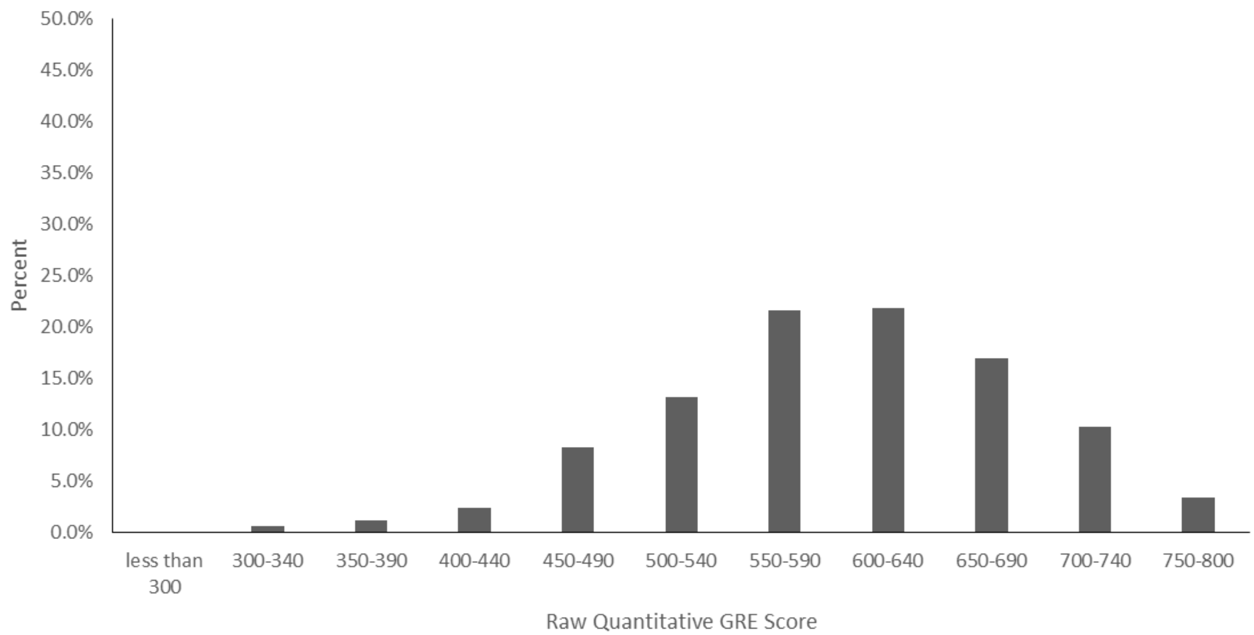

Figure 11. Raw GREQ scores for students enrolled 2006-2013.

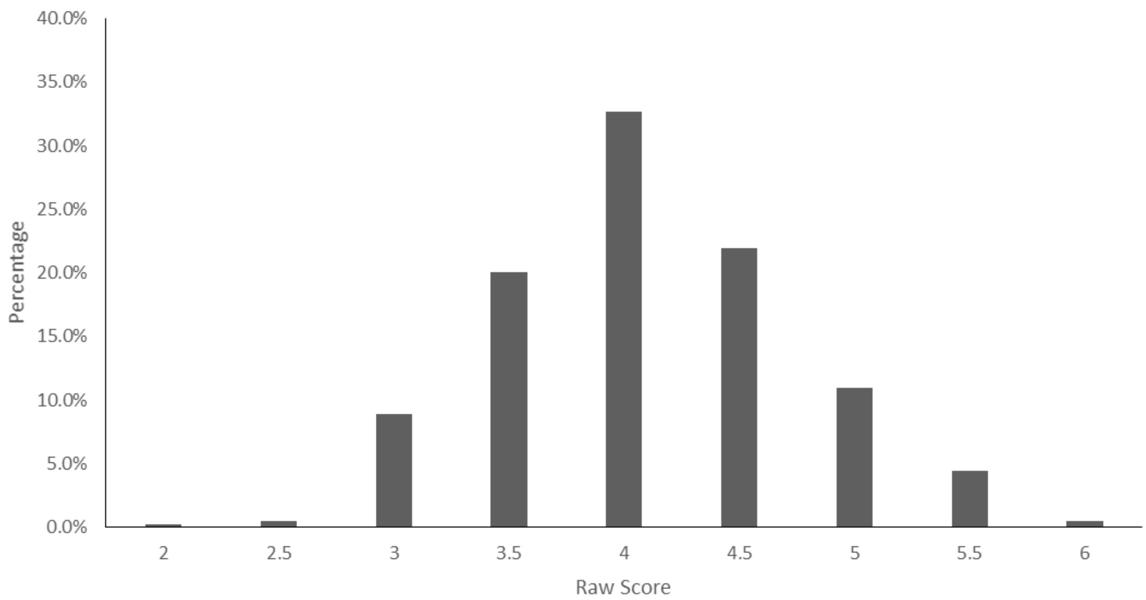

Figure 12. Raw GREW scores for students enrolled 2006-2013.

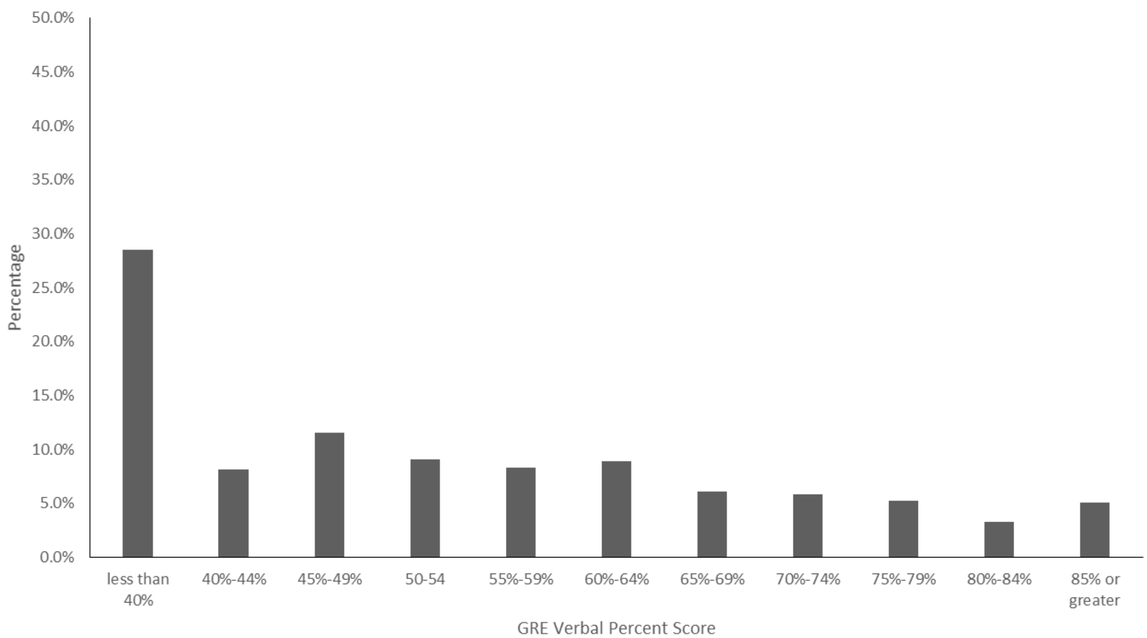

Figure 13. Percentile GREV scores for students enrolled 2006-2013.

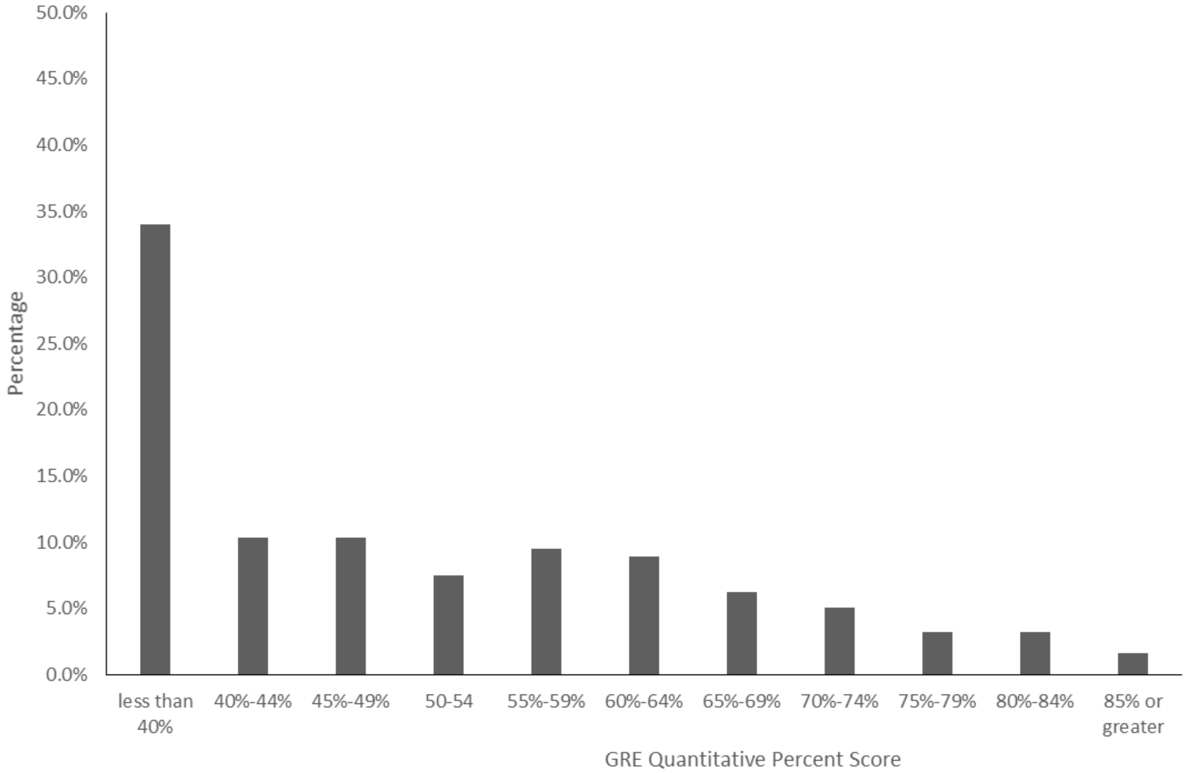

Figure 14. Percentile GREQ scores for students enrolled 2006-2013.

