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STRENGTH IN NUMBERS:
PSYCHOMETRICS OF THE STEM-US QUANTITATIVE ASSESSMENT

CHERYL P. TALLEY, PH.D.
DIRECTOR,
HBCU STEM US CENTER- ANALYTIC HUB

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INTRODUCTION

This is the second of a series of white papers designed to update the HBCU STEM-Undergraduate Success Research Center Community on findings associated with the Analytic Hub. The STEM-US Center’s Analytic Hub is a unique entity within the STEM-US Center. The Hub was created to assist researchers in answering the fundamental questions- “WHAT ACADEMIC INTERVENTIONS WORK AT HBCU’S AND WHY DO THEY WORK?” Now in year four, of the first five years of funding, the Center has generated some answers. This series will focus specifically on findings resulting from the collaborations between external faculty partners associated with the Analytic Hub.

The first of this series, “What works and why: Findings from Project Knowledge,” (Talley, 2024), summarized the research of Project Knowledge, an academic intervention and research project conducted at Virginia State University that began 2014. The purpose of Project Knowledge was to use a methodology that had been shown to be effective (mentoring) and by using a psychosocial theory (PVEST, Spencer 1997) determine the intervention’s most critical and essential components. The conclusion of the Project Knowledge intervention research was that an effective academic intervention builds academic skills in an emotionally-safe space while nurturing self-confidence; encouraging self-efficacy; and promoting self-agency. An impactful academic intervention uses metrics that are indicative of academic behavior change resulting in sustained improvement in academic performance. Using these definitions we posit that all impactful interventions are effective but not all effective interventions are impactful.

Close examination and refinement of the essential elements of effective and impactful interventions became the focus of the work of the Analytic Hub beginning in 2019. The iterative nature of the Hub’s research eventually led to the added considerations of replicability and scaleability of impactful intervention. Thus the Hub’s research followed three distinct lines of inquiry:

1. Identifying what specific types of academic interventions are effective at increasing academic performance for entering HBCU students.
2. Identifying the essential and common components that contribute to their efficacy.
3. Examination of the impact and sustainability of effective interventions by focusing on replication and scaling.

It should be noted that the consideration of impact and sustainability is aligned with the recommendations of “Efficacy, Effectiveness and Scale-up Research types” as stated in Common Guidelines for Education Research and Development, A report from the Institute of Education Science and the National Science Foundation (2013)

This present writing aims to inform student affairs professionals, faculty and intervention researchers about the Hub’s effort to use the knowledge obtained from research objective #2 (identifying the essential components of an effective intervention) to investigate research objective #3 (how to use those components to deliver impactful interventions to hundreds of students in multiple settings). For the purpose of the investigations, key terms in Objective #3 were assigned specific meanings because in general parlance, “effective” and “Impactful” may mean different things to different audiences. Therefore in our initial line of inquiry, the following terms were operationalized as follows:

- **Efficacy** - the results from a specific set of activities that can be measured to show a causal relationship between the intervention and academic behavior change
- **Impact** - measurable and quantifiable outcomes associated with academic behavior change that when sustained over time result in improved academic performance, eventually improving retention, persistence in STEM and graduation rates.
- **Replication** - The efficacy of the intervention can be reproduced by other researchers in other settings. Thus, obtaining the same or similar results in various contexts with different populations of students.
- **Scaleability** - The intervention can be scaled up with fidelity to accommodate significant numbers of students
- **Sustainability** - effective interventions projects (or their components) are institutionalized and outlast the external funding

Linda Darling Hammond once remarked on the “pop-corn” nature of academic interventions; potentially impactful activities that are not sustained once the grant ends.
More prevalent in our view, are “cotton candy” interventions. Interventions that provide an initial burst of excitement and energy but lack the nutritious effect needed for the long term. Moreover, familiar types of academic intervention activities that obtain a legacy status can continue without ever being shown to be effective or impactful. These are intervention efforts in which there are no measures indicating that participants experience sustained academic behavior change or improved academic outcomes once the intervention ends.

In our view, academic behavior change provides the measurement necessary to demonstrate scientific rigor. As stated in White Paper #001, less attention given to measurable and sustained student outcomes in many studies, contributes to the paucity of replicable Discipline-Based Educational Research (DBER) at HBCU’s. We believe that this and other shortcomings have contributed to an intervention landscape full of individual silos of effort and more popcorn! More importantly, the need for scaleable interventions that will help more students remain in school, persist in STEM and graduate from college goes unfulfilled.

We chose the Phenomenological Variant of the Ecological Systems Theory (PVEST) to address several methodological issues. We sought an ecological systems approach to create a common lens and a common language for examining disparate types of interventions. To assist in that aim, a well-regarded ecological systems theory such as PVEST was needed to focus a quantitative assessment instrument on variables associated with resilience instead of comparative deficits. Moreover, we believed that a PVEST-informed, student-facing assessment instrument, would provide a means of further refining the theory itself, based on real-life application. We asserted that specific focus areas, once elucidated by the theory and identified by the assessment could guide effective academic intervention activities regardless of the type of intervention activities used. Thus the tri-directional nature of the research rational rested on an interactive approach that related theory to assessment; assessment to activities and activities back to theory.

