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Article

Students' Motivation and Engagement in the Implementation of Individual Development Plan for Underrepresented Minority (URM) Students in Undergraduate STEM Training Programs

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Abstract: Despite recent progress, statistics show an urgent need for growth in the numbers of underrepresented minority (URM) students in STEM fields. An individual development plan (IDP) has been used to assist Ph.D. trainees in exploring career paths, developing short- and long-term career goals, and creating action plans to achieve these goals. The National Institutes of Health (NIH) and many institutions require the completion of the IDP by graduate students, postdoctoral researchers, and junior faculty mentees to enhance career development. However, little information exists regarding how motivated and behaviorally engaged undergraduate URM undergraduate students are in using IDP as a tool to develop their STEM career pathway. In this study, researchers present data from the motivation levels and behavioral engagement factors that are associated with the effectiveness of the IDP with 20 URM students recruited for the REP Summer program. A total of 85% of students strongly agreed that the IDP was most effective in assessing and reflecting on their academic and professional goals. The mentorship needs were met by 80% of the students, while 75% of the students agreed that the IDP was very effective in helping to identify short-term and long-term goals for their undergraduate studies. Moreover, 70% of the students were satisfied with the IDP in developing an action plan, identifying short-term and long-term goals for their professional careers, and assessing their scientific skills, interests, and values. URM students are intrinsically and extrinsically motivated to implement the IDP and pursue careers in STEM. Findings suggest that URM students' motivation and behavioral engagement levels impact the effectiveness of the implemented IDP with these students. There is a need to identify factors that enhance the effectiveness of the IDP to determine how to maximize the career development of URM students in STEM programs.

Keywords: motivation; self-regulation; student engagement; individual development plan

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Citation: Edwards, N.; Goodwin, R.L.; Khalil, M.K.; Fowler, L.A.; Nathaniel, T. Students' Motivation and Engagement in the Implementation of Individual Development Plan for Underrepresented Minority (URM) Students in Undergraduate STEM Training Programs. *Educ. Sci.* **2024**, *14*, 313. https://doi.org/10.3390/educsci14030313

Academic Editor: Brian M. McSkimming

Received: 18 January 2024
Revised: 6 March 2024
Accepted: 7 March 2024
Published: 15 March 2024

1. Introduction

1.1. Background and Significance

The underrepresentation of racial/ethnic minorities in STEM careers is a national concern, as evidenced by the National Institutes of Health's (NIH) continued support for research education programs for underrepresented minority (URM) students [1]. One of the factors contributing to the underrepresentation of minorities in STEM programs is that many are not equipped with the academic tools that can help them effectively navigate the educational and professional pathways in STEM career development [2]. The individual development plan (IDP) is described as a multi-constituent career planning tool that guides trainees through a self-assessment of competencies, provides a platform for the exploration of STEM career paths, supports the development of short- and long-term career goals, and facilitates the creation of action plans to achieve these goals [3,4]. The IDP was first introduced in 2002 by the U.S. Federation of American Societies for Experimental Biology [5]. In 2014, the NIH mandated the inclusion of IDP for graduate students and postdoctoral researchers in the NIH grant progress report [6–8]. The goals were to provide a tool that is capable of enhancing the structure of a training environment, facilitating better communication between mentees and mentors, aiding in identifying and pursuing career paths, guiding the identification of skills and knowledge gaps, and creating action plans for addressing such gaps [7]. With the IDP, trainees and advisors can better communicate as the IDP provides feedback while opening a dialogue between them. As a form of evaluation, performance feedback can be provided by the IDP, and it has the potential to increase awareness and motivation and facilitate self-regulation skills [9]. This means that using the individual development plan can have a significant impact on one's achievement, motivation, and goal attainment. IDPs are suggested to be a staple career development activity for Ph.D. trainees, primarily related to supporting trainees' preparation for and decisions in navigating a diverse job market [10].

1.2. Significance

Little information exists regarding the use of IDP in the career development of URM undergraduate students. The investigation of the value of IDPs in promoting mentoring and career-relevant outcomes for graduate students lends more validity to this argument [1]. Findings from this study support the need for more empirical research and evidence on the impact of the IDP, particularly with undergraduate students, as they contain preliminary assessments and correlations of the IDP with mentoring, STEM, and career attitudes. Not implementing an IDP in many research educational research programs is a missed opportunity to provide all students with a tool that provides defined, practical methods and feedback for supporting comprehensive career planning and strategic development grounded in personal career aspirations in STEM programs. The failure of this approach is also a missed opportunity since students can enhance their performance when they perceive provided feedback as a valuable tool that encourages and nurtures future actions and tasks that are positive and grounded in knowledge, beliefs, and strategies [9]. This may contribute to one of the reasons, among others, that many URM students are not prepared to pursue a graduate program or succeed in a STEM degree in college. This study aims to fill a crucial gap in the existing literature by investigating the efficacy of utilizing individual development plans (IDPs) among undergraduate STEM students while examining the relationship between motivational levels and student engagement in the IDP process.

With the urgent need to equip URM students with the skills and guidance to pursue careers in STEM successfully, the REP program served as a pipeline program to promote workplace diversity and the development of highly qualified URM students for graduate school in STEM fields. It also provides intensive modeling of science instruction and an understanding of the theoretical knowledge grounded in the research that they undergo. The goal of using the IDP in this program was to provide URM students with a tool that fosters the self-assessment of current skills, creation of a strategic plan, prioritization of progress, alignment of objectives, and promotion of a learner-centered approach [11]. In an individualized development plan (IDP) framework, motivation and engagement play a critical role in fostering proactive goal pursuit, sustained commitment, and personal growth among undergraduate STEM students. The relationship between these factors and the IDP process should be clearly understood to identify effective strategies for increasing student engagement, resilience, and, ultimately, career development success.

In this study, the IDP was implemented for the development of short-term and long-term academic and professional goals and explored the effect of intrinsic, extrinsic, and amotivational levels and URMs engagement in maximizing their career development in STEM programs. The objectives of this study are to (1) examine how the individual development plan influences the development of short-term and long-term academic and professional goals in undergraduate students and (2) explore the relationship between motivational levels and student engagement during the individual development plan process. The objectives are explored through the following research questions: (1) How effective is the individual development plan in the academic and research planning of undergraduate students in STEM? (2). How have the motivational levels of the URM participants in the NIH R25 program changed over time? (3). What are the main factors that impact the student engagement levels of URM students in STEM?