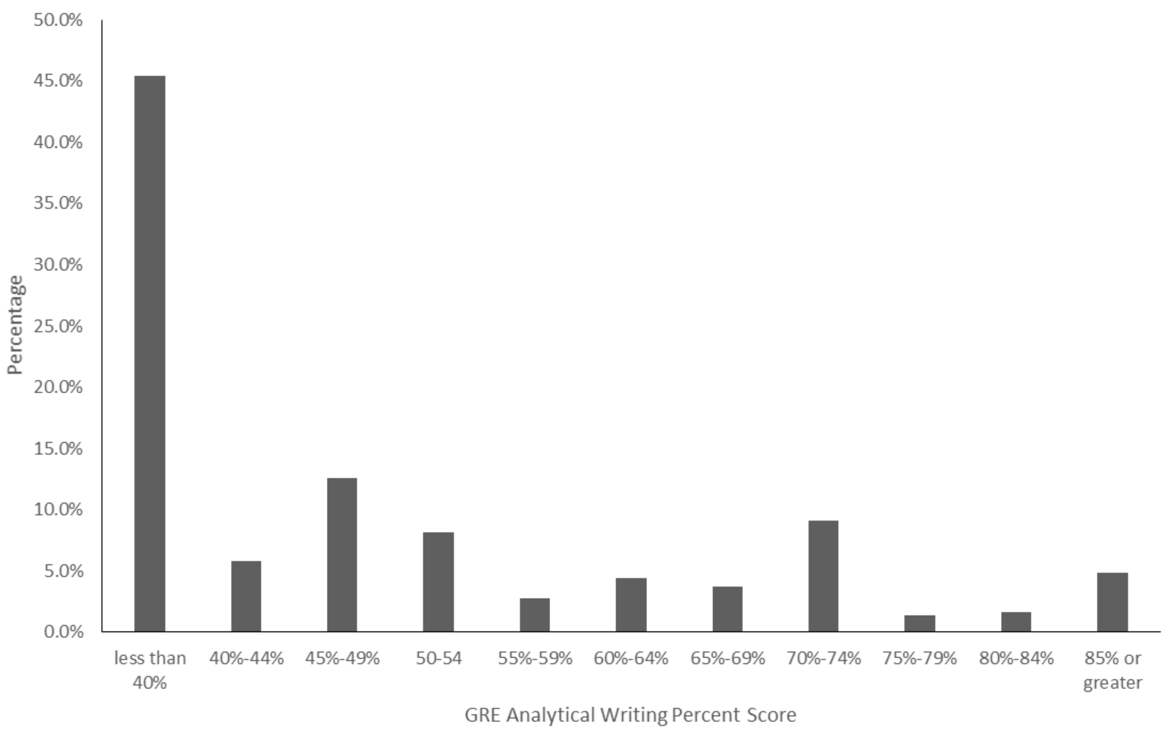

Figure 15. Percentile GREW scores for students enrolled 2006-2013.

Persistence of the Participants

With the general data collected on the students enrolled during the research period, the next step was to look at these data in regards to persistence. Each of the categories listed above has been broken down into the six categories and compared to all the students combined. Figures 16–19 compare the student demographics to each persistence category. Figure 20 compares the admission type to each persistence category.

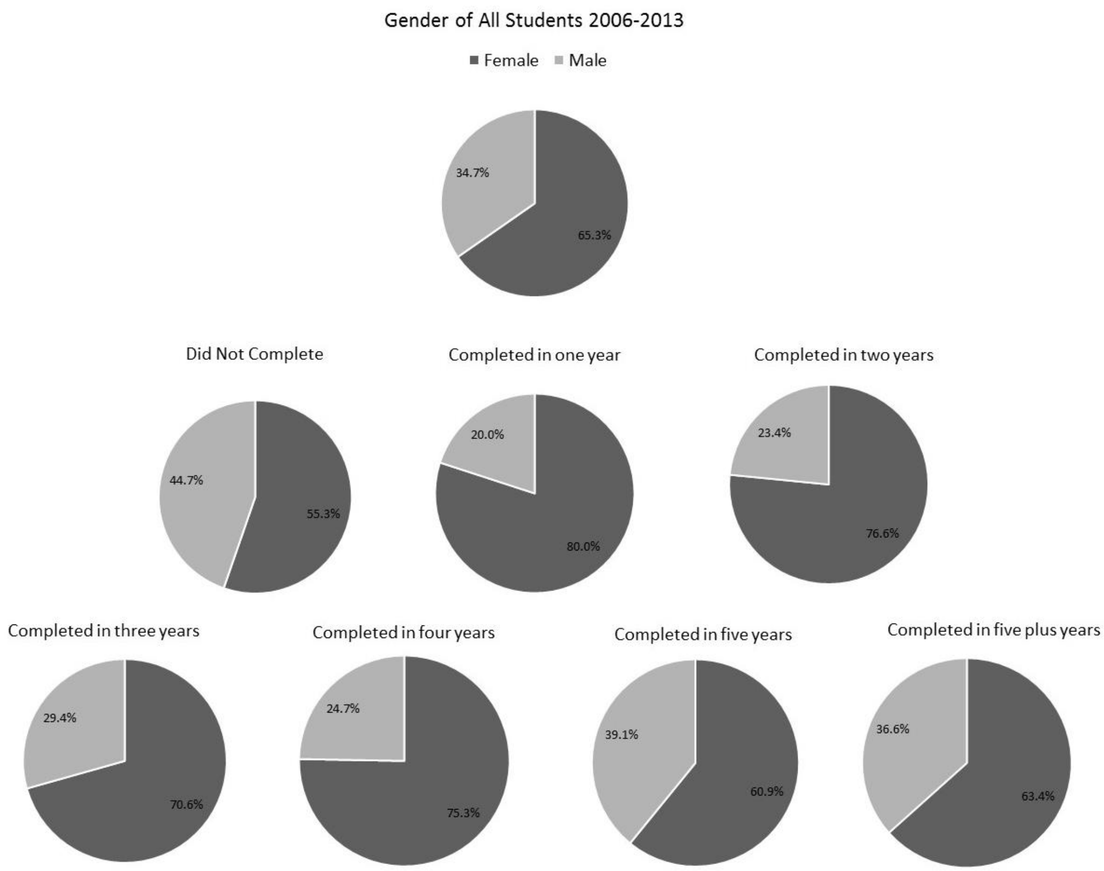

Figure 16. Breakdown of gender of M.S. degree students by completion rate.

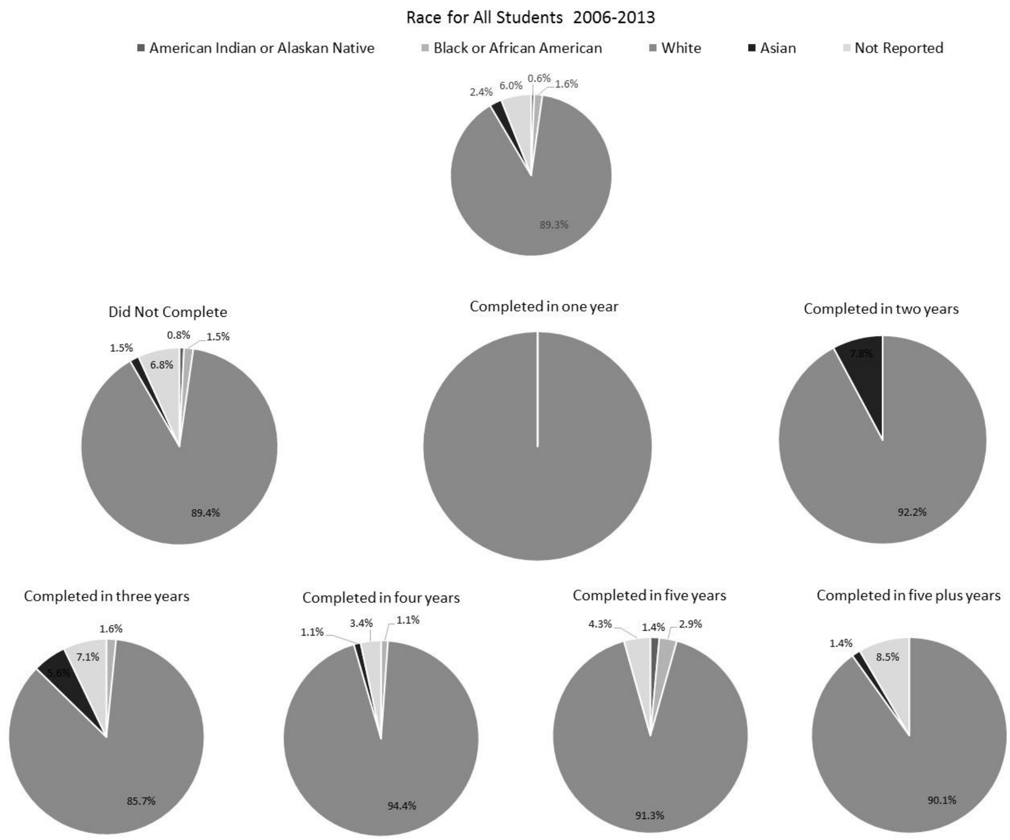

Figure 17. Breakdown of race of M.S. Degree students by completion rate.

