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# Establishing Enhanced Learning Outcomes in Science For First Generational Undergraduate College Students

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**Abstract**

First-generation students represent an increasing percentage of the demographic for college and university enrollment at both the undergraduate and graduate levels. Since 2001, results from the National Center for Education Statistics Longitudinal Study, indicates 'higher percentages of first-generations college students attended public postsecondary institutions-76 vs. 72%' (Redford & Hoyer, 2017). There is insufficient research, however, concerning how first-generation students' needs are different, even unique, from those students who are second-generation and beyond attending college (National Center for Educational Statistics, 2017). Since this increase of students enrolling in post-secondary education, 'understanding the needs of first-generation students is imperative more now than ever' (Gibbons and Woodside, 2014). The intent of this study is to determine the effectiveness of pedagogical methods applicable to the needs of first-generation college students. Successful implementation of selected pedagogical methods will optimistically establish enhanced student learning outcomes for first-generation students. This proposed research design will be a mixed methods study, utilizing both quantitative and qualitative analysis. Quantitative data will consist of both pre- and post-test scores measuring self-confidence towards science learning. Pretest data will provide an initial comparison of first-generational students with their general population counterparts in terms of similarities and differences. Qualitatively, the study will utilize ethnographical examination to frame interview questions and shape the choice of pedagogical methods employed – this is to include interview data, select narratives, pedagogical artifacts, and student work samples. In addition, this analysis will utilize phenomenological interview methodology to frame first generation students' self-confidence, self-efficacy towards science and science learning.

*Keywords: First Generation, Science Teaching, Science Learning, Student Self-Confidence*

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# Introduction

## Problem Statement

First-generation college students generally classify as the generation of students in which a parent has not obtained post-secondary education or the completion of a post-secondary degree (Thayer, 2000). 'Extensive research exists in regards to the characteristics of these students who are identified as first generation college students, yet pervading trends within this population of students can serve as useful understandings for those teaching in the college classroom' (McMurray and Sorrells, 2009). Past educational research conducted has found no differences in GPA between first-generation and traditional college students (Zalaquett, 1999). Reasoning for such academic success with first-generation students can be attributed to the Higher Education Act of 1965. This provides additional funding by the federal government that supports students overcoming financial barriers to higher education. TRIO programs exist to address social, economic, academic, and cultural barriers towards higher education, who are often among the first in their families to attend college (Coles, 1998). However, limited evidence exists in regards to instructional methods that positively influence first-generation student's educational success.

## Purpose Statement

The purpose of this study is to determine the effectiveness of pedagogical methods employed specifically to meet the needs of first-generation students enrolled in an introductory college biology course. In addition, a secondary purpose of this study will be to determine whether this pedagogy is equally effective in enhancing science learning for general undergraduate students (non-first-generation college students). A mixed methods quantitative and qualitative investigation will be conducted, for which pilot data will function as a baseline in

the development of qualitative data collection. This qualitative material will include semi-structured interviews, student narratives, instructor self-narratives, and pedagogical artifacts.

**Central Question:**

What pedagogical methods employed are most effective in providing the intended science learning outcomes?

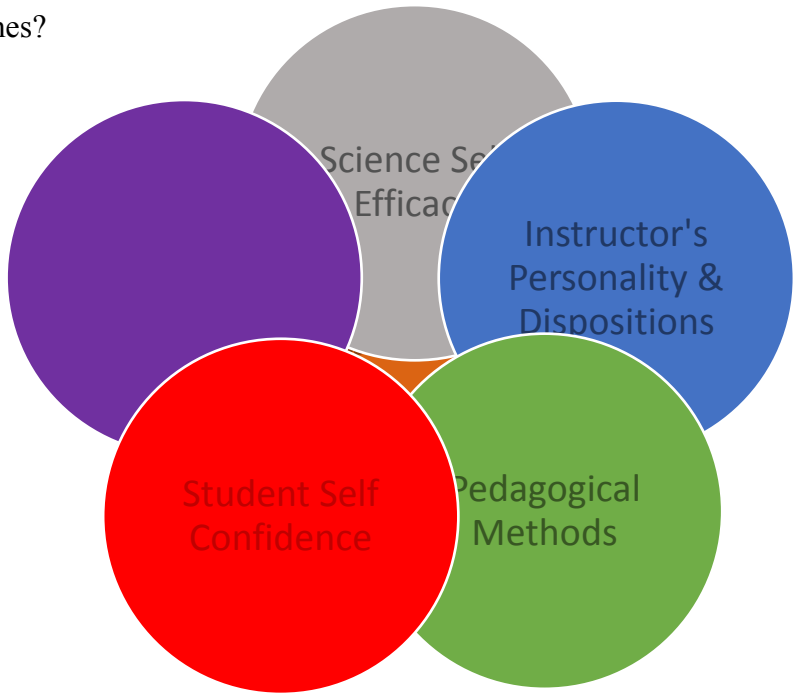
**Sub questions:**

1. What teaching strategies are most influential for increasing students' self-confidence and efficacy towards science?

2. How do students' confidence in science learning change from the beginning of semester, mid-semester, and conclusion of the course?