1.3. Conceptual Framework

1.3.1. Attachment Theory

The attachment theory provides meaning to the guiding principles of human behavior as well as an explanation for why people act in certain ways [12]. An understanding of the attachment theory sheds light on the factors contributing to what motivates students to learn, set goals, and their interactions with their peers. There are two stages of attachment, the second of which occurs in adulthood. This relationship, which is pertinent to undergraduate students, is based on the experiences they have that solidify their connection to one another [12]. Examining student engagement is related to both motivation and attachment theory since it can help determine how involved students are with other learners and mentors, what concepts they are learning, and how driven they are to keep going after achieving their goals. As they strengthen these attachments, these interactions can have an impact on their experiences and their self-determination. These encounters can influence their experiences and sense of self-determination as they deepen these ties.

1.3.2. Self-Determination Theory

The concept of self-determination centers on motivation, personality development, and the impact these factors have on an individual's overall well-being. This is contingent upon the individual's capacity to comprehend how their cultural dynamics influence their conduct, both on themselves and those in their immediate environment [13]. Self-determination is a continuation of motivation since it calls on a person to consider elements that can support and develop a desire and will to achieve. Self-determination has been classified into three distinct categories: relatedness, competence, and autonomy [14]. These classifications are predicated on a person's moral compass, abilities, and level of attachment to belongings or people. Students are frequently driven from within to accomplish their goals because they feel a sense of accomplishment when the goal is accomplished. Extrinsically motivated students are driven to accomplish a goal to lessen the possibility of an undesirable result. As students grow and succeed, they can correlate the behaviors that they exhibited with the expectancy to continue to achieve.

1.3.3. Situated Expectancy Value Theory

Based on students' motivation, achievements, and outcomes, the situated expectancy-value theory can predict whether a task will be fulfilled, which is situational (Beymer et al. 2022 [15]). The students' desire to complete the task reflects where they place their values. A task's value can be determined by its degree of interest, identity, utility in achieving a goal, and whether it requires too much effort to complete (Beymer et al. 2022 [15]). It also considers the self-efficacy beliefs and how they judge these abilities as they place value on a task. Students, especially those pursuing professions in STEM fields, rely heavily on the situated expectancy-value theory as their major tool for evaluating potential career pathways. This is also essential for supporting them with initial courses that are possible roadblocks to their success [15]. To use successful self-regulatory skills, students navigate through activities that include contextual expectancy-value analysis.

1.4. Literature Review

1.4.1. Achievement Goals and Motivation

A positive correlation was found between academic achievement, social support, and levels of connectedness within an academic setting [16]. As students feel more connected to the people around them, they feel more supported. The challenges experienced by underrepresented STEM students include a lack of job prospects defined for the recommended major, a lack of science identity, and a lack of a sense of belonging [17]. Achieving a goal or desire is fueled by the interests, desires, and wants of an individual. Achievement motivation is a combination of behaviors, instincts, activities, and influences that motivate a person to achieve their goals [9]. For students, these goals are driven by their learning experiences and career aspirations because they are modified as they gain more knowledge, make inferences about assessments and progress, and receive rewards [9]. Students are more motivated to set and achieve their goals when they receive positive forms of feedback. Students' strategies for completing tasks that call for cognitive processes efficiently also affect their drive to achieve.

1.4.2. Motivation

Motivation includes actions and aspirations to achieve objectives that are led and influenced by both internal and external concepts [18]. These ideas of intrinsic motivation, being motivated internally without receiving external reinforcement, and external motivation, obtaining external reinforcement, are other names for these internal and exterior concepts. Understanding the various elements and forces that influence an individual's motivation is fundamental. One major element is the confidence of an individual, which is also known as expectancy belief, and the other is their interests, which are identified as value beliefs. A person's confidence, or expectation belief, is one important component; their interests, or value beliefs, are the other [19]. There is a positive correlation between the expectancy or value beliefs of an individual and their motivation levels. When a person is motivated, it can be positively associated with how they learn, achieve, perform, and their coping abilities. Motivation can also be contingent upon an individual's identity and surroundings, which mainly manifests as a gender gap [19]. Females who are more driven by their values may be deterred from a career in STEM to meet the needs of their families, whereas men may be less likely to face this pressure and expectation. While men may be less likely to experience this pressure and expectation, value-driven women may be discouraged from pursuing a STEM job to care for their families. The feedback that a student receives can serve as a motivator to pursue and maintain STEM career interests.

While IDPs are suggested to be a staple career development tool [20], URM students' motivation levels and behavioral engagement are significant in achieving the goals of the implementation of IDPs. Motivated students are more likely to pursue their goals in a manner that is positively related to higher levels of intrinsic motivation as well as academic achievement since they receive satisfaction from participating in activities, which is ultimately responsible for their continued dedication [16]. Student engagement and academic motivation are predictors of academic performance [21]. Behavioral engagement and related motivations of URM students, as well as a sense of the purpose for their learning, are significant variables affecting their academic success [22]. Students who are willing to act or engage academically are expected to motivate themselves to learn [20,23] and, thereby, fulfill the cognitive activities required to be academically successful [20,24]. Therefore, motivation is essential because it drives learning and improves learning outcomes [11]. Although motivation can be conceptualized as a unidimensional construct varying in quantity or amount, motivation also differs based on quality or type [25]. For example, while intrinsic motivation describes the undertaking of an activity for its inherent satisfaction, extrinsic motivation describes behavior driven by external rewards or punishments, abstract or concrete. Therefore, intrinsic and extrinsic forms of motivation are distinct not only in their origins but also in their consequences for learning and well-being, with more intrinsic forms generally showing more adaptive value [26,27]. How both intrinsic and extrinsic forms of motivation and student engagement levels change during the implementation of the IDP in a summer REP for URM students is not fully understood. Since the motivational and student engagement levels of the URM students in a REP are important for their academic success, the current study will investigate how

URM's motivation and behavioral engagement impact the effectiveness of the implemented IDP on the URMs.