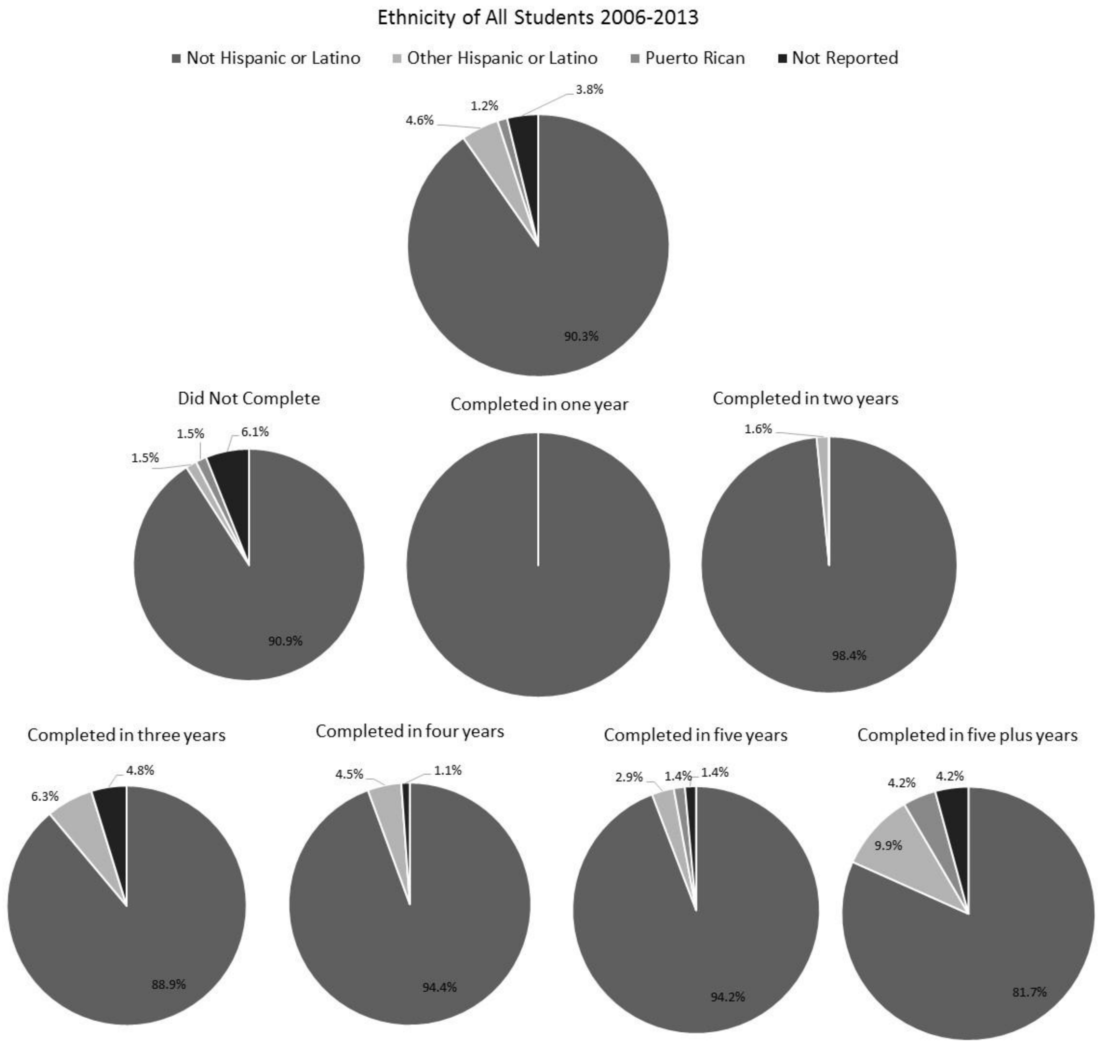

Figure 18. Breakdown of ethnicity of M.S. degree students by completion rate.

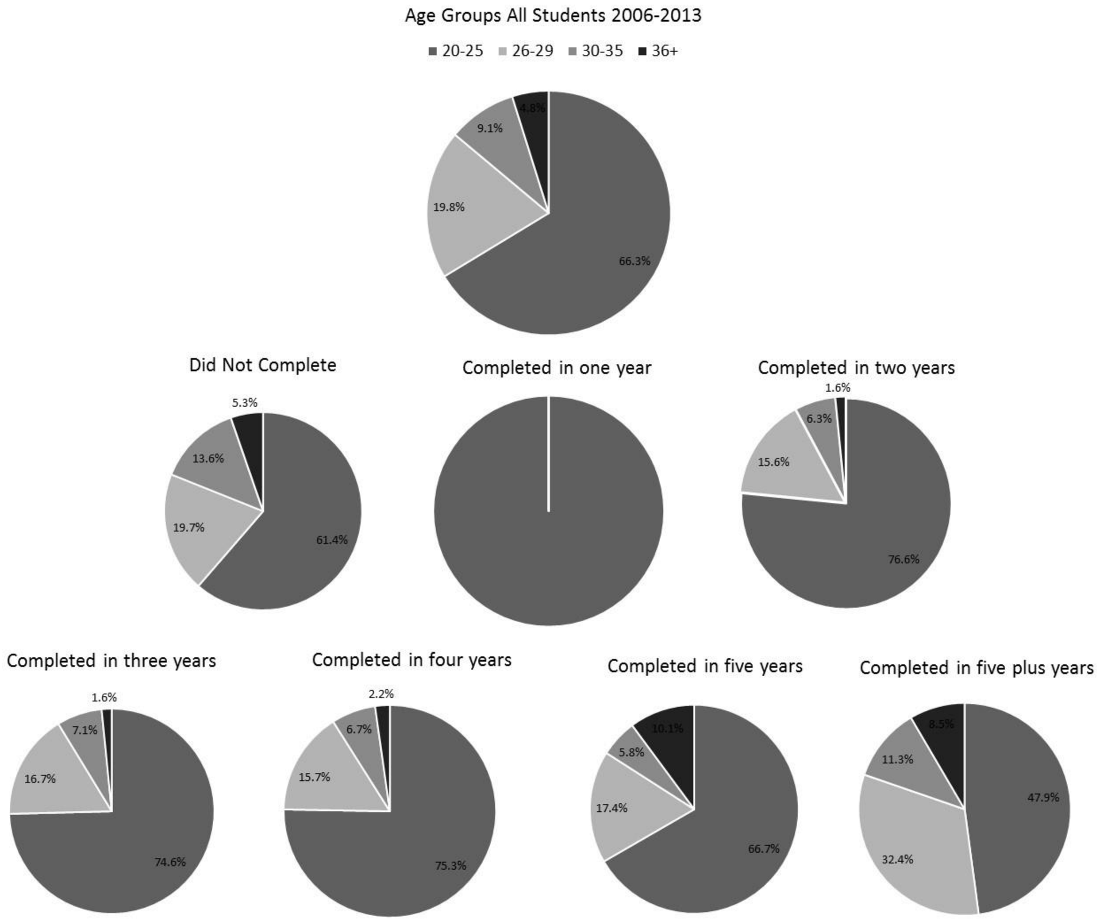

Figure 19. Breakdown of age of M.S. degree students by completion rate.