3. How do students' learning characteristics 'enhance or impede' self-confidence towards science?

4. How does the instructor's personality and disposition influence students' attainment of learning outcomes?



## Key Terms

**First-Generation.** First-generation students are those whose parents may have postsecondary certificates, course credit hours from a postsecondary institution, or an associate's degree, but have not obtained a four-year bachelor's degree. Historically, these students are less likely to plan for attending a four year college, and not likely to persist towards completing a bachelor's degree. First-generation students who enroll at post-secondary institutions are often developing their acceptance of belonging in college, of which the first year is often the most significant. These students generally come from lower-income demographics and often work part-time to supplement family income.

**Science Teaching.** Science teaching is the methods of instruction to teach students science content and the processes of science. This incorporates teaching techniques that embrace inquiry-based, student-centered learning, and cooperative learning. In each of these techniques, the goal is to account for the needs of diverse learners, provide scientific instruction through active learning, and alternative assessment. The National Science Education Standards outlines standards in teaching science, for which 'a teacher must have theoretical and practical knowledge and abilities about science, learning, and science teaching' (NRC, 1995). These standards are grounded in assumptions of:

- What students learn is influenced by how they are taught;
- Student understanding is developed through individual and social methods;
- Instructors' actions are predisposed by their own perceptions of science and as a subject that is taught and learned; and
- Instructor accomplishments are influenced by their own understanding of relationships with students.

Furthermore, the Next Generation Science Standards (NGSS) indicates three approaches for science instruction that include implementing disciplinary central ideas (content), scientific and engineering practices, and integration with multiple core concepts. NGSS focuses on the progression of knowledge across grade levels, which allows for dynamic building of understanding throughout a student's entire scientific education (NGSS, 2013).

**Science Learning.** Science is the general subject, which examines the natural world, its universal structure and natural phenomena through observation and experimental investigation. Science learning focuses on the processes in which the learner achieves accurate science knowledge and understandings in the nature of science, processes of science, and develops enhanced scientific literacy. The National Science Education Standards defines science learning as an active process that involves physical and mental activity, in which 'learning science is something learners do, not something this is done to them' (NRC, 1995). The goal in science learning is to develop an understanding of what science is; confront self-misconceptions of science; what science does or does not accomplish; and how science contributes to technology and society. More so, the Next Generation Science Standards (NGSS), science-learning goal is to provide all students with high-quality education that engages in scientific practices that construct meaning within both science classrooms as well as informal settings (NGSS, 2013)

**Student Self-Confidence.** Self-confidence is self-assurance in one's own personal ability, talent, or aptitude and considered a positive attribute in which a person can accomplish successfully a designated goal or activity. This also refers to a sense of his or her own competence and skill, and their own perceived capability in dealing effectively with various situations (Shrauger and Schohn, 1995).

## Literature Review

Information presented in this proposal delineates context regarding first-generation students' access to higher education, opportunity for success as post-secondary learners, and specific educational pedagogy that may enhance their potential for academic achievement.

**Post-Secondary Educational Access.** In 1964, President Lyndon B. Johnson signed and enacted the Economic Opportunity Act, which provided federal funding for what now identifies as the national TRIO programs. This Higher Education Act passed in 1965 authorized a variety of institutional, student, and programmatic aid initiatives for higher education. This accounted for significant financial access by providing 74% of all financial aid available to students enrolled in postsecondary education in the United States, thus affecting considerably higher education. This is possibly considered the single most important piece of legislation (Hannah, 1996) influencing the direction of higher education. Since its conception as an Office of Higher Education Programs, it eventually reformed into the Educational Opportunity Centers (EOC) in 1972. TRIO subsequently expanded their educational purpose and access for students who are eligible as program participants. TRIO thus named for the original organization in programs of the three: Upward Bound, Talent Search, and Student Support Services (U.S. Department of Education, 2019). More so, since 1990, the U.S. Department of Education formulated and extended further scholastic opportunities towards eligible high school students in preparation for college as the Upward Bound Math/Science Program. Upward Bound provides underserved populations, preparatory educational advancement in Math and Science concerning post-secondary education (McElroy and Armesto, 1998). These federally funded TRIO Programs advance the continuum of educational support beginning in junior high school (middle school) and continues through to college (post-secondary). Nationally more than 2,700 TRIO programs

exist to serve at least one million low-income and first generation students annually (Engle, 2007). Distinctively they serve as the Higher Education Act, for which the U.S. Federal Government continued its investment in more equitable higher education access. TRIO constitutes as Talent Search, Upward Bound, Upward Bound Math/Science, Educational Opportunity Centers, Veterans Upward Bound, Student Support Services, and the Ronald E. McNair Post-Baccalaureate Achievement Program (Engle and Tinto, 2008). The programs encouraged numerous first-generation students to possess aspirations towards attending college, retention, incentives for resulting in the completion a bachelor's degree and beyond. These programs aim to prepare secondary education students towards distinguishing themselves as college-equipped by addressing academic gaps through tutoring and educational support, which improves their academic attainment (Engle, Bermo, and O'Brien 2006).