1.4.3. Student Feedback

As students navigate through assessments, goals, and learning strategies, they will need guidance and feedback from someone who can help them understand and interpret how these entities correlate. Through these interactions, the student can identify their intended outcomes, acknowledge their status, and consider their capabilities and abilities that will help guide them in their future tasks [9]. Students receive feedback primarily from their families, friends, and teachers. The faculty members in the STEM undergraduate programs are a vital asset to the feedback process because they have a favorable correlation in their abilities to motivate students to persevere and persist through their classes [28]. Students must demonstrate this degree of comprehension and dedication to finish their degrees and, in some cases, to be encouraged to pursue graduate studies. The degree of faculty involvement and availability is a significant factor in student feedback and can be demonstrated in the form of social conversations, support during a crisis or adversity, and expressing concern [28]. In addition to fostering healthy self-regulation in students, positive comments and interactions help to create lasting connections.

URM students intend to pursue STEM degrees at similar rates to other groups, but in any STEM field, they will struggle to achieve equal representation in degree attainment. A large part of preparing first-generation, low-income African American and Hispanic students for success in STEM is providing the guidance that they often lack during college enrollment. Those pursuing STEM majors receive both science instruction and theoretical knowledge that link concepts and training, thus strengthening and building knowledge as it is modeled [29]. Despite this, they are still lacking positive forms of support to help them make meaning of these concepts. By promoting critical thinking, facilitating problem-solving and decision-making, and incorporating peer feedback, effective models and guidance enable students to construct meaning from their learning [30]. A lack of resources and financial means to support their degree completion and professional advancement is another issue that affects students from disadvantaged and minority communities.

1.4.4. Self-Regulation

Self-regulation requires students to take control and accountability for the way that they learn. The ability to set goals, monitor their progress, and tailor their learning strategies to best meet their needs is evidence of self-regulation [16]. As they become successful, it facilitates a sense of persistence and tenacity within students. They put in effort and labor to accomplish their objectives and reap extra rewards. Learning is also strengthened because the implementation of self-regulatory skills integrates motivation, cognition, and behaviors [16]. Self-regulation requires the integration of will and emotions in addition to careful actions and behaviors. People must adjust their beliefs and behaviors to carry out an action plan that permits achievement to meet their intended goals [31]. This could sometimes call for exercising restraint. The ability to manage conflict, withstand the desire for reinforcement, or pursue an objective is known as self-control [31]. Motivation requires self-regulation, especially for students aspiring to careers in STEM fields, as they must overcome obstacles and hurdles.

2. Methods

2.1. The Study Population

A total of 20 URM students were recruited, and the demographics for the 20 students include African American (50%), Asian (15%), Caucasian (20%), Hispanic (5%), and Mixed Race (10%). One of the mixed-raced students identifies as both African American and Hispanic. The other identifies as both African American and Caucasian. Of the participants, 75% of them also identified as being socioeconomically disadvantaged. Scholars identifying as socioeconomically disadvantaged meet one or more of the following characteristics:

lower education rates, lower income, were homeless at any point, were in foster care, eligible for free or reduced lunch, first-generation college student, eligible for Federal Pell Grant, received support from a special supplemental nutrition program for Women, Infants, and Children (Figure 1). Females composed 80% of the students, while 20% were male students. Participants included students majoring in the following disciplines: Biology, Biochemistry, Bioengineering, public health, Exercise Science, and Kinesiology. Institutional review board approval was obtained [IRB #Pro00113174] for this study.

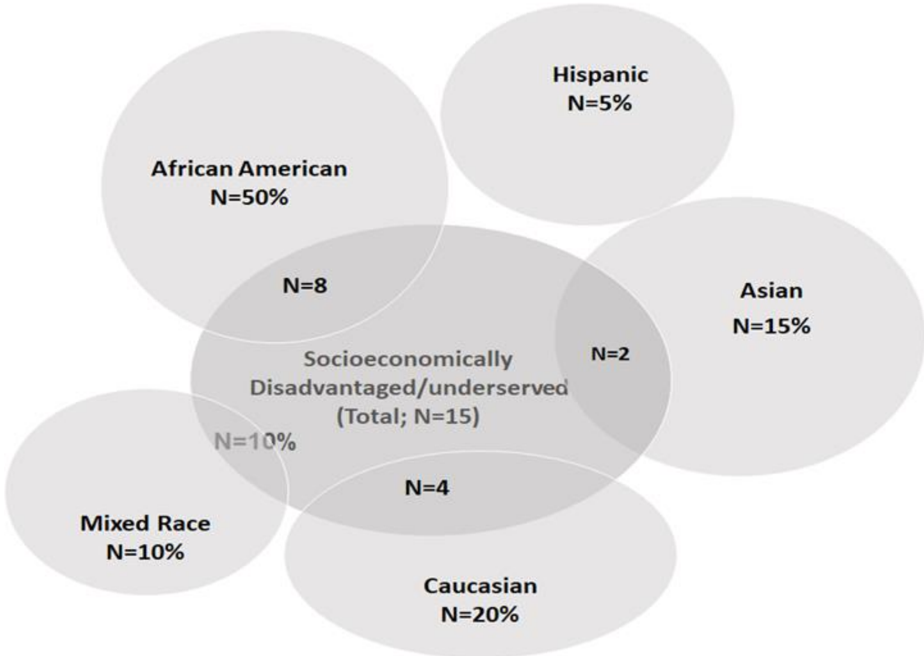

Figure 1. URM demographics of REP participants (N = 20).

2.2. Description of the Summer Research Education Program

NIH R25 REPs are geared toward educating and exposing undergraduate students to scientific, biomedical, behavioral, and public health academic training and research that will aid in preparing them for the next phase of their educational and professional careers. The goal of NIH R25 programs is to support educational activities that encourage URMs in STEM programs to pursue further studies or careers in scientific research. This program focuses on improving underrepresented racial and ethnic minority students' research experience, academic skills, and readiness for career advancement in STEM programs. Twenty underrepresented minority (URM) students were recruited from South Carolina colleges and universities specializing in STEM fields through social media sites, flyers, brochures, virtual meetings with probable research mentors, word-of-mouth, and targeted recruitment from research mentors at collaborating colleges and universities with a 100% response rate.