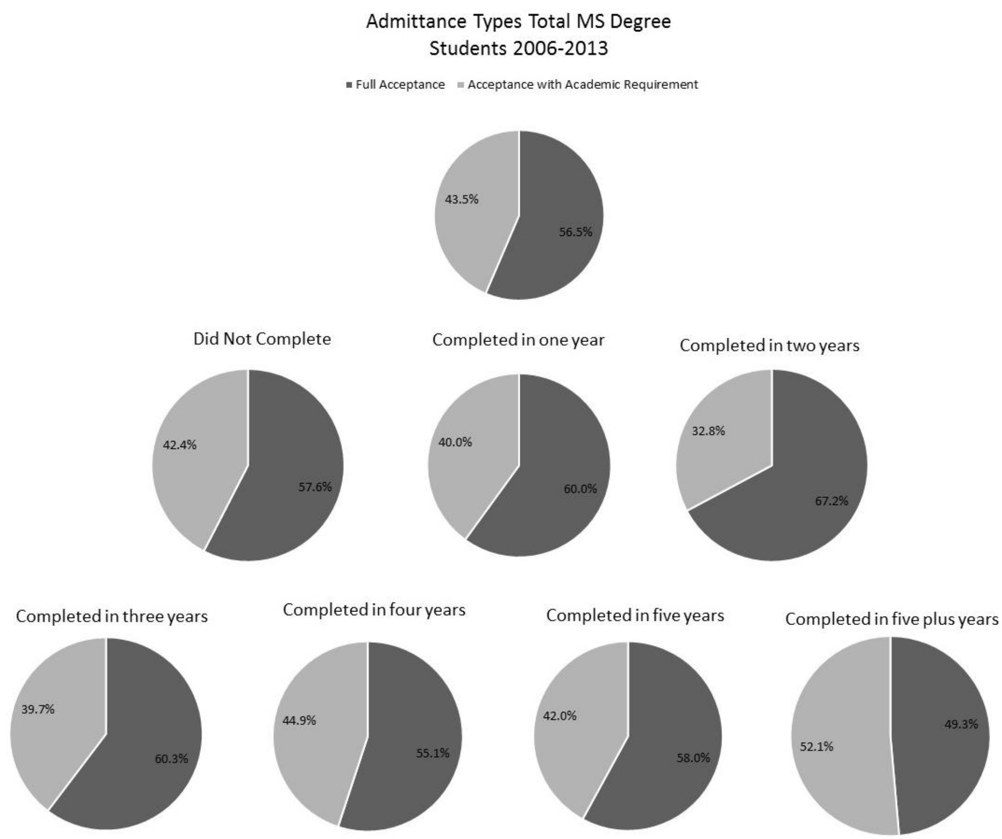

Figure 20. Breakdown of admittance types of M.S. degree students by completion rate.

While the majority of students did complete the degree program (Figure 21), it is also important to delve into the 27% who did not complete the program (Figure 22). This includes reviewing all of the academic data, especially the UGPA and UMGPA broken into the persistence categories (Figures 23 and 24). When split into the seven categories, there is a different median for each year.

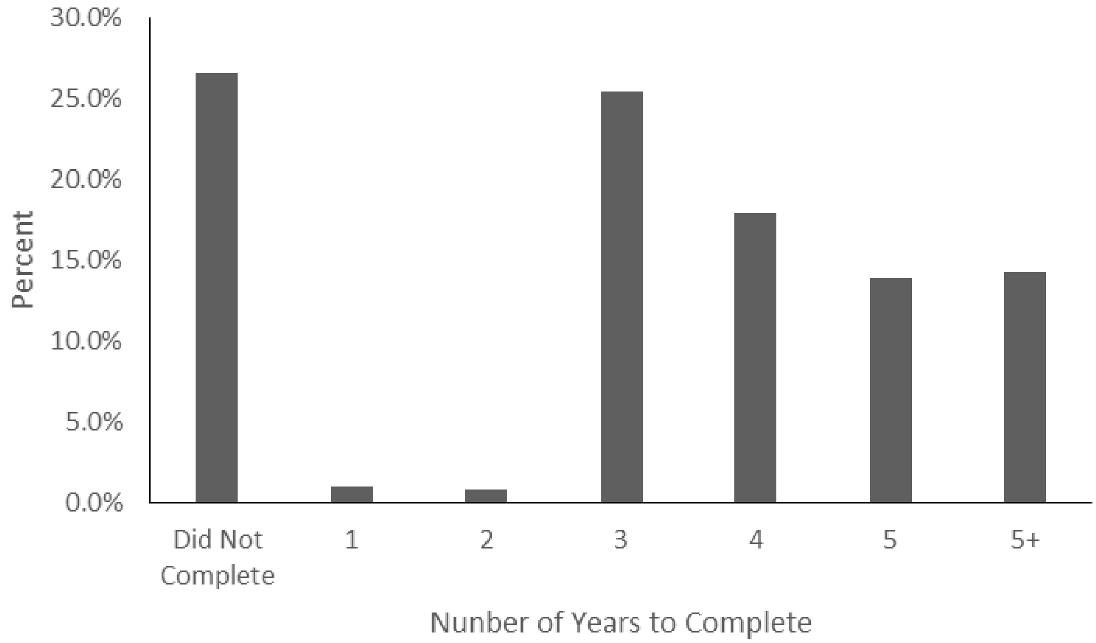

Figure 21. Breakdown of all students' completion rate 2006-2013.

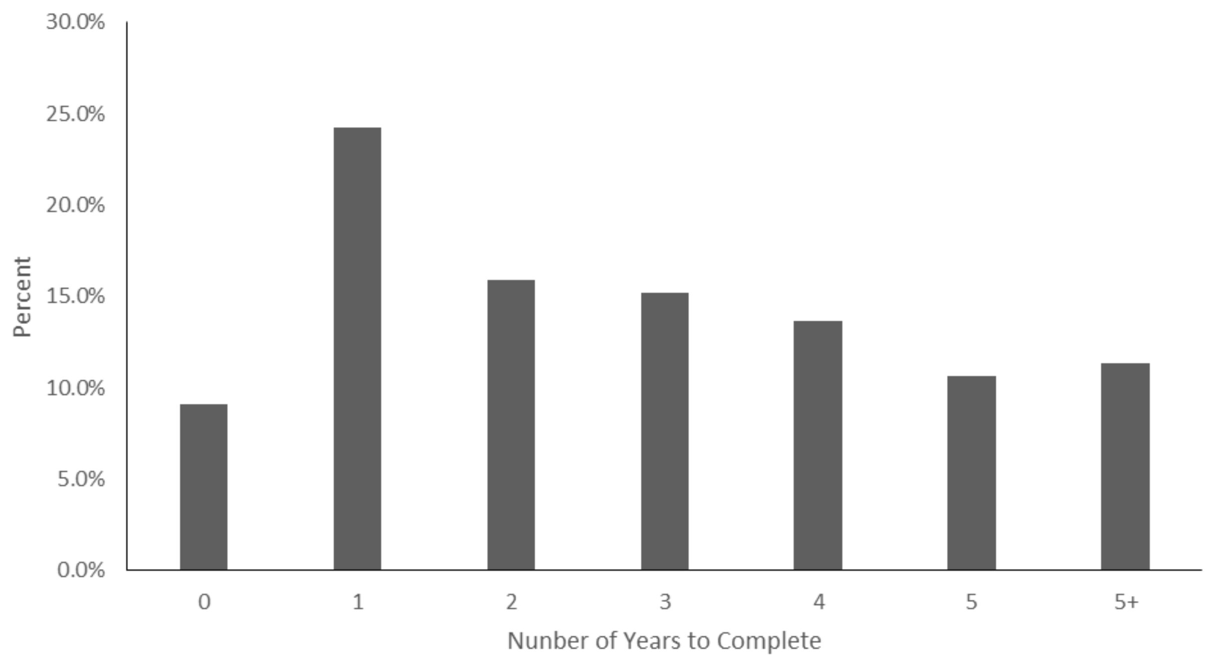

Figure 22. Breakdown of students who did not complete and number of years in the program 2006-2013.

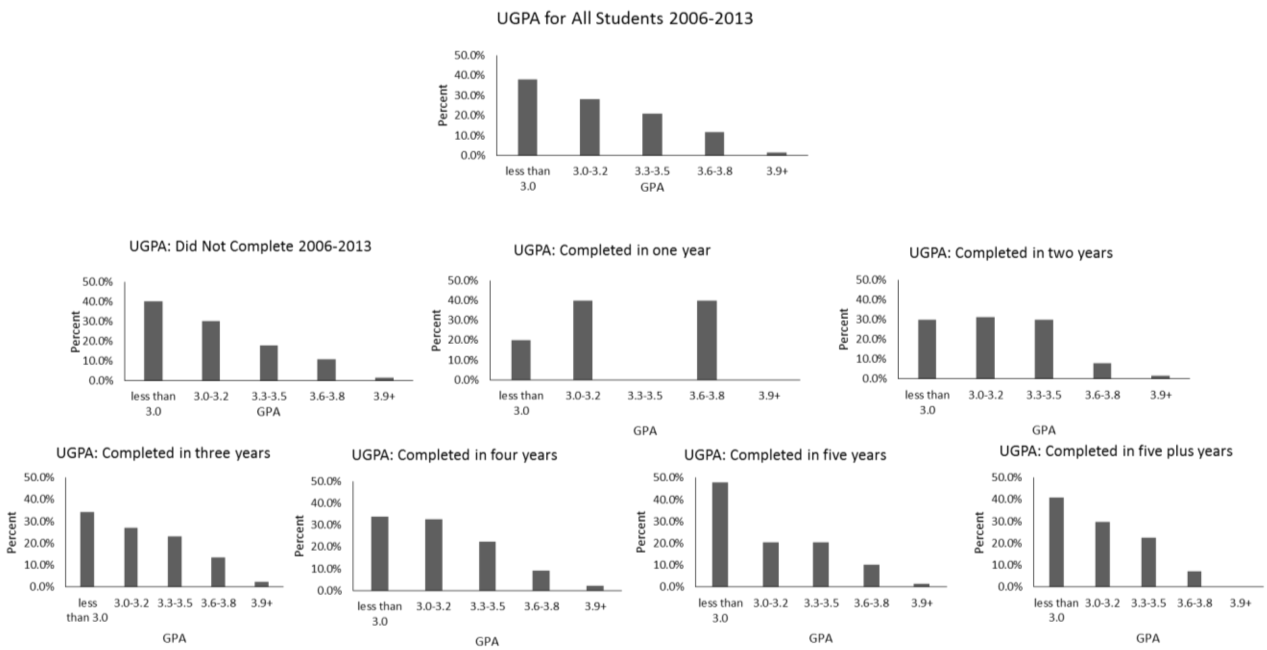

Figure 23. Breakdown of UGPA by persistence category.