**First-Generation Students.** First-generation students are those identified as whose parents did not obtain a post-secondary degree. They also constitute the demographic of students who engage in aspiring to attend college in which to advance or to honor the family (Gibbons and Woodside, 2014). Generationally students today are different from their previous generations**,** in that participation rates for these underrepresented groups have gained momentum in increased acceptance to attend post-secondary institutions. With the increasing proportion of first-generation students, this is likely to exemplify an increased percentage from either an immigrant family or increased minority demographic. One indicated result in the increase of current diversity is the number of first-generation students now identified in college because neither parent had more than a high-school education (Pascarella et. al., 2004). Twice as many first-generation students are either African American, Hispanic or from additional minority backgrounds (Chen, 2005). Although novel in the notion of attending college, they still consider themselves as the first in their families to hold ambitions of successfully obtaining a bachelor's

degree (Carnevale and Frye, 2000). First-generation students often tend to come from families with lower incomes and seemingly have lower academic achievement in high school (Terenzini et al. 1996). Characteristically, because first-generation students' parents have not completed the four-year college experience and obtained a degree, the family unit may lack abilities in guiding the student towards accessible academic resources. Often these parents cannot help their student with enrollment procedures, college coursework, tasks, or academic deadlines (Brooks-Terry, 1988; Zalaquett, 1999).

**First-Generation College Experiences.** Many grade school students envision their own future of achievement within a specific profession. This may be personalized from movies, exposure to professions, television, and in school experiences. Nevertheless, what has often compelled students towards prospective aspirations in achieving any goal is acceptance and a sense of belonging. Before a student has even determined what their future goal with respect to academic attainment might be, they often indicate if they feel they belong. Studies since the 1980's theorized how students' integration within their social and academic college environments predicts if they are likely to remain at their institution (Tinto, 1987). Research into social and class backgrounds indicate how cultural modes of self will transfer with first-generation students to their college settings. Stephens et. al. (2012) investigated how universities' cultural norms often influence and ultimately affect first-generation students' experiences in college. Often a predictor for success with first-generation students is whether they are college ready. College readiness is one of seven of the nation's educational priorities for post-secondary students (U.S. Department of Education, 2000). However, this readiness still centers on standardized testing and assessments, overlooking historical or cultural variables that hinder some students. Byrd and MacDonald (2005) investigated how first-generation students' life experiences contributed to the development of their own perceived skills as critical

components for success in college. Participant students' from this study indicate that work experiences and family motivations are non-academic skills recognized as also important to their college success.

**Success of First-Generation Students.** The Higher Education Act of 1975 subsequently increased federal student financial aid, supporting many students who felt they initially could not afford college. This also increased opportunity for first-generation students' access to post-secondary education. TRIO, as a federally funded program addresses the social, economic, academic, and cultural barriers faced by low-income students. Because of TRIO's initial purpose as expansion of the Higher Education Act, it has been since 1998, Congress appropriated $600 million for TRIO, thereby having it become the largest grant program administered by the U.S. Department of Education (Coles, 1998). TRIO's legislative mandate requires individual and collective evidence ensuring program success, notable famous Americans include Franklin Chang-Diaz (the first Hispanic astronaut), Angela Bassett and Viola Davis (two notable African American actresses), Patrick Ewing (Georgetown University basketball coach) and U.S. Congresswoman Gwen Moore (U.S. Department of Education/TRIO, 2019). A once TRIO program participant LaKresha Graham, delivers her own reflective thoughts in 'Learning a New World: Reflections on Being a First-Generation College and the Influence of TRIO Programs' (Graham, 2011). Graham as an African-American female highlights her own experiences through self-reflective narrative, thereby chronicling her story of guidance to post-secondary educational success. TRIO programs, personally and professionally, developed her interests towards college, and ultimately prepared her throughout college for an academic career. Due to these successes, literature on education and development of first-generation students should include more investigations in the conditions under which achievement of these students occurred and what factors allowed them to thrive (Demetriou, Meece, Eaker-Rich, & Powell,

2017). Demetriou et al., deliver their qualitative investigation of experiences from 16 successful first-generation college students. Concentrating on a developmental paradigm, the research describes how the principle of interactions and student environments provide explanations in appreciating undergraduate retention. Student success is not always predicted because of high-standardized test results or socio-economic backgrounds. There should be attention to those students who succeed regardless of pre-college factors. Blackwell and Pinder (2014) utilize a grounded theory approach that explores how first-generation minority students flourish irrespective of their family backgrounds. The results found that first-generation students' inner drive for attending college is the central motivating factor influencing their success in which they realize that completion of a college degree can afford an improved life for themselves or even their family.