Successful admission and acceptance in the REP program comprised of the following components: (1) a student having a URM status; enrollment as a sophomore, junior, or senior at a college or university in South Carolina; a GPA of 3.0 or higher; and U.S. citizenship or valid Green card. (2) Completion of an NIH R25 summer application that included an application, college transcript, personal statement, and two letters of recommendation. (3) Successful completion of an interview with faculty and Program Coordinator. (4) Receipt of signed REP acceptance letter. The exclusionary criteria for the NIH R25 program encompass international students without a valid green card, rising freshmen, and graduating undergraduate students. Following acceptance, each student was matched with a research mentor who was closely aligned with their major or area of research interest. The 2022 summer program consisted of seven weeks of academic seminars, research, and career planning. Educational seminars were held in the morning and focused on the following areas: aging research, scientific writing, data analysis, preparation for graduate or professional school, preparation of a curriculum vitae, statement of interest, administration of the Learning and Study Strategies Inventory (LASSI), poster presentation, and oral presentations. In the afternoons, students engaged in research with their research mentors. Students were required to complete at least thirty hours of research each week. Research and peer mentors provided guidance and strategies to help each student represent their research and findings in both a poster and oral presentation. The program concluded with an annual symposium where the students conducted oral and poster presentations. After the summer program, students continued to receive mentorship through monthly meetings and attendance at national conferences.

2.3. Description of the IDP for Research Education Program

A modified IDP tailored to meet the needs of our undergraduate students in STEM was used. The National Institute of Health and the Federation of American Societies for Experimental Biology's (FASEB's) individual development plan for Postdoctoral Fellows was used as a guide and model for the development of the IDP used for the NIH R25 program. The IDP was adapted from a literature review of IDPs used with doctoral students and within professional organizations [32–34]. In designing the IDP, researchers focused on equipping them with skills that can help them clarify their goals, conduct a self-assessment of current skills, create a strategic plan, prioritize progress, align their objectives, and promote a learner-centered approach and meaningful activities toward their career advancement in STEM programs. Therefore, the IDP comprised assessments, a goal outline, an action plan, and mentoring worksheets. URM students completed the following assessments to identify their interests, values, and scientific skills: (1) Scientific Skills Assessment, (2) Interests Assessment, (3) Values Assessment, (4) Training and Mentoring Self-Assessment, (5) Biomedical Transferrable Skill Assessment. Assessments were used to guide students' planning for their academic and professional aspirations. They also engaged in one-on-one sessions to communicate their needs and the results from the assessments to form effective and relevant short- and long-term goals. Mentoring worksheets were also used to communicate their progress with their short-term goals.

For the implementation of the IDP, URM scholars recruited to REP evaluated their status at the beginning of the program in achieving these goals and then identified the short-term and long-term action steps they would need along the way. Short-term goals were any goals that they would like to complete within a year of starting the summer REP, and long-term goals were goals and activities that they sought to obtain within five years.

Each URM implemented their IDP as a part of the REP before the official start of the summer program, URMs engaged in a one-on-one IDP orientation with the Program Coordinator. During this orientation session, the Program Coordinator explained the IDP process to URMs using the IDP checklist (Figure 2), which covered each aspect of the process and how it would benefit them as they fulfilled their academic and career goals. Orientation also included a step-by-step tutorial on how to maneuver through the myIDP website to retrieve the scientific skill, interest, and value assessments. Each assessment and its benefit, along with how to interpret the results to formulate academic and professional goals, was explained to each URM while allowing them to ask questions for clarity. URMs were guided through each page of the IDP as the expectations and requirements for successful completion were described. All URMs were expected to complete and submit the first six pages of the IDP, which included the online and paper assessments and self-assessments, before their first IDP one-on-one session. The official IDP process began the first week of the REP. During the first week, the motivational levels and behavioral engagement levels of the students were assessed.

NIH R25 PROGRAM

Individual Development Plan (IDP)

As you engage in the NIH R25 program, it is important that you use the Individual Development Plan (IDP) to help you to fulfill your academic and career goals from acceptance and beyond.

Student Name: ______________________

☐ **1. Welcome to NIH R25 Zoom Meeting**
During this meeting, we will go over myIDP website, the IDP plan, and the expectations for the program. I will show you how to navigate through the myIDP site and answer any questions you may have.

☐ **2. Scientific Skills Assessment**
On the myIDP website you will be able to take a scientific skills assessment. This assessment will identify the scientific skills and knowledge that you do well in and the areas that need intervention.

☐ **3. Interest Assessment**
On the myIDP website you will be able to take an interest assessment skills assessment. This assessment will identify the scientific tasks that you enjoy doing and the ones that you least like to do.

☐ **4. Values Assessment**
On the myIDP website you will be able to take a values assessment. This assessment will identify the aspects of work and their outcomes that are most important to you.

☐ **5. Individual Development Plan- Year 1**
Please complete pages 1-6. These pages will explain the purpose of the IDP, effective tools to use it, your roles and responsibilities, the roles and responsibilities of the advisor, and self-assessments.

☐ **6. Reflect and Review**
Now that you have taken time to assess your skills, interests, and values take some time to reflect on what the results show you. **Briefly look over the Individual Development Plan, pages 1-6 and do some more reflecting.** We will discuss your reflections in our next meeting

☐ **7. Individual Development Plan One on One**
For the first official one on one, we will discuss your goals for yourself. We will complete pages 7-8 together. You will also bring pages 1-6 so we can review them. We will also discuss the Mentoring Worksheet and how to complete. **IDP, pages 1-8 due by: June 16, 2023**

☐ **8. Mentoring Worksheet**
Each week you will complete a mentoring worksheet to assess the goal(s) you plan to work on for the week. It is ideal for you to choose your goals the week prior. You may not meet with your mentor each week, but you will discuss your progress from each week.

☐ **9. Individual Development Plan One on One- Session 2**
In the second one on one session, we will discuss successes, necessary interventions, and any resources you may need to assist you for the duration of the program.