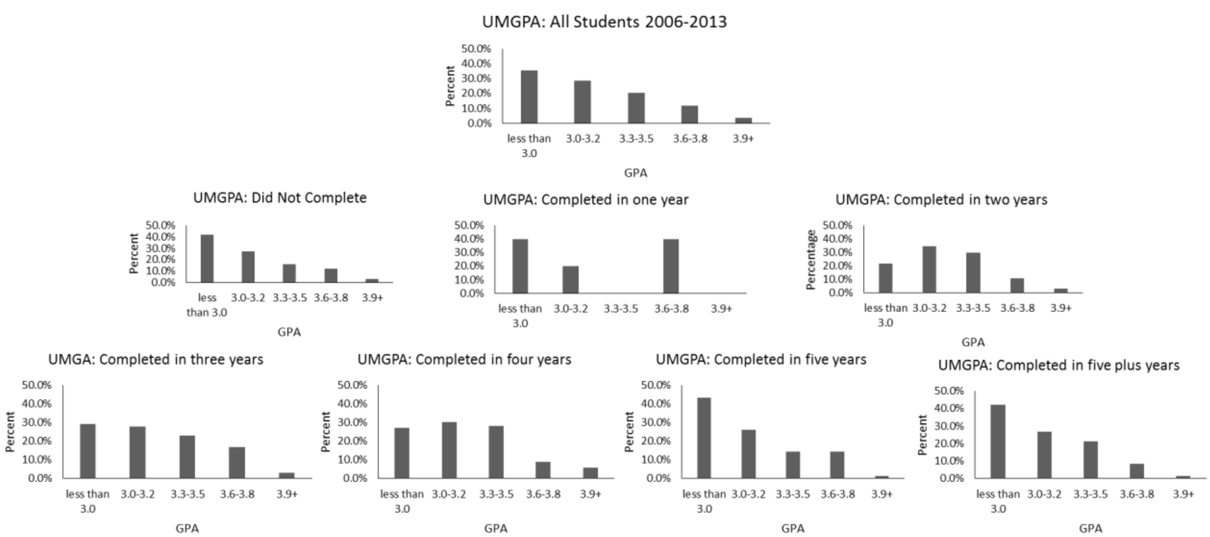

Figure 24. Breakdown of UMGPA by persistence category.

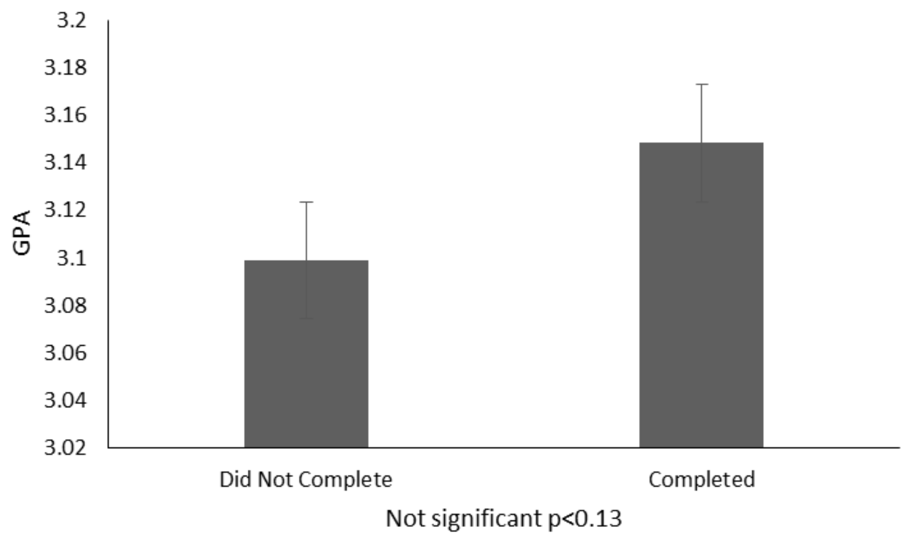

Figure 25. Two tailed t-test of unequal variances for UMGPA comparing students who graduated vs students who did not complete (not significant).

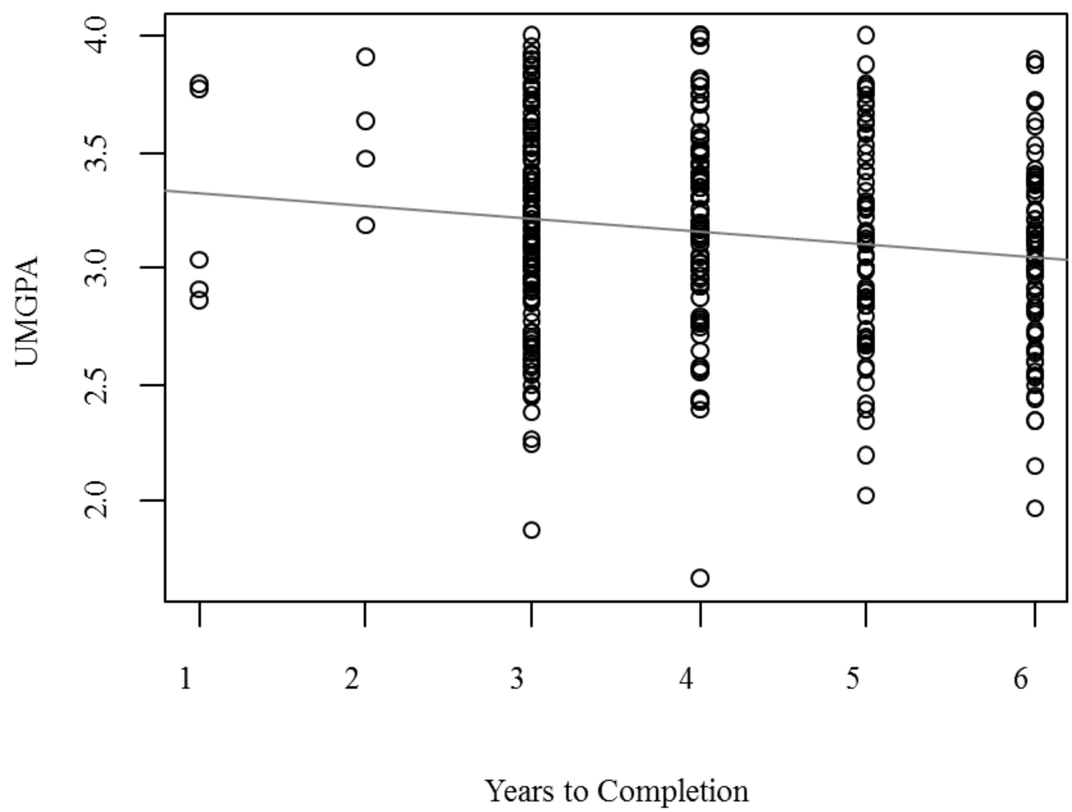

Figure 26. Linear model for UMGPA vs years to completion ($p<0.002$).

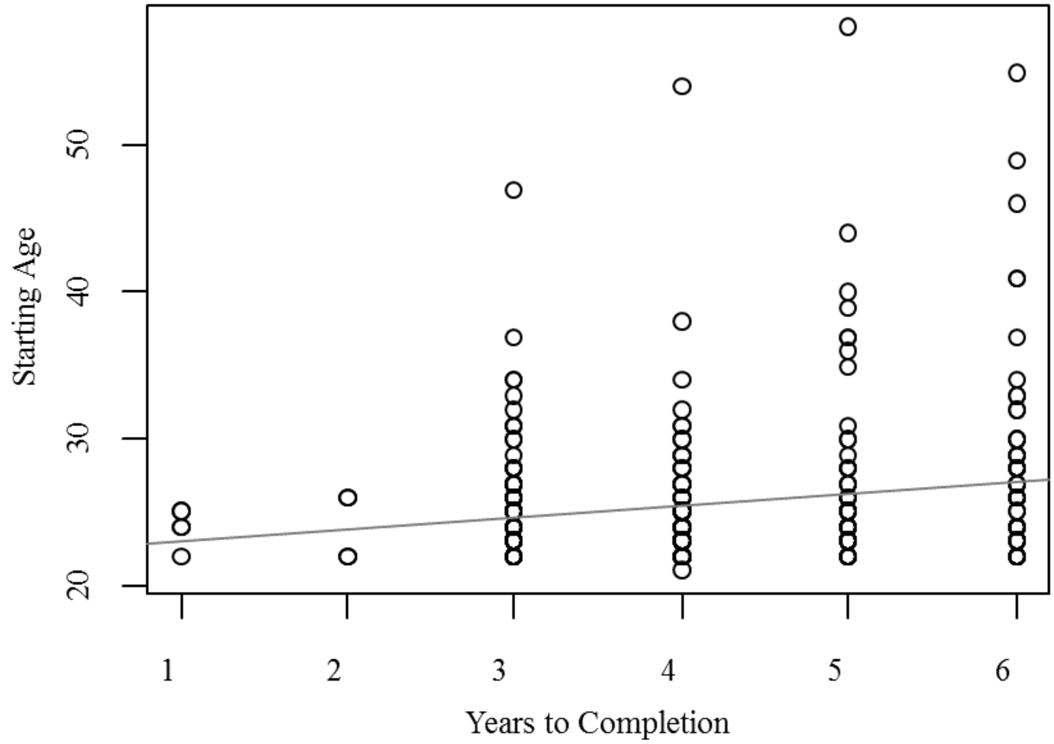

Figure 27. Linear model for age vs years to completion (p<0.00012).