**Pedagogy for Successful Learning.** A faculty member preparing for his oral communication course following their departmental orientation states, "After the orientation ended…I started working on my syllabi for two different sections of oral communications-one for first-generation students and another for non-first generation students. Even though both classes had the same course requirements, I made a mental note that first-generation students have different pedagogical needs compared to their peers, which prompted me to rethink my pedagogy" (Hao, 2011). This faculty instructor provides justification in the use of critical compassionate pedagogy, for which he delivers open communication with students and allows open discussions that establish teachings that works with all learners. Through this methodology, instructors can implement a variety of approaches that not only accommodate the needs of first-generation students, but also to learners representing a diverse body of students. First-generation students may isolate academically and identify as still 'catching up' or possibly display an imposter syndrome, "am I really smart enough for college?" Understanding perspectives from

which students start post-secondary education and their initial confidence can be useful as qualitative variables that may very well influence student achievement outcomes. A study conducted by Everingham, et al., assessed mathematical learning with student engagement to determine how particular engagements may positively influence confidence and achievement for studies enrolled in interdisciplinary science. Because mathematics contributes to problem solving for socio-scientific issues of food security, renewable energy, and environmental sustainability, these researchers identified why there is a need to advance knowledge of engagement pedagogical practices. These practices were intended to benefit educators in their ability to heighten student engagement as a method for overcoming anxieties and low levels of confidence (Everingham, Gyuris, and Connolly, 2017). The theoretical context they delineated was a framework to guide new teaching and learning practices grounded on research in student engagement, mathematical confidence, and technology competency for pursuing the improvement of student learning outcomes and overall student learning experiences. The goal of the research was to understand how strategies for engagement enhance mastery of subject matter and the importance of educators sharing pedagogical philosophes of teaching interdisciplinary science to deliver more successful student learning outcomes.

**Positioning**.

I have taught first-generation students, as a biology instructor for five years now. I have determined through my instructional experiences that knowledge can be successfully accessed by all who are willing to learn. Interestingly, before my employment as a UNL instructor, I researched learning behavior in corvids (e.g., blue jays, pinyon jays, and Clark's nutcrackers) in what was the Avian Cognition Laboratory. For eleven years as a researcher, I successfully trained corvids to complete various cognitive tasks. Most notably my first experimental task was

to facilitate Blue Jays in attentively pecking an operant screen for associative positive reinforcement (Goto, Bond, Burks and Kamil, 2014). This research was to examine visual search and attention, episodic memory, decision-making, choice determination, spatial learning, and hierarchical relationships between groups of species (Stevens, Kennedy, Morales, and Burks, 2016). Managing such projects allowed me to gain a profound understanding of learning and behavior. What is the motivation for a subjects' success in learning the task? What can I do as the experimenter to facilitate a positive learning association that never had been experienced by the subject (now student)? These questions would eventually lay the foundation of my teaching philosophy, as well as a method by which to motivate and inspire student learning.

I am not a first-generation student. My family educational lineage classifies me as third-generational college educated. I am a woman and, further identifiably, a woman of color. Yet, I always recognized myself academically as being an honor student in grade school and high school. College was never an afterthought nor a hesitation for my achievement future. However, as I maintained my academic disciplines in college, I overlooked my minority status. I identified through an academic lens in how I belonged, 'I am here because I am academic and education is my purpose.' Conceptually this is how I identified. My purpose for my pursuits was always one of educational scholarship and ideologically that an individual is always capable of learning. I discerned that my self-determination and drive is intrinsic, my grandmother was an educator as a secondary education art teacher, and my mother attained two master's degrees and even attended MIT as an undergraduate student. This life of educational attainment seemed destined for me even before I was born.

My educational experiences as a child were successful, being that I came from a heritage of educators and I did not struggle in my quests for learning. My schoolmates always identified

me as ‘smart’, and I never disappointed my mother during my secondary education years. However, that is not to say that I did not have moments of struggle. There were periods I did not succeed in certain subjects. I found that I was weak academically in math by high school. The instructor was gruff and did not seem to care if we even learned the material. I worked hard conceptually to understand, only to be left frustrated and more confused. Most of my classmates expressed the same frustration, as only two of our classmates seemed successful in the course. It was then I came to recognize that educators really make the difference in how a learner experiences their educational success. How was it that I an academic student, now struggled to understand new material that always came so easily in my learning? Regardless, of these academic circumstances, my persistence allowed me to overcome these obstacles at times throughout my education. Reflecting as a young student, my grandmother expressed to me “make sure you balance your life, I don’t want to see you always just studying.” While in elementary school, I did not fully understand what this message intended to convey. Yet, as I continued through to high school with academic success, this message now brought clarity. Her intention for me to understand was that ‘you will not be great in everything, but you will be successful in something’. This affirmation influenced me, and distinguished a meaningful purpose for me, and hopefully others who experience difficulty in working towards a goal that does not come easily. From the moment, I was a young undergraduate deciding to pursue my passion for biology, I determined I would encourage other learners to understand how science is significant knowledge that has purpose in their lives.

**IRB and Ethical Compliance**

This study will be submitted for IRB approval, fully recognizing the ethical factors required for qualitative investigation of human subjects (Creswell and Poth, 2018). Students

surveyed will remain anonymous, unless a student indicates that their identity may be publicized as a narrative participant. All research members will have CITI training, including research assistants. This study utilizes undergraduate students enrolled in the purposely-selected sections of introductory biology courses (Biology 101 and Life Science 120) at the University of Nebraska-Lincoln. Sections of these introductory biology courses are designated by the biology department for Student Support Services-TRIO program students that require permission to enroll. These sections average 25 students during the academic year (fall/spring). There is a general student enrollment for the summer eight-week course section for Life 120, averaging 30 students for which the same instructor provides course instruction. Pilot data, survey data, and student records are kept confidentially secured. The results of this study are to be analyzed and presented to the Biology Department, TRIO-Student Support Services Program, and the College of Education and Human Services (per dissertation completion). Due to the position of the instructor within the School of Biological Sciences and TRIO-Student Support Services, results of this study may prove to be beneficial for departmental curriculum implementation and TRIO-Student Support Program grant implementation.