☐ **10. Individual Development Plan One on One- Session 3**
For the final session for the summer, we will discuss your overall thoughts and perceptions of the NIH R25 program in its entirety. **IDP, pages 9-16 due by July 27, 2023**

Figure 2. Individual development plan checklist.

Three biweekly IDP one-on-one sessions were conducted during the seven-week summer program with each URM. The first session occurred during the first two weeks of the program. The Program Coordinator discussed the results of the assessments with each student during the first one-on-one session. Each mentor or program director discussed with each URM student the career interests, majors, and goals of the students to identify short-term and long-term goals for their academic, professional, and research endeavors. A 70-20-10 rule was implemented, which requires that 70% of goals are acquired through specific learning experiences [35,36]. For the URMs, their direct experiences came from their research projects and collaborations with the research mentors. Each day, URMs further investigated their research topics, with a minimum requirement of 30 h per week for research. Many students exceeded the minimum number of hours required for research per week. In addition to learning experiences, 20% of goals are expected to be achieved through exposure and feedback [36]. The URMs received feedback in the following interactions: (1) scheduled meetings with research mentors, (2) scheduled meetings with the Program Coordinator to review the IDP, and (3) scheduled journal club meetings. The final component to the achievement of goals is 10% education [36]. The URMs attended learning and enrichment activities daily for each week of the program. These activities included but were not limited to discussion on the graduate school admissions process, aging research, academic integrity in research, learning strategies, the biology of aging, writing a statement of interest, reading a scientific article, aging, and health, data analysis in scientific research, social context of aging, writing an abstract, designing a conference poster, test-taking strategies, preparation of a curriculum vitae, clinical aspects of aging, and other motivational strategies and workshops.

Once the short-term goals were determined, REP students identified their mentorship needs and created an action plan that highlighted the steps that they would take to achieve each goal within a year and the professional activities that would assist them in this process. The professional activities included but were not limited to participation in the academic learning seminars that the students took part in during the mornings of the summer program. Each week, the students used a mentoring worksheet to identify at least one short-term goal that they would pursue, a critique of the accomplishments and/or obstacles they faced while completing the goal(s), and if they needed to write their goal or strategy to achieve the goal. REP students took part in collaborative discussions with their research mentor on the progression of their goals. Open-ended interviews were conducted during the second IDP one-on-one session. The duration of the open-ended interviews utilized to assess engagement spanned two weeks, with each interview lasting for 30 min. This allowed students to discuss their successes and areas for improvement. Successes, possible interventions, resources, mentorship needs, and overall thoughts and perceptions of the REP and the IDP were reviewed during the final IDP one-on-one session.

Motivational levels were reassessed during the final week of the summer program. URMs reflected on their experiences using the IDP component of the REP on the last day of the program. The IDP included short-term and long-term academic, professional, and research goals that the URMs will continue to pursue after the summer program ends, which is why the IDP process continues beyond the summer. Each month, the Program Coordinator and the Principal Investigator hold a monthly meeting to check in with each student, check on their academic and graduate school progress, and provide additional mentorship and resources as needed.

2.4. Data Collection

2.4.1. Evaluation of the IDP

The IDP was completed by 20 URM student participants in the summer 2022 REP and received a certificate of successful completion. They completed the components of the IDP program, which included the following: (1) IDP orientation, (2) online and written scientific and biomedical assessments and self-reflection, (3) pre- and post-assessment of Academic Motivational Scale, (4) open-ended interview, (5) three biweekly individual development plan one-on-one sessions, (6) IDP evaluation. All REP students were able to use their IDPs to complete at least two of their short-term goals within three months of the conclusion of the summer program. Students evaluated the overall program and their perception of how it met their academic and research needs. It also included a section dedicated to evaluating the effectiveness of the IDP and its ability to identify the knowledge, skills, and experiences that enabled the students to develop short-term and long-term academic, research, and professional goals. Students were required to complete six questions interpreting the development of short-term and long-term goals, action plan development, knowledge gained through the attainment of mentorship needs, weekly reflection and goals, and scientific assessments. Each item was measured using a five-part Likert that ranged from strongly disagree (1) to strongly agree (5). The evaluation questions correlated with the components of the individual development plan.

2.4.2. Evaluation of the Motivational Levels

The Academic Motivational Scale, in English, was used to gauge the URM participants' motivation levels [37,38]. The Academic Motivational Scale gauges a person's level of intrinsic, extrinsic, or amotivation toward going to college and pursuing their desired vocation [39]. A 28-question Academic Motivational Scale measures how intrinsically (12), extrinsically (12), or motivated (4) an individual is towards entering college to pursue their chosen career field [40]. The instrument was administered before the start of the program and then at the end of the program. Some sample questions from the scale included the following questions regarding why they chose to go to college: (a) Because with only a high school degree, I would not find a high-paying job later on; (b) Honestly, I do not know, I feel that 'I am wasting my time in school; (c) Eventually, it will enable me to enter the job market in a field that I like because I want to have "the good" life later on; and (d) for the satisfaction I feel when I am in the process of accomplishing difficult academic activities. The 7-point Likert responses included are does not correspond at all, corresponds a little, corresponds moderately, corresponds a lot, and corresponds exactly.

The answers to the questions are categorized based on the types of motivation, which yields seven components. The subscales exhibit the following correlations with the three motivation types: a lack of motivation, extrinsic motivation (external, introjected, and identified regulations), and intrinsic motivation (intrinsic motivation towards knowledge, accomplishments, and stimulation) [39]. Twelve statements are used to examine intrinsic motivation, twelve more statements are used to examine extrinsic motivation, and the final four statements gauge the degree of amotivation. Based on the internal consistency it shows, this scale was proven to be valid and reliable [39]. A coding system was used to capture the participants' answers.