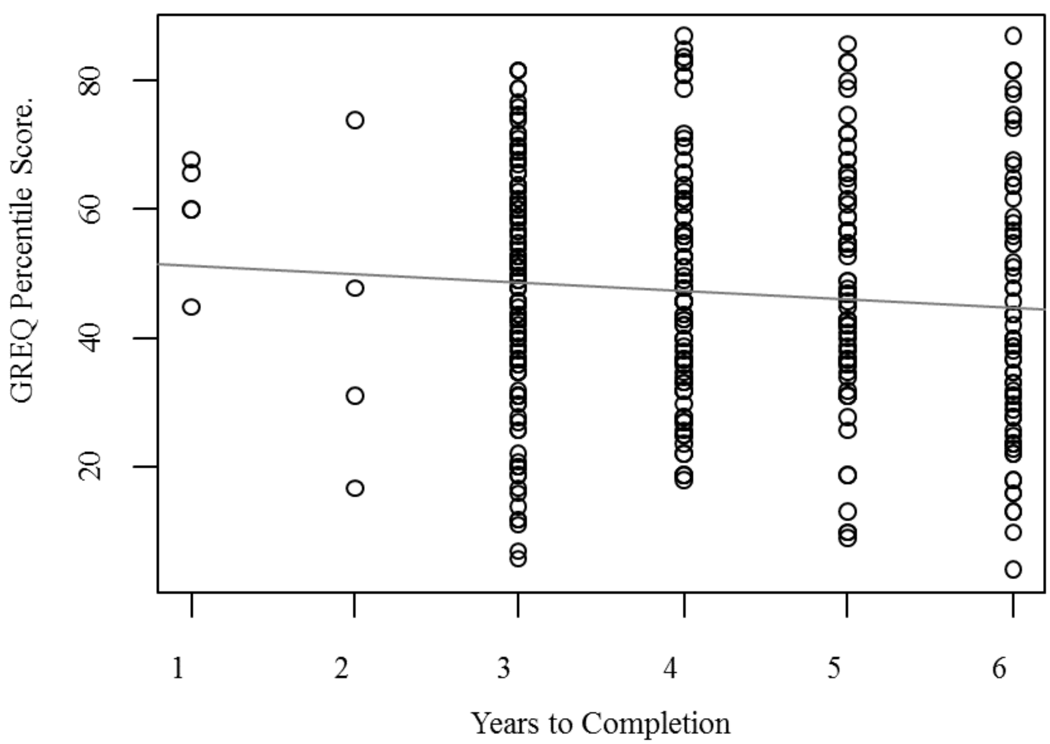

Figure 28. Linear model for GPAQ percentile score vs Years to completion (p<0.1).

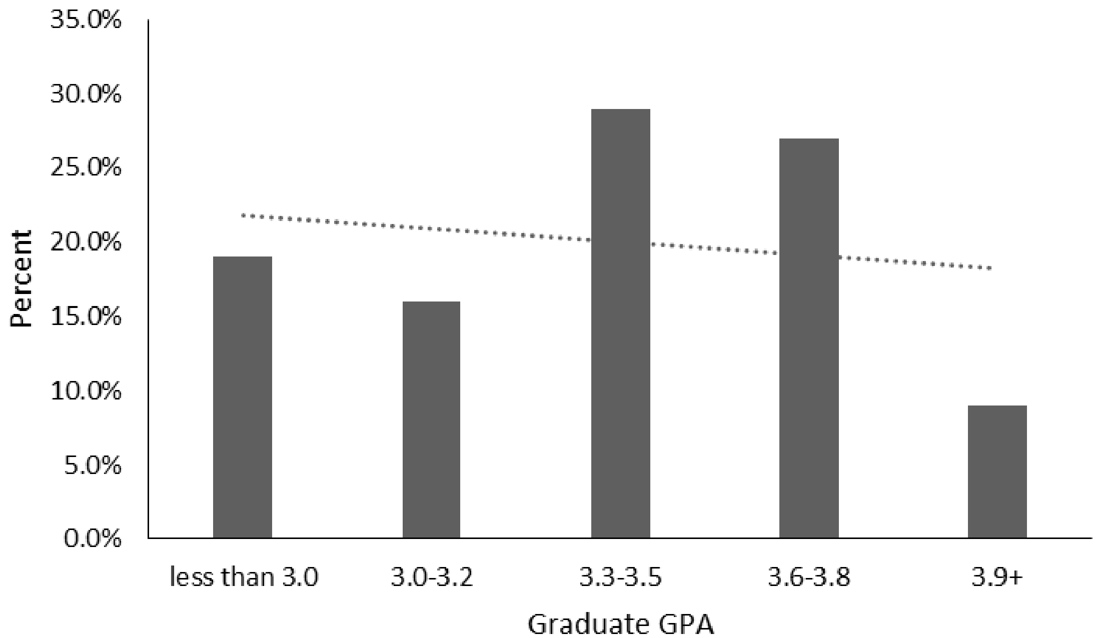

Figure 29. Graduate GPA for students who did not complete the degree.

Findings for Research Question 1

The findings for research question one which was what is the best criteria (Using GRE, UGPA, UMGPA, persistence, gender, race, age, ethnicity) to generate a Full Acceptance candidate in the marine science programs? When reviewing the data for all completed years, the UMGPA ($p<0.002$) is the primary factor pointing towards success. The GRE scores are not a significant contributor to success ($p>0.05$). Race and ethnicity are not significant factors, nor is age ($p>0.05$). UGPA is a not a contributing factor as well ($p>0.05$).

Findings for Research Question 2

The findings for research question two which was what is the best criteria (Using GRE, UGPA, UMGPA, persistence, gender, race, age, ethnicity) to generate an Accepted with Academic Requirements candidate in the marine science programs? The UMGPA is the primary criteria that points to success with these master's candidates UMGPA (p<0.002). The secondary criteria is the student's age when entering the program. The younger students finished faster (p<0.00012).

Findings for Research Question 3

The findings for research question three which was can one criteria (Using GRE, UGPA, UMGPA, persistence, gender, race, age, ethnicity) predict persistence better than others? Yes, the UMGPA is shown to be the most relevant of the admissions requirements (p<0.002). As this is the last eight courses within the applicant's major, it shows the ability of this potential student to comprehend the basic scientific method and concepts required in the master's program. The UGPA (p<0.1) can be augmented by the applicant taking courses outside the more disciplined science programs. This can then skew the UGPA into an acceptable range without the scientific background needed for the program.

Gender, race, and ethnicity (all p<0.1) are not shown to be contributing factors to completion. However older students are shown to take longer to complete the degree (p<0.0001). This may be related to family and employment restrictions, which are not such an impediment to the traditional student.

The GRE scores do not show a viable pattern for success. As these exams are taken on a single day, it does not show what one person can do over a long period of years. There is no significance between a high GRE score in any category and a shorter period to completion (p>0.05).

Findings for Research Question 4

The findings for research question four which was can all of the criteria (Using GRE, UGPA, UMGPA, persistence, gender, race, age, ethnicity) in the form of a multiple-effects model, describe persistence in a way that can be easily interpreted? With the development of the linear models, it was determined that there are two significant criteria when looking at a success model. Those are the highly significant UMGPA versus completion with a $p<0.002$ and age versus completion with $p<0.00012$. When creating the entire linear model using all criteria, it was found that all GRE scores as well as UGPA masked the significance of the UMGPA and age. With a $y=22.3 \pm 0.8$ it was shown that the age of a student predicts the speed of completion. The younger the student, the faster they complete their degree.

Summary

While there was plentiful data about the admissions and persistence of master's in marine science students, there is little relevance to most of the quantitative admission requirements to completion of the degree. The strongest indicator is the UMGPA which shows the most influence on how a student can comprehend and succeed in a marine science program. The GRE scores are shown to have little impact on the success of a student, and only the GREQ shows a trend for success. The UGPA can be increased by an applicant taking courses with a higher probability of scoring an A. Most of these are outside the science fields and would not assist the student in completing a marine science program.

Chapter 5: Discussion

Overview of the Study

Neither universities nor their students want to expend time, effort, and financial support/aid on an applicant who fails to complete the marine sciences program. The purpose of this correlated study was to examine at the master's program admissions criteria as well as demographic factors and determine what contributes to persistence in the program, and what factors would point to the successful completion of a marine science master's program. The literature shows that educational research needs to create a composite evaluation of all these areas to create an authentic view of the STEM pipeline applicant who will successfully complete a graduate program and enter the workforce (Gilman et al., 2015).