## Methods and Procedures

### Data Collection
### Quantitative

As indicated within the purpose statement, a mixed methods quantitative and qualitative investigation will be conducted. Quantitative data collected will be used as a baseline in the identification and development of the qualitative component of the research design. The quantitative research planned for this study aims to determine measurable degrees of data regarding number of students enrolled in the designated sections as first-generation compared to

non-first-generation, degrees of variation in surveyed science confidence, and self-efficacy towards science learning. Projected for the qualitative data component are the inclusions of semi-structured interviews, student narratives, instructor self-narratives, and pedagogical artifacts.

Piloted study surveys will provide references in framing questions regarding indicated factors as noted above. Student participants complete questions as to performance within the course, which focuses on student accountability (Expectations for Success, see Appendix A). Participants are students enrolled within sections of introductory biology courses designated by the biology department for Student Support Services-TRIO program, of which permission is required to register during the academic year (Fall/Spring). Participants are given an Expectation for Success questionnaire the first week of the course to complete in class. Specific questions request participants to state their own expectations and identify their personal level of responsibility within the course (e.g., completion of assignments, exam preparation, and attendance). These expectation questions encourage participants to provide a brief response, as indication for how they intend to be accountable throughout the semester. During week two, a pre-survey questionnaire is administered (see Appendix B), which evaluates the classification of each student (i.e., freshman, sophomore, junior, senior), whether the student is first-generation or non-first generation, age, gender, biology major or non-major, and purpose for enrollment in the course. Within the pre-survey, teaching methods are probed as to which is most beneficial for each of the students' learning (Appendix B, question 9). Additionally, science self-confidence is surveyed to determine students' baseline at the start of the course (Appendix B questions 15-19).

A mid-semester survey administered at week ten (see Appendix C), re-questions participants' expectations for success in a manner similar to that which was inquired at the start

of the course. These questions will re-examine how students at this point in the course semester are achieving their personal responsibilities within the course (e.g. completion of assignments, exam preparation, and attendance). Science confidence is also re-assessed, as well as teaching methods by which participants' now determine as successful towards their learning (Appendix C, questions 4-7).

The final pilot survey will be administered in week fifteen, designated as Student-Final-Assessment (see-Appendix D). This post-survey re-questions same factors that participant students indicated as being their personal responsibility to achieve success during the course (e.g., completion of assignment, exam preparation, and attendance). Additionally, this final assessment, post-survey assesses participant science confidence, teaching methods, and personal confidence to take future science courses. Piloted science self-efficacy questions applied are from 'The Development of a College Biology Self-Efficacy Instrument for NonMajors' (Baldwin, et. al., 1999). This self-efficacy instrument, developed by Baldwin et.al., consists of twenty-three statements regarding confidence in relation to biology, in which student participants answered response category concerning their personal confidence. Response categories range from totally confident (A), very confident (B), fairly confident (C), a little confident (D), or not at all confident (E). This self-efficacy instrument designed, intended to stimulate students into thinking about their own beliefs, attitudes, and behavior patterns regarding science. Results specified that this Biology Self-Efficacy Scale is valid and a reliable tool, as it provides a complete perspective of student's confidence levels by allowing an existing research base on student's attitudes toward science or biology.

**Data Collection**
**Qualitative**

The pre and post-surveys results will assist in providing ethnographic examination for structuring interview questions and shaping the choices of pedagogical methods engaged. Because ethnography focuses the shared and learned patterns of groups, and because these methods commonly implemented are interviewing and collections of written and non-written sources of information, this research will include data sources from semi-structured interviews, select narratives, pedagogical artifacts, and student work samples. Semi-structured interviews allow mixed methods studies to be a useful adjunct to supplement and add depth to standardized survey questionnaires that may not effectively address information without more open-ended questions and extended probing of themes (Newcomer, et al. 2015). Adams provides instructional methods in 'Conducting semi-structured interviews, The Handbook of practical program evaluation,' for obtaining qualitative data formulated with semi-structured interviews that allows the researcher to ask probing, open-ended questions regarding topics that respondents may not be candid in answering if sitting in peer environments. This qualitative method also allows asking open-ended questions when the researcher is interested in knowing the independent thought of each individual (Newcomer, et al. 2015). Semi-structured interviews in this study will be developed from select student participants to explore emerging information resulting from analyzed survey responses. Narrative information obtained from participants, will allow the researcher to focus on selected individuals by gathering information through the collection of their stories, reporting these individual experiences and chronologically ordering the meaning of those experiences (Creswell and Poth, 2017). Procedurally the conduct of narrative research may not follow a prescribed matrix within the approach; however, this

narrative research will provide the best means in capturing detailed stories or life experiences in how students experience their science learning and achieve meaningful outcomes.