2.4.3. Evaluation of Student Engagement Levels

Data on student engagement levels were collected using an open-ended interview that comprised ten questions. The researcher designed the interview questions, drawing from the participants' social experiences and interactions throughout the program. The interview asked students to describe what was going well, the challenges they faced, what they valued in the program, and how the program connects to their career choices and the outside world. They were also queried about the relevance of the program to their future, the number of people they connected with, their ability to stay focused, time spent on research, suggestions for better forms of engagement, and a recount of their interactions. Some sample questions from the interview include the following: (a) What aspects of the NIH R25 are going well for you? (b) Can you see how the activities in the program relate to the outside world or your future? If so, please explain. (c) If you were a research mentor, what is the one thing that you would do to make it more engaging for all students? (d) How do you feel about the quality of your interactions with the people in the program? Responses from the questionnaire were categorized as either behavioral, cognitive, or emotional levels of student engagement. The IDP allowed research mentors and the Program Coordinator to contribute to the level of engagement that the scholars showed toward their research and aspiring careers. In addition, it allowed the students to realize their capabilities and their potential in finishing their undergraduate program and applying to graduate and professional programs.

2.5. Data Analyses

2.5.1. Quantitative Data Analysis

All statistical analyses were performed using the Statistical Package for Social Sciences v26.0 for Windows (SPSS, Chicago, IL, USA). Descriptive statistics were used to analyze students' responses provided in the IDP evaluation. The percentages of URMs' responses were determined from the questionnaire administered to determine URM's perceptions of the IDP experience and its effectiveness in the development of their short- and long-term academic and research goals for a professional career in STEM fields. The percentage distribution of the impact of IDP on URMs' knowledge gained in mentorship needs for their STEM career pathways was determined. We also analyzed data for reflection on weekly goals, identification of accomplishments and obstacles, and an assessment of current scientific skills, interests, and values.

Mean values for the intrinsic, extrinsic, and amotivation levels of URMs in the pre- and post-assessment were determined. Differences in the different motivational levels for intrinsic, extrinsic, and a lack of motivation for all pre- and post-assessments were analyzed using one-way ANOVA with repeated measures. Tukey post hoc analyses were used to determine significant ($p < 0.05$) differences in the pre- and post-intrinsic, -extrinsic, and amotivation motivation levels. The power determination revealed 71.4% power and $d = 0.13$. PASS 2023, version 23.0.2, was used for the power analysis.

2.5.2. Qualitative Data Analysis

To measure student engagement, URMs' responses to open-ended questionnaire questions were analyzed using thematic analysis to pinpoint common themes and patterns among participants. The word cloud analysis was created using Free Word Cloud Generator and was used to provide a visual representation of the frequently used words for the qualitative data regarding behavioral, cognitive, and emotional engagement levels. The analysis also revealed the themes for the in-depth analysis of the experiences and perceptions unique to the URM participants, individually and collectively. Responses to the ten open-ended questions were further explored to highlight specific quotes and personal accounts to provide additional insights.

3. Results

3.1. Evaluation of the IDP

A total of 20 URM students participated in the summer program, which included an IDP modified for the REP undergraduate students. Participants comprised 4 males (20%) and 16 females (80%) from seven colleges and universities in the state of South Carolina. Statistical analyses using the Statistical Package for Social Sciences v26.0 for Windows (SPSS, Chicago, IL, USA) were used to gather descriptive and correlational statistics. The individual development plan (IDP) evaluation's scaled responses were analyzed using descriptive statistics. A distribution of student answer percentages was used to determine how effective the individual development plan was with undergraduate URM students. The distribution of responses by students to each item on the evaluation survey for the IDP of the REP is presented in Table 1. As shown, ≥70% of URMs strongly agreed that the IDP effectively developed their academic and professional goals for all the six activities evaluated.

Table 1. Distribution of responses by students (n = 20) to each item on the 2022 program evaluation survey, n (%) for the individual development plan of the REP program.

Activities	Strongly Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Strongly Agree
1. Development of short-term and long-term academic goals for continuation in my undergraduate degree.	(0)0	(0)0	(2)10	(3)15	(15)75
2. Development of short-term and long-term research goals for continuation in my professional journey.	(0)0	(0)0	(1)5	(5)25	(14)70
3. Development of an action plan to help me achieve my short-term goals.	(0)0	(0)0	(1)5	(5)25	(14)70
4. Gained knowledge in my mentorship needs that will aid in my academic and professional journey.	(0)0	(0)0	(1)5	(3)15	(16)80
5. Reflecting on weekly goals and identification of accomplishments and obstacles.	(0)0	(0)0	(2)10	(1)5	(17)85
6. Assessment of my current scientific skills, interests, and values.	(0)0	(0)0	(1)5	(5)25	(14)70

Note. N = 20.

3.2. Evaluation of the Motivational Levels

The results for intrinsic motivation, extrinsic motivation, and amotivation are presented in Figure 3. A one-way ANOVA with repeated measures revealed a significant difference $F(1, 19) = 1230.41$, $p < 0.001$) in URM student performance between the six pre- and post-assessment variables. Tukey's post hoc test analysis revealed students' performance in the pre- and post-intrinsic and -extrinsic motivations were not significantly different (* $p > 0.05$) but were significantly higher than URMs' performance for the pre- and post-amotivation (** $p < 0.05$). URM participants are more extrinsically motivated to pursue jobs in STEM, according to the data shown in Figure 3. The three subscales of extrinsic motivation are external regulation, introjected, and identification. The term "external regulation" refers to conduct that is controlled by outside forces like incentives and limitations. When someone starts to internalize the reasoning for their actions, it is known as introjected extrinsic motivation. Identification extrinsic motivation occurs when a person's actions are regarded and valued as significant because they chose them.

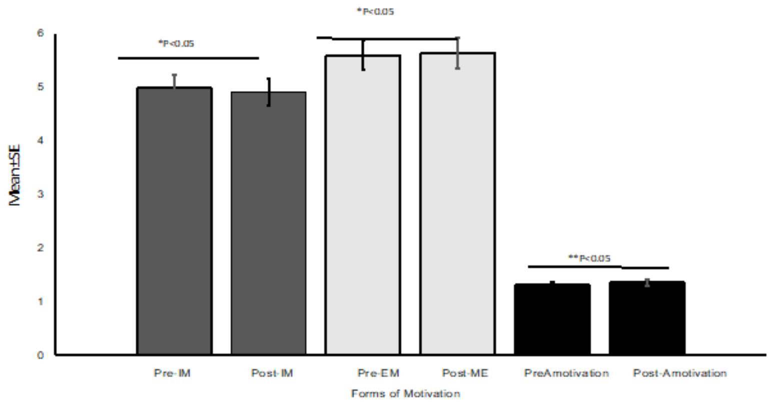

Figure 3. Averages pre- and post-assessment of intrinsic, extrinsic, and amotivational levels of URM participants (n = 20).