While many research projects have looked at individual issues in the breakdown of the STEM pipeline, these evaluations of various pipeline breaks have focused on single issues such as underrepresented students, gender, non-traditional students, GPA or GRE scores, or combinations of two of these foci (Espinosa, 2011; Allen-Ramdial & Campbell, 2014; Bielby et al., 2014). This study reviewed all of these factors and how each correlate to the successful completion of the master's of science in marine sciences.

Implications of Findings

When developing the admissions process for a STEM graduate program, and specifically a marine science STEM program, administrators look for a relationship between valid predictors and performance outcomes. These predictors are an important part of the process as it helps to ensure the success of the students in the program. Institutions have a responsibility to admit those students that are able to complete the program; otherwise, students are placed at a disadvantage and will waste time and money (Gayle et al. , 2011).

The M.S. in marine science degree focused on in this study shows that seventy-five percent of the students who enroll complete the program. Fifty-seven percent completed in three to five years, while thirty-eight percent completed in the two to three year range, which is considered a standard timeframe for degree completion (NSU, 2015). The non-traditional students were shown to take longer to complete the degree ($p<0.0001$), which can explain part of the skewedness towards longer completion time.

With $p>0.05$, the GRE scores show no significant value to completion of the master's degree. While the literature states that the GRE shows a comparison and balance of students from various schools (Kuncel et al., 2009), there was nothing in the dataset that contributes to that theory. Even analyzing the individual GRE sections (GREV, GREQ, GREW) showed little more than a trend ($p>0.05$).

Various literature on post-baccalaureate STEM programs focuses independently on persistence, reviewing ethnicity, age, and gender (Bielby et al., 2014). The issue of gender as regards to STEM degrees continues to garner attention in both academic and public realms (Stoet & Geary, 2012). Women are continually underrepresented in the advanced levels of natural sciences (Bleske-Rechek & Browne, 2014). While the student population of this study is greater than 65% female, it must be noted that a larger portion of the male population ($p<0.05$) tends to not complete or take a longer period of time to completion of the degree. The race and ethnicity numbers are too small to be of any significance in this study.

While the UGPA is a commonplace criterion for the graduate application process, and is considered a measure of academic achievement (Imose & Barber, 2015), one issue with the UGPA is the variability of teaching standards and grading evaluation. Grading systems vary between universities as well as between individual courses. It is difficult to compare UGPA from different undergraduate schools as courses and curriculums vary (Bailey, Rosenthal, & Yoon, 2014). Undergraduate students quickly learn which courses are considered "easy" to impact their GPA. This results in a student who has had to contribute less to achieve a higher grade (Gershenfeld et al., 2015). This research study confirmed this study as the UGPA was not significant in completion of the degree ($p>0.05$).

One way to offset the skewed GPA is to look at the undergraduate major GPA (UMGPA) in their admissions process (Burmeister et al, 2014). The UMGPA, usually defined as the last 60 hours in major coursework, has shown an even higher correlation to success (Imose & Barber, 2015). This research study confirms this correlation between the UMGPA and completion of the degree ($p<0.002$). As the UMGPA focuses only on the student's major, it eliminates the "easy" courses that impact a student's UGPA.

Persistence in the STEM fields ranks at 52% in the biological sciences (NSF, 2014). Once admitted into the M.S. in marine science graduate programs, various issues can impact persistence. For the university, a high level of persistence indicates that the graduate admissions and education processes are working synchronously to produce the STEM researcher, and not losing time, effort, and money on admitting graduate students who lack the strong background to successfully complete a graduate degree (Habley et al., 2012). In this research study, of those students that did not complete (27%), less than 5% actually flunked out of the program (GGPA<3.0). In fact, most of the students who did not complete were in the program for greater than two years before leaving.

According to the program's catalog, all coursework should be completed by that time. This implies the student was in the research phase of their program, either the thesis or capstone track. So while research has shown that the fit with faculty interests ranks as the predominant reason a student chooses a specific graduate school, the faculty supervision given to the student must also be evaluated (Colarelli et al., 2012).

While there is no statistical data currently associated with faculty versus student completion, greater than 70% of the students that did not complete were in the program for more than three years. At this point, the student is working in a tutorial format with their major professor. While the student and the major professor might want to continue their research after three to five years, one issue that can affect their completion of the degree is financial. Once the student reaches 150% of the degree's required credits, they have failed student academic progress (SAP) and can no longer receive federal financial aid (NSU, 2015). This creates a burden on the student. Failure to complete these levels of knowledge would impact the STEM pipeline and persistence into the STEM workforce (Foltz et al., 2014).

Limitations of the Study

Other factors, including letters of recommendation, the statement of career goals essay, research tracks, and the total number of students in the graduate program were not included in this study. Data for these areas have not been collected, and the information is anecdotal. These are areas that need to be expanded upon in the M.S. marine sciences program.

Letters of recommendation allow the graduate admissions office to see a personal view of an applicant's academic success. These letters are regarded as providing a guide to the applicant's performance and giving a qualitative review to balance the quantitative view of the UGPA and GRE (Kuncel et al., 2014). While the graduate school of marine science requires three letters of recommendation from each applicant, there is little in the applicant history to determine if they contribute to a student's success. It is recommended that the letters of recommendation be included in the quantitative data by ranking them using a Likert type scale (Babbie, 2005). By having the recommender fill out a small survey as well the letter, it will allow the admissions office to balance the academic scoring with the real-life potential of an applicant. The ability for an applicant to have the fortitude and mental strength to complete a master's program is just as important as the academic quantitative data, if not more so. This shows true persistence to complete the degree.

The statement of career goals is the primary writing example for the graduate program. Writing is the primary communication in the STEM fields. Most information between researchers occurs in journals, abstracts, and posters. The inability to communicate succinctly leads to the lack of advancement in the STEM workforce (Husbands Fealing & Myers, 2012). The length of the statement ranges from 500 words to three pages. Currently there is no process to review this writing example. A process needs to be created which reviews the applicant's preparation for communicating in a basic academic style, which includes organization, grammar, style, and depth of language (Swales & Feak, 2004).

Research has also shown how funding agencies believe that lower quality students diminish the reputation of a research facility and ultimately the amount of the school's external funding (Stephan, 2012). It is important to understand the history of the master's of science programs as well as the development of university research funding to understand the significance of a successful admission pool. The M.S. in marine sciences currently has no complete instrument (other than looking at course registrations) to review what student is on what research track (capstone or thesis). Students have the ability to take a capstone or thesis track for their final project (Nova Southeastern University Oceanographic Center, 2014). This information would have benefited the research in determining which track was the most successful and least time consuming. This would lead to lower costs for the student and the ability for the program to increase the turnover rate with the faculty to increase contact hours with more students at various stages in their degree program.

The collection of departmental admission data for graduate applications is vital (Johnson-Motoyama et al., 2014). A strong limitation to the study was the decrease in the number of students that could be used in the study. Numerous parts of applications were missing, especially in the earlier incoming students. Much of that was due to the transition from paper to electronic storage with the university. While a few of the applicants were in the dual admissions programs with the university's undergraduate school, most of the lost data was due to incomplete data entry.

Recommendations for Further Research

In today's educational environment, faculty are finding students are increasingly passive in the learning process. More and more faculty are reporting students expecting their entire education path will be laid out with minimal effort on the student's side (Harris & Cullen, 2010). Research has shown that in today's digitally driven economy, at least a baccalaureate and, in the natural sciences, a master's degree is absolutely required to become economically independent. This has led to an unprecedented influx of students to the realm of higher education, many of whom are not prepared for the academic environment and its challenges (Kuh et al., 2010). It is because of this influx that the datasets must be expanded.

While this is a correlated study, it is recommended that a qualitative study be matched with this dataset. One issue to look at is the faculty contributions to the completion of a student's degree. An area to research and document includes contact hours, mentoring, and participation of the faculty member during the student's degree process, especially the research phase. Master's of science programs in the marine sciences traditionally require a faculty member be assigned to a graduate student (Willey, 2012). So while research has shown that the criteria ranking potential graduate students is important, the fit with faculty interests ranks as the predominant reason a student chooses a specific graduate school (Colarelli et al., 2012). Lack of interest from the faculty and/or student can lead to failure in persistence. One suggestion is to create a review process where the student and faculty member can determine fit and sustainability in the research project.

When reviewing the STEM pipeline from undergraduate, to graduate, to workplace, researchers found that the number of STEM graduates have declined in the past 10 years (Maltese & Tai, 2011). Areas reviewed looked at anti-deficit areas and how students not normally considered STEM student prospects can be included and succeed. The adult learner (non-traditional student) can impact persistence as well as the quantitative and qualitative measures submitted to the admissions committee (Kuncel et al., 2014). Non-traditional students, those aged 30 or more, do take longer than the traditional student to complete, and this must be worked into the admissions and advising process. While first-year students of any age must deal with the change in school, people, and in most cases, location, this can be a very stressful time for those in the higher risk categories of non-traditional students. These non-traditional students have the potential to become successful members of the STEM workforce, but requires the development of specific plans to accommodate their busy schedules and family life. These at-risk students are need extra time and encouragement from the faculty and staff in the program.

Direct Impact of Study

Master's degree programs and their graduate admission departments are struggling to find a strategy to enhance the U.S. workforce (Allen-Ramdial & Campbell, 2014).With the completion of the data analysis, it was presented to the chair of the marine sciences department. Action was implemented immediately on three items: admissions procedure, advising process, and data collection. While only in place for three months, all seem to be beneficial.