Additional qualitative data collected will be from course artifacts that demonstrate the instructor's lesson planning approaches and teaching abilities. Because the course assignments vary and approaches to lessons may involve backward-design teaching models (McTighe and Wiggins, 2012), peer group work and integration of learner and knowledge assessments, these artifacts are easily obtainable. The curriculum driving the course instructional plans that promote:

- an overarching central focus of critical concepts
- objectives that align with inquiry and problem solving based instruction;
- STEM content and practices;
- student collaboration through active learning;
- real-world connections;
- use of instructional technology-Canvas;
- interdisciplinary connections; and
- formative and summative assessments

(Rink et. al., 2016). Student work samples will also be collected from class work performed during class concept exercises, active learning engagement activities, and assignments designed from course materials.

Research investigators (including the instructor) will conduct selected participant interviews. The semi-structured interviews will last between 30 and 45 minutes, and may last longer dependent upon if students choose to elaborate in providing more context to their responses. Interviews will be audio-recorded and written field notes will be taken by the investigators. Members of the research team will transcribe interviews and conduct a follow up review for accuracy with participants selected for interviews (i.e. member checking).

## Data Analysis
### Quantitative

Quantitative data captured from pre and post surveys will produce results regarding number of students enrolled in the designated sections as first-generation compared to non-first-generation, degrees of variation in surveyed science confidence, and level of self-efficacy towards science learning (Baldwin et. al., 1998). The total number of participants are yet to be determined, however students enrolled in designated biology introductory courses and of whom complete with a course grade will be determinants for the total sample size (n=25/course section).

To measure science self-efficacy an instrument developed by Baldwin, Ebert-May, and Burns (1998) will be used. This instrument was selected on its face validity because of its development to specifically measure self-efficacy of biology college non-majors. Within the development phase, Baldwin et. al., determined that there were 23 items that could be subdivided into three factors. These factors included: 1) methods of biology (internal consistency reliability, coefficient alpha=0.88); 2) generalization to other biology/science courses (internal consistency reliability, coefficient alpha=0.88; and 3), and application of biological concepts and skills (internal consistency reliability, coefficient alpha=0.89). This instrument was reported to possess construct validity by correlating the three factors of self-efficacy with an established set of subscales developed for a test produced by the National Association of Biology Teachers and National Science Teachers Association.

## Data Analysis
### Qualitative

Qualitative data evaluates thoughts, concepts, and themes that arise from materials obtained (Creswell and Poth, 2018). Semi-structured interviews, select narratives, pedagogical

artifacts, and student work samples intend to provide details and theme descriptions for science confidence, science learning, and indications of successful pedagogy employed. It is possible a phenomenological relevance will emerge from interviews and select narratives as an interpretive process to give meaning to that which students have experienced. Moustakas indicates how the transcendental approach to phenomenology allows the researcher to interpret more on descriptions of the experiences from the participants (Creswell, 2018; Moustakas, 1994). While analyzing interviews and narratives, this information is reduced to significant statements, from which themes emerge. Pedagogical artifacts and student works samples selected will reflect the range of biology concepts introduced and in which participants engaged throughout the course. Artifacts and work samples will reflect the range of learning engagements which produce successful learning outcomes (Rinke et. al., 2016).

## Discussion

First-generation college students now represent a substantial proportion of the demographic for undergraduate students for which 20 years ago was considered underrepresented (U.S. Dept. of Education, 2000). Much of the previous research focuses on disparities and socio-economic influences that factor into academic success or attainment by first-generation students, yet limited research has been performed to identify factors that account for academic success and achievement. It is optimistic, in addressing this study's central question, that correlational analyses will yield meaningful results; results that suggest which pedagogical methods employed were effective in providing successful science learning outcomes. Whether these results are significant, will be determined from analyses of surveyed data. Piloted surveys provide reference for obtaining qualitative information that cannot be attained from categorical responses alone. Interpretation of these findings will hopefully generate

themes that emerge regarding students' science self-confidence and self-efficacy, as they improve pre to post survey. Through the analyses of results, the researcher also expects to identify factors concerning the instructor's personality, disposition, and in how the instructor employed methods of instruction that contribute to an increase of students' self-confidence.

Based on prior research results reported on self-efficacy, it is suggested that these strategies for understanding students' behaviors can facilitate development of approaches that increase students' motivation to understand and study biology (Baldwin, et. al., 1998). Baldwin, et al., also reported utilizing a self-efficacy tool as a pre-and posttest indicator which allows instructors to gain insight into their students' biology self-efficacy. Self-efficacy is related to students' confidence levels. It is anticipated that students' self-efficacy and confidence increase as they are engaged in tasks that are more complex during the course. Furthermore these scales can be useful indicators that influence choices that faculty make about their teaching practices.

The finding from this study can be useful in determining how curricula can be developed for first-generation students and pedagogical methods established that enhance learning outcomes in science for both first-generational and non-first generational college students.

**Limitations**

Limitations for this study include:

1. Student participants are enrolled at the University of Nebraska-Lincoln.
2. Student participants must be enrolled in designated sections of introductory biology courses and of whom complete with a final course grade.
3. Limited to a single semester of student participation.