3.3. Evaluation of Student Engagement Levels

The results from the thematic analysis are represented in Figure 4, which found four themes among student engagement levels of REP participants. The first theme is behavioral engagement in research. Responses indicate that the URM students engaged when participating in scientific research. One participant stated, "The aspect that is going well is strengthening my research abilities". One participant stated, "The aspect that is going well is strengthening my research abilities". Another student corroborated, stating, "I would say the research. I feel like we have gotten a lot done in a quick amount of time. We are almost done with the data and everything that we need". The second theme is behavioral engagement in academic seminars related to career development. Students were eager to participate in the morning educational seminars. A student stated, "I enjoy the morning sessions and their focus". Sessions on statistical data analysis, creating a curriculum vitae, scientific writing, how to write an abstract, and academic integrity were among the academic seminars that URMs were enthused to pursue.

The third theme discovered is cognitive engagement in career and graduate school preparation. URMs understood the importance of learning to apply for graduate school and how the academic and research skills they developed in the program can positively impact their careers. This was very important to our URM students. One student's decision to apply and accept participation in the REP is rationalized in the following statement: "It has the best of both worlds because you have research and professional development". Another student articulated their appreciation for career preparation in the following response, "The things that we are doing with my research mentor and my peers is great preparation for a job or my post-career aspirations. The morning sessions are very beneficial for learning how to prepare for graduate school".

The final theme is emotional engagement in the connections with the research mentors and Program Coordinator. Emotional engagement is the amount of enthusiasm an individual has towards learning or a task. A participant stated, "I wish there was a way to be more involved with all of the research mentors". This theme was also supported by another participant who stated, "For me, it would probably be interactive activities. One thing that tends to make people less interested in a topic is if they are always sitting down. If we were moving around and interacting more then we could be more engaged". Accounts from participants are attributed to some participants taking part in the summer program onsite. In contrast, the remaining took part in their home institutions as a part of a hybrid collaboration. Both the onsite and hybrid participants had the opportunity to meet, collaborate, and interact with each other in person during the symposium and NIH R25 Awards and Dinner held on the final day of the summer program. The final theme is emotional engagement in the connections with the research mentors and Program Coordinator. The perceptions among onsite and hybrid participants were unanimous regarding the emotional investment and interactions they experienced with their research mentors and the Program Coordinator. They felt the lines of communication were open and their needs were met as they were identified. The following statements from participants are positively aligned with the theme: "My research mentor and the coordinator are very quick to respond to emails. They are probably the only people that I email outside of my peers. That makes it a lot easier when you have prompt responses". "For my research mentor, he is very encouraging, he allows you to make your mistakes and he helps you. For the abstract, he gave me a hands-on abstract by writing it on the board, which was very encouraging. For my peers, they are very encouraging, if I miss something from the research mentor, they are very helpful in making sure I get it". And, "When it comes to my coordinator, she is really helpful. A lot of things that I don't understand, but she does a great job of explaining it to me. When it comes to the research mentors, they help inform me on certain aspects of research that I wasn't sure of. It also helps me in terms of research and preparing for school, especially in terms of taking the MCAT". Students generally felt that their connections with their research mentors and Program Coordinator enhanced their academic learning and research experiences and prepared them for graduate programs.

Figure 4. Word cloud analysis for a visual representation of the frequently used words in URM students' evaluation of the IDP.

4. Discussion

The major findings from this study are as follows: First, URM students strongly agreed that the IDP was very effective in clarifying and planning their academic and professional goals. Second, they were more intrinsically and extrinsically motivated to pursue careers in STEM but displayed lower amotivational levels. Finally, URM participants were behaviorally engaged when learning about the different activities of the program, including research, academic seminars related to career development, graduate school preparation, and engagement with the research mentors and Program Coordinator. These findings demonstrate the IDP's effectiveness in helping maximize the career development of URM students in STEM programs. The thematic analysis indicated that students would be more emotionally engaged if there were more peer collaboration and hands-on activities. Successful and effective implementation of the components of the individual development plan can positively aid in achieving the overall arching theme of recruiting more URM undergraduate students to pursue graduate pursuits in STEM. Findings also reveal that URM students strongly agreed that the IDP was very effective in their academic and professional goals, revealing the positive impact of using IDP to identify career paths, guide the identification of skills and knowledge gaps, and create plans for addressing these gaps to enhance the academic growth of URMs. Other studies also reported similar findings in the field [28–31]. However, this study is unique in that it used the IDP with undergraduate students in STEM, modified to include scientific assessments and weekly reflections, while also evaluating motivational levels. An individual development plan (IDP) proved highly effective in clarifying and strategizing academic and professional goals for underrepresented minority (URM) students in STEM programs, therefore underlining its importance in optimizing their career paths. Students' success in achieving their academic and professional goals highlights the importance of utilizing IDPs to identify career trajectories, identify skills and knowledge deficiencies, and design actionable plans for filling these gaps, thus enhancing academic growth for URMs. By offering personalized roadmaps tailored to the student's aspirations, creating a sense of ownership and accountability, and providing structured guidance and support throughout their academic and professional journeys, individual development plans are effective in facilitating goal achievement, motivation, and enhanced engagement among students.

The use of the IDP allowed researchers to develop specific interventions that could identify STEM career paths for URM students. This provides a platform for the exploration of STEM career paths and supports the development of short- and long-term career goals, including the creation of action plans to achieve those goals. The continuous assessment and reflection of the goals within the IDP allowed the Program Coordinator and the research mentors to coach and invest in the individual successes and accomplishments of each URM student. Each meeting contributed to building a positive, working, and nurturing relationship that challenged URMs to align their short-term and long-term goals with their academic and career expectations. It was observed that extrinsic and intrinsic motivations were not significantly different in the pre- and post-tests among REP participants. There was a noticeable difference in amotivational levels before and after the evaluation. Intrinsic and extrinsic forms of motivation were reported to be positively correlated among URM students, and the presence of extrinsic motivation predicted higher levels of intrinsic motivation over time [32]. Findings also reveal that there is a relationship between motivation and student engagement that can help URM students find success during pipeline programs and mentorships designated for STEM undergraduate students. These forms of support should appeal to their extrinsic needs and pride and facilitate connections that will help to enhance research, academic learning, and graduate program preparation.