In conducting a literature review of admissions requirements and information for master's of science in the marine sciences, there are vagaries in the weight of each requirement (Cannady et al., 2014). With the data from this research study showing that UMGPA is of primary importance, it has been given more weight during the admissions process. Sedlacek (2014) noted that there is little correlation between the GRE score of an applicant and their ultimate success in a STEM program. This research study confirmed this statistic. So the GREs, while still required, are weighted less than before. These test scores will be used to evaluate students for potential scholarships, but not admittance into the program. The admissions office is in the process of revising the entire admissions procedure and requirements; this will include a group of faculty evaluating the letters of recommendation and the statement of career goals with a Likert scale system (Babbie, 2005).

STEM graduate programs in Fisk-Vanderbilt and the University of South Florida have reduced the weight of the GRE score during the applications process. Their admissions committees select applicants based on a set of skills and character attributes that align the potential student with their program (Miller & Stassun, 2014). The results from this research study have allowed the graduate marine sciences admissions and program offices to pinpoint incoming students that are at potential risk of falling behind or not completing the degree. These students are flagged upon entrance into the program and are monitored on a semester basis. By being proactive with these students, the program office is able to guide them into support channels and not lose them in anonymity.

With the aging and increasing diversity of the US population and the increased use of technology in the workplace and in the classroom, the percentage of nontraditional students is expected to increase over the next quarter century (Shepherd & Nelson, 2012). With this knowledge, non-traditional student advising has been expanded. The non-traditional student advisor is trained to work with students that need extra time, patience, and help with technology. The non-traditional student advisor is available off of normal working hours to alleviate the stress of these older students from having to take time off from their work to have their questions answered.

While the research questions might start to focus on which method should be used, it is the purpose of the research that brings the method into focus (Creswell, 2012). This research study brought to light various inadequacies of data collection for the graduate marine sciences admission and program offices. A standard protocol has been developed and a template designed that all members of these offices are using to input data. By continually using these templates, the data collection should be standardized despite inevitable employee turnover.

Conclusions

Kuncel et al. (2013) noted that many aspects of the graduate application process have been reviewed and evaluated. Meta-analysis has ranked the various portions of the admissions application and how it relates to persistence. Future research indicates that drilling into admissions and persistence data will develop a finer process in pointing to the success of a STEM graduate applicant. This correlated study of a graduate admissions program provides important quantitative data to administration. This fine tunes what they are looking for in a marine science masters student and allows them to predict students with extra needs. Before this study, the program office was using possibilities, probabilities, and small scale statistics to determine their course of action. These statistics show that a strong master's candidate is one that does well in their major classes in undergraduate, has the ability to adapt to the rigors of a graduate program, and has the perspicacity to see it through.

This research study has shown that GREs have little to contribute to the admission process in the master's of science in marine science. The majority of the applicants score below the admission requirement, yet they persist. It is recommended by this researcher that the graduate admissions office of the marine sciences program review the use of the GRE as a mandatory admissions requirement. The cost of the exam plus the overt stress put on a potential applicant for a result that does not relate to persistence could be detrimental to the acceptance process of the program (Bleske-Rechek & Browne, 2014). The letters of recommendation are a key factor not studied here. It would be interesting to see if the new application process, using a Likert scale on letters of recommendation and a strong weighted UMGPA, would strengthen the application pool and thus the students in the program.

The final result of this research project is not to reject a prospective student, as this data shows most students who apply to the master's of science in marine biology will complete. This project gives the administration advanced knowledge about a particular student type and how to develop an academic and advisory plan to increase success and decrease time to completion in the program. This includes developing specific plans for non-traditional students and accommodating their busy schedules and family life, and at-risk students who are first-time graduate students in their families and need extra time and encouragement from the faculty and staff in the program.

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Appendix A

Dean's Approval Form

January 28, 2015

Applied Research Center
Nova Southeastern University
1750 NE 167th Street
North Miami Beach, FL 33162

University IRB Office:

As Dean of the Oceanographic Center, I have given Ms. Melissa L. Dore permission to review and use student and admission archival data stored by the Oceanographic Center. I have spoken with Ms. Dore and understand the scope of her research, her use of the data, and how it will be beneficial to the Oceanographic Center.

I understand how the data will be gathered and that all personal identifiers will be stripped from the data by the program office before being presented to Ms. Dore and that it the project will be done in a confidential and appropriate manner.

Should you have any questions, please feel free to contact me.

Sincerely,

Richard E. Dodge, PhD
Dean
NSU Oceanographic Center

Appendix B

United States Universities With Master's of Science Degrees With a Major/Concentration in the Marine Sciences

University Name	Major
Bowling Green State University	Biological Sciences
California State University	Marine Sciences
Coastal Carolina University	Coastal Marine and Wetland Studies
College of Charleston	Marine Biology
Florida Atlantic University	Biology
Florida Institute of Technology	Marine Biology
Florida International University	Biology
Harvard University	Organismic and Evolutionary Biology
Hawai'i Pacific University	Marine Sciences
Humboldt State University	Fisheries
Nicholls State University	Marine and Environmental Biology
Nova Southeastern University	Marine Sciences
Oregon State University	Fisheries Science
Rutgers University	Oceanography
San Diego State University	Marine Biology
San Francisco State University	Marine Biology
San Francisco State University	Marine Sciences
Savannah State University	Marine Sciences
Sonoma State University	Biology
Stanford University	Biology
Stony Brook University	Marine Science
Texas A&M Corpus Christi	Marine Biology
Texas A&M Galveston	Marine Biology
Texas State University	Aquatic Resources
University of Alaska Fairbanks	Marine Biology
University of Alaska Fairbanks	Oceanography
University of California San Diego (Scripps)	Marine Biology
University of Florida	Fisheries and Aquatic Sciences
University of Georgia	PhD Marine Sciences
University of Maine	Marine Biology
University of Maryland	Marine Estuarine Environmental Sciences
University of Massachusetts	Marine Biology
University of Miami	Marine Biology and Fisheries
University of New England	Marine Sciences
University of New Hampshire	Marine Biology
University of North Carolina- Chapel Hill	Marine Science
University of North Carolina- Wilmington	Marine Biology
University of Oregon	Biology
University of Rhode Island	Oceanography

University of San Diego	Marine Sciences
University of South Alabama	Marine Sciences
University of South Florida	Biological Oceanography
University of Southern Mississippi	Coastal Sciences
University of Texas- Austin	Marine Science
University of Washington	Oceanography
University of West Florida	Biology
University of Connecticut	Biological Oceanography
Western Washington University	Environmental Science
William and Mary - VIMS	Marine Science

Appendix C

GRE Concordance Tables for Verbal and Quantitative Portions of the Exam (Educational Testing Services, 2016a)

ETS GRE

Table 1D: Verbal Reasoning Concordance Table

Prior Scale	Current Scale	% Rank*
800	170	99
790	170	99
780	170	99
770	170	99
760	170	99
750	169	99
740	169	99
730	168	98
720	168	98
710	167	98
700	166	97
690	165	95
680	165	95
670	164	94
660	164	94
650	163	92
640	162	90
630	162	90
620	161	88
610	160	85
600	160	85
590	159	82
580	158	80
570	158	80
560	157	75
550	156	72
540	156	72
530	155	68
520	154	64
510	154	64
500	153	60

Verbal Reasoning Concordance Table (continued)

Prior Scale	Current Scale	% Rank
490	152	55
480	152	55
470	151	51
460	151	51
450	150	47
440	149	42
430	149	42
420	148	38
410	147	34
400	146	30
390	146	30
380	145	26
370	144	23
360	143	19
350	143	19
340	142	17
330	141	14
320	140	11
310	139	9
300	138	7
290	137	6
280	135	3
270	134	2
260	133	1
250	132	1
240	131	1
230	130	
220	130	
210	130	
200	130	

*Based on the performance of all individuals who tested between July 1, 2012 and June 30, 2015. Percentile ranks are updated yearly.

Prior Scale	Current Scale	% Rank*
800	166	91
790	164	87
780	163	85
770	161	79
760	160	76
750	159	73
740	158	70
730	157	67
720	156	63
710	155	59
700	155	59
690	154	55
680	153	51
670	152	47
660	152	47
650	151	43
640	151	43
630	150	39
620	149	35
610	149	35
600	148	31
590	148	31
580	147	27
570	147	27
560	146	24
550	146	24
540	145	20
530	145	20
520	144	17
510	144	17
500	144	17
490	143	14
480	143	14
470	142	12
460	142	12
450	141	10
440	141	10
430	141	10
420	140	8
410	140	8
400	140	8
390	139	6
380	139	6
370	138	4
360	138	4
350	138	4
340	137	3
330	137	3
320	136	2
310	136	2
300	136	2
290	135	1
280	135	1
270	134	1
260	134	1
250	133	1
240	133	1
230	132	
220	132	
210	131	
200	131	

Note: Score users should use special care in evaluating test takers who received a Quantitative Reasoning score at the top end of the prior 200-800 score scale. Now, with the current 130-170 score scale, we can provide more differentiation for higher ability test takers. However, test takers who took the prior test and received an 800 on the Quantitative Reasoning measure, received the highest score possible that they were able to earn on the measure. Therefore, this information should be considered when making admissions decisions.

*Based on the performance of all individuals who tested between July 1, 2012, and June 30, 2015. Percentile ranks are updated yearly.