4. Limited by the number of first-generation students available during the targeted study semester.
5. Sections generally consist of an enrollment of 25 students.
6. Some data sources consist of student self-reports which may or may not accurately reflect a student's personal history.
7. Only a subset of study participants will be selected for interviews. These students may not represent the total pool of possible participants.

**Conclusion and Implications**

Research regarding first-generation college students' within higher education has not been deficient. However, there is a gap in the current literature regarding educational success of first-generation students. There are common first-generation college student characteristics, which are widespread enough to warrant actions on the part of instructors (McMurray and Sorrells, 2009). The University of Nebraska-Lincoln has increased programs and opportunities for success of first-generation students through programs such as: First Husker Program, First-Generation Nebraska Initiative, recruitment programs and activities for first-generation scholars, university scholarship programs (Emerging Leaders, William H Thompson Scholars Learning Community, OASIS), and federally-funded programs (Student Support Services and McNair Scholars). This study offers opportunity to examine specifically how instructional methods influence first-generation students' learning, especially within designated introductory biology courses. Utilizing a mixed methods approach allows quantitative and qualitative measurements to be achieved, leading to further understandings of students' attitudes towards science, self-efficacy, science confidence, and learning attainment. With valid and reliable self-efficacy instruments, this allows for quantitative applications in student-surveyed data with regard to

confidence and self-efficacy, especially first-generation college students at the University of Nebraska-Lincoln. Qualitative information obtained offers voice to their learning experiences, which facilitates a deeper understanding in how these experiences are shaped. Providing opportunities for students to give reflections within the course to which methods of instruction is beneficial to their learning, unlocks opportunities for instructors to utilize meaningful pedagogy that applies to specific learning needs of college students.

The goal of this study is to highlight the successes of first-generation students learning, as well as attributions of improved science learning. Understanding learning attainment of students allows for understanding that instructors have a better chance of meeting learning needs for all students. Although this research specifically targets first-generation students, findings may parallel to non-first generation students with resects to similarities in learning needs. Barton (2001) indicates, "We are currently involved in generating a kind of science education that values both excellence and equality, and we are charged with the task of actively pursuing curricular and pedagogical strategies that remove barriers of exclusion so that all may be scientifically literate for community and educational reasons." This investigative prospect allows for insights into the needs of undergraduate students in learning science, and how factors of student self-confidence, self-efficacy, pedagogical methods employed, and overall learning outcomes determine the likelihood of science learning success.

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**Appendix A**

Student Learning **Pre self-assessment**
Please complete thoroughly and print information clearly
Life 120 Spring 2019

# Expectations for Success

1. What will you as the student do to insure completion of all assignments?

2. How will you prepare for exams?

3. How will you insure attendance? What do you anticipate would keep you from being on time & consistent with your accountability in attending?

4. How is your confidence towards science now (low, medium, high)?

5. What do you anticipate the course instructor will engage with in teaching methods for your learning?

6. What methods in teaching best support your learning?

7. As a result of completing this course how confident are you that you will be successful in another biology course?

**Appendix B**

Life 120 Spring 2019
Section 001
Survey Participant #_____

1. What is your current year at the University of Nebraska-Lincoln?
   A. 1st Year
   B. 2nd Year
   C. 3rd Year
   D. 4th Year
   E. 5th Year +

2. Are you a first generation student? Yes or No _____
   (Does parents/parent have a four-year degree from an accredited college?) Yes or No_____

3. Age: _____

4. How do you identify in gender? (E.g. Male, Female, Non-Binary, Choose not to identify) _____

5. What is your intended major (program focus as an undergraduate)?

6. Are you a biology major or taking most of your program courses in Biology?

7. What is the purpose for taking Life 120?

8. What do you find as strengths in the instructor's teaching method?

9. What instructional methods have been beneficial to your learning? (lecturing, group engagement, application activities, use of instructional video, concept engagement, model activities and assignments)? List all that apply.

10. How is this classroom environment for science compared to other courses you have had?

11. What teaching applies in this course that is not applied in other science courses?

12. What changes would you make (if any)?

13. Feedback for other students: What advice would you give to another student who is considering taking this course (section)? Please provide a brief explanation.

14. What would you consider of the instructor (traits) that affects your science learning? Please explain your answer.

**Regarding the second set of questions:**

A. If you are about 100% confident/sure
B. If you are 75% confident/sure
C. If you are 50% confident/sure
D. If you are 25% confident/sure
E. If you are <5% confident/sure

15. How confident are you that you will be successful in another biology course? ____

16. How confident are you that after listening to a lecture focused in biology, you could explain main concepts to another person? _____

17. The course (or section) developed my ability to interact with diverse groups of people _____

18. How did/How much have the models given in class help you comprehend the material better? _____ Please explain.

19. How confident/likely are you to use this course material towards subsequent science courses?_____ Please explain why you chose your answer.

20. How confident are you reading a biology textbook since taking this (section) course?

21. Would you have learned just the same if there were no models applied in your learning? Please explain why you chose your answer.