Findings from Yates and Patell [32] support the results of this study that URM students have higher extrinsic and intrinsic motivations compared to low amotioovation. The IDP may have contributed to the stronger interest in STEM education and training, which was observed in the current study and could suggest higher levels of intrinsic motivation. Moreover, it is possible that the relationship between intrinsic and extrinsic forms of motivation in our URM students was less antagonistic (i.e., less negative). In this context, a higher amotivation in the current study could have resulted from several negative consequences, such as reduced engagement in constructive activities during the REP and participation in the IDP. In addition, a higher amotivation could have been associated with a lack of involvement and commitment to a career pathway in STEM fields, reduced value of academic tasks related to the research education program, and lower intention to pursue future activities of the IDP, leading to dropout. To implement the research education program, researchers provided an interactive social activity that allowed URMs to discuss choices in their academics and relatedness, where each URM felt loved, valued, and accepted by peers and mentors and felt a sense of belongingness to a social context [25]. The provision of the above needs may lead to the internalization of initial external regulations, thereby reducing amotivation by enhancing self-determination. This is supported by other studies [28,32] that social context which provide basic psychological needs of autonomy, competence, and relatedness are supportive and helpful in the internalization process, thus lowering amotivation. Moreover, the low amotivational levels may also indicate that our URMs value the work and perceived different intrinsic or extrinsic reasons for participation because participation did bring about desired outcomes for more URM participation in STEM-related careers [28–31].

URM students were more behaviorally engaged when learning to conduct scientific research, analyze data, write scientific abstracts or papers, and learn about academic integrity in conducting scientific research. In addition, URM students were very enthusiastic and willing to invest in a task associated with cognitive engagement in their career and graduate and professional school preparation. In general, the perceptions among URM participants were unanimous regarding the emotional investment and interactions they experienced with their research mentors and the Program Coordinator. They felt that their connections with their research mentors and Program Coordinator enhanced their academic learning and research experiences and prepared them for graduate programs.

Despite the effectiveness of the IDP with undergraduate URMs, this study has its limitations. The small sample size may affect the generalization of the findings. Due to the challenges of recruiting male URM students to the summer program, male and female participants were not equally represented. There is a tendency for bias in the self-reported data from the questionnaires. The IDP was implemented in the second year of the program. Therefore, data are limited to one year of implementing the summer REP. Using the IDP in the subsequent years of the program will help broaden the scope of the population size, characteristics, and outcomes. Our finding that $\geq$70% of URMs strongly agreed that the IDP was very effective in developing their academic and professional short and long-term goals strengthens the need to equip URM students with the skills and guidance to successfully pursue careers in STEM. The use of the IDP in the subsequent years of the program will help to broaden the scope of the population size, characteristics, and outcomes. The IDP consisted of general scientific and biomedical assessments, which is a limitation to its effectiveness. URM participants represented career paths from various majors within STEM, but the assessments and mentor pairing were not specific to the chosen career path of all selected students. It would benefit the participants to assess their scientific skills, interests, and values using an assessment that is aligned with their chosen major or career path. Being paired with a research mentor who has experience and education in the same or related major and career path as the students will allow them to have a more in-depth mentoring relationship. The final limitation is the length of the summer program. The IDP requires the URM participants to identify and set short-term and long-term goals that they will strive to achieve within one to five years, but the summer program was only for seven weeks. To provide mentorship, guidance, and support for the completion of the long-term goals, the IDP process will need to continue beyond the summer program.

5. Conclusions

With the need to equip URM students with the skills and guidance to successfully pursue careers in STEM, the REP represented a pipeline program to promote workplace diversity and the development of highly qualified URM students for graduate school pursuing careers in STEM fields. In this study, the IDP was implemented to provide URM students with a tool that fosters the self-assessment of current skills, creation of a strategic plan, prioritization of progress, alignment of objectives, and promotes a learner-centered approach. In addition, their motivational levels and student engagement were analyzed during the implementation of IDP in a summer REP. The main findings show the importance of implementing IDP for URM students and how a supportive, interactive social environment may help reduce amotivation and promote extrinsic and intrinsic motivation in a summer training program. Future recommendations for continued use and impact of the effects of the individual development plan (IDP) with undergraduate URM students will require additional qualitative research. Conducting case studies with returning URM participants will allow data that are more specific and detailed regarding their motivational levels and student engagement levels. It will provide ease when tracking their successes in goal achievement and the graduate school admission process. Returning participants will also find a greater benefit in completing a modified IDP that builds upon the skills that they learned with the initial IDP. A modified IDP for a returning participant should encompass a SWOT analysis of their chosen career path; development of Specific, Measurable, Achievable, Realistic, and Timely (SMART) goals; and one-on-one individual development sessions that are geared towards action plan development. Overall, the implementation of the IDP will yield more significant results if there is more relationship-building and networking among all of the participants, research mentors, peer mentors, and the Program Coordinator.

Author Contributions: Conceptualization, N.E. and T.N.; methodology, N.E. and L.A.F.; software, N.E. and L.A.F.; validation, N.E. and L.A.F.; formal analysis, N.E. and L.A.F.; investigation, N.E., R.L.G., M.K.K. and T.N.; resources, N.E. and T.N.; data curation, N.E. and T.N.; writing—original draft preparation, N.E.; writing—review and editing, N.E., R.L.G., L.A.F., M.K.K. and T.N.; visualization, N.E. and T.N.; supervision, N.E. and T.N.; project administration, N.E. and T.N.; funding acquisition, T.N. All authors have read and agreed to the published version of the manuscript.

Funding: NIH Grant Number: omitted the funders had no role in the study design, data collection, analysis, decision to publish, or manuscript preparation. #1R25AG067034-01.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of the University of South Carolina IRB #Pro00113174.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Acknowledgments: We thank Nick Poupore for his contribution to this manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

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