**Appendix C**

Survey Participant Number:_____

Student **Mid-semester Assessment** – March 2019/10 week
Please complete thoroughly and print information clearly
Life 120 Spring 2019

# Expectations for Success

1. What are you as the student accomplishing to insure completion of course assignments?

2. How are you preparing for exams? When do you work on the study review guide?

3. How are you insuring attendance? Have you been on time & consistent with accountability in attending? If not why?

4. What is your confidence towards science now (low, medium, high)?

5. What is the course instructor engaging within the course/semester that is currently instrumental to your learning and confidence?

6. What methods of instruction are best supporting your learning? List all that apply.

7. Will you complete this course? Yes/No?
   How confident are you towards science and science learning now?

**Regarding these set of questions:**

A. If you are about 100% confident/sure
B. If you are 75% confident/sure
C. If you are 50% confident/sure
D. If you are 25% confident/sure
E. If you are <5% confident/sure

8. How confident are you that you will be successful in another biology course? ____.
   Why? Provide a brief description.

9. How does/How much have the models and illustrations engaged in class help you comprehend the material better? _____ Please explain.

10. How confident are you now in reading a biology textbook since taking this (section) course_____?

**Appendix D**

**Student Final-Assessment** – April 2019/15th week
Please complete thoroughly and Print your responses clearly
Life 120 Spring 2019

# Expectations for Success

1. What did you as the student accomplish to insure completion of course assignments?

2. How did you prepare for exams? When did you work and complete the study review guide (1 week before, weekend before, a few days before)?

3. How did you insure consistent attendance? Were you on time for each class & consistent with your accountability in attending? **If not why?**

4. What is your confidence in science now (low, medium, high)? **Why?**

5. Explain exactly what the instructor did in teaching that was instrumental to your learning and confidence? **Provide examples and explanation**.

6. What methods of instruction best supported your learning? **List all that apply**.

7. How confident are you towards science and science learning now and **why?**

**Regarding these set of questions:**

A. If you are about 100% confident/sure
B. If you are 75% confident/sure
C. If you are 50% confident/sure
D. If you are 25% confident/sure
E. If you are <5% confident/sure

Please use the indicated A, B, C, D, or E for your answer choice, and provide the explanation for why.

8. How confident are you now that you will be successful in another biology course? ____. Why? **Provide a brief reason.**

9. How did/how much have the models, illustrations or concept activities engaged in class helped you comprehend the material better? _____. **Please explain**.

10. How confident are you now in reading a biology textbook since taking this (section) course_____? Did this course assist in your understanding of the textbook content?

**Appendix E**

Baldwin, J. A., Ebert-May, D., & Burns, D. J. (1999). The development of a college biology self-efficacy instrument for nonmajors. Science Education, 83(4), 397-408.

**APPENDIX: SELF-EFFICACY INSTRUMENT**

This survey contains 23 statements about your confidence in doing things related to biology. For each question, think about how confident you would be in carrying out a given task. There are no right or wrong answers. These are just your own thoughts and feelings about these topics. There are *three* demographic questions as well.
All answers should be filled in on the bubble sheets provided. For each statement in the survey, fill in the bubble next to each question:

A. If you are TOTALLY CONFIDENT that you can do the task.

B. If you are VERY CONFIDENT that you can do the task.

C. If you are FAIRLY CONFIDENT that you can do the task

D. If you are ONLY A LITTLE CONFIDENT that you can do the task.

E. If you are NOT AT ALL CONFIDENT that you can do the task.

**Practice Item**

How confident are you that you could give a presentation about birds in northern Arizona? Suppose that you were "fairly confident" that you could give a presentation about birds in northern Arizona. You would write the letter "C" in the blank next to the question.
*Thank you for your participation!*

1. How confident are you that after reading an article about a biology experiment,

you could write a summary of its main points?

2. How confident are you that you could critique a laboratory report written by another

student?

3. How confident are you that you could write an introduction to a lab report?

4. How confident are you that after reading an article about a biology experiment,

you could explain its main ideas to another person?

5. How confident are you that you could read the procedures for an experiment and

feel sure about conducting the experiment on your own?

6. How confident are you that you could write the methods section of a lab report

(i.e., describe the experimental procedures)?

7. How confident are you that after watching a television documentary dealing with

some aspect of biology, you could write a summary of its main points?

8. How confident are you that you will be successful in this biology course?

9. How confident are you that you could write up the results to a lab report?

10. How confident are you that after watching a television documentary dealing with some aspect of biology, you could explain its main ideas to another person?

11. How confident are you that you will be successful in another biology course?

12. How confident are you that you could write the conclusion to a lab report?

13. How confident are you that after listening to a public lecture regarding some biology topic, you could write a summary of its main points?

14. How confident are you that you would be successful in an ecology course?

15. How confident are you that you could analyze a set of data (i.e., look at the relationships between variables)?

16. How confident are you that after listening to a public lecture regarding some biology topic, you could explain its main ideas to another person?

17. How confident are you that you would be successful in a human physiology course?

18. How confident are you that you could tutor another student on how to write a lab report?

19. How confident are you that you could critique an experiment described in a biology textbook (i.e., list the strengths and weaknesses)?

20. How confident are you that you could tutor another student for this biology course?

21. How confident are you that you could ask a meaningful question that could be answered experimentally?

22. How confident are you that you could explain something that you learned in this biology course to another person?

23. How confident are you that you could use a scientific approach to solve a problem at home?