The expansive research rationale was also aligned with the STEM-US Center’s founding mission statement, as reported in a Morehouse College press release in Fall 2020.
The STEM-US Research Center's comprehensive work includes: a holistic strategy integrating research, education, outreach, and knowledge transfer. This approach is needed to effectively disseminate, at local, state and national levels, the contributions, impact, and positive legacy of HBCUs in broadening participation; a common theoretical framework that helps to identify student vulnerabilities while developing the necessary support for promoting resilience, success, and retention; and research-based protocols and analytical findings that will inform mainstream education reform, as well as contribute to the larger goal of overcoming race-related educational disparity in the United States.

In White Paper #001 we detail how PVEST was used to design and implement the academic intervention known as Project Knowledge. In this paper we will discuss the PVEST-Informed assessment instrument that was further developed by consultants and researchers associated with the STEM-US Center. Data sets produced by the use of this instrument were used to address the Hub’s initial research objectives and have guided Project Knowledge replication efforts. Using a large data set allowed us to broaden the scope of the intervention to beyond the perception of the student so as to include the learning context. This new emphasis led to additional research questions:

4. How can the use of theory and hypothesis testing that examines student performance as measured by indicators of academic behavior change be used to examine other aspects of the learning context?
5. What psychometric tools are the most useful in examining contextual factors associated with the entire learning (and teaching) ecosystem (ie data from mixed method research designs)?
6. How can multi-institutional data sets that allow for the use of person-centered statistical analysis be used to characterize the multi-dimensional nature of a successful HBCU student at different HBCU’s?

With this approach we posited that the emphasis on psychological constructs, such as Grit, Growth Mindset and Self-Efficacy for example, while helpful in characterizing the student are limited in scope. The research literature is replete with studies that focus on single variables of interest. However, we agree with social scientist Edmund Gordan that the acquisition of that knowledge, while useful to educational researchers does not always produce the depth of understanding needed to make that knowledge useable by
regular classroom teachers. Thus the goal of educational research should be not just the production of knowledge but also the pursuit of understanding. That pursuit of understanding became the mission of the Analytic Hub and has resulted in an expansion our thinking and our use of theory.

**PVEST: A FOUNDATION FOR ECOLOGICAL VALIDITY**

As a theory, PVEST is elegant in both its complexity (in terms of hypothesis testing) and its simplicity (in terms of explanation). We begin this work with the relatively simple explanation of Protective and Risk factors as was used in this line of research. First, PVEST asserts that all human beings have strengths and vulnerabilities that occur as a result of living in the world. Since our focus is on education that occurs in the United States at Historically Black Colleges and Universities, we consider the strengths and vulnerabilities associated with racial distinction and race consciousness as potential factors.

There are five stages in the PVEST model. The first of the five stages of the PVEST model allows for a deeper examination of the strengths and weaknesses of the student as seen from the student’s own perspective. In this stage we describe the heterogenous nature of the HBCU student population and identify personal characteristics and net vulnerabilities that could potentially influence a student’s reaction to academic stress. Moving counter-clockwise, in stage 2, the model asserts that the stressor, in this case entering the college environment is the stress engagement and will elicit coping behaviors that the student has used previously. These reactionary behaviors (stage 3) will either be adaptive to this new situation or maladaptive as defined by the outcome. If the outcome is maladaptive, (for example, skipping class to avoid seeing the professor after earning a low quiz grade) then there is a need for an intervention that would help students to avoid the low quiz grade (intervention between stages 1 and 2) or react differently (intervention between stages 2 and 3). Following a successful intervention, the new responses (meeting with the professor in order to understand what went wrong) when repeated lead to behavior change and eventually a shift in one’s identity. This is the growth and development that will lead to new challenges and new stressors (stage five). Rinse and repeat.
This dynamic process of growth and change occurs within and across multiple levels of analysis. The intervention can occur at the micro level, where the student figures out how to self-correct. This is the micro-system level. It is possible that friends or associates can provide suggestions on a course correction, the Ecosystem level. The course instructor or the department may have ways to reach out to students with low quiz grades, the mess-system level. It is possible that the student would have known what to do following a low quiz grade by having participated in bridge programs or college enhancement programs before entering college (macro-systems level).

Moreover the student is not an independent agent, but exists within intersecting systems that influence their lived experience. Therefore, to fully understand the learner and what happened to cause a failing quiz grade, one must also consider the student’s perceptual frame. The perceptual field contains the learner’s entire past and the systems that have contributed to it; family neighborhood, social background, social economic status, etc. Therefore, the perception of the student at any moment has been influenced by a myriad of external factors. To truly understand the factors behind the low quiz grade, a researcher would need to assess elements from the perceptual field. Yet, even if a single

Fig 2 From the Analytic Hub webinar series, “Tea with Melvin Hall” Fall 2022.
assessment were able to capture elements from the student’s entire perceptual frame, those perceptions could change the next day depending upon external events. Consider the impact of a student’s perceptual field by events like the murder of George Floyd or of a Covid-related death of a loved one.). Furthermore, just like no students are alike, no two HBCU’s are alike. The learning context: the relationship with faculty; the structure of the major; the campus culture all will have impact on the student’s perceptions of themselves.

To assess all of the elements associated with the perceptual field is impossible. However, it is possible to capture some elements within the perceptual field that are representative of the dynamic and multi-dimensional nature of the student’s experience. This is what is known as Representative Design and was first discussed by psychologist Egon Brunswik in 1956. Brunswik asserts that the consideration of these influences is necessary for ecological validity. Thus, a goal of the Analytic Hub was to consider ecological validity as part of a broad assessment strategy. The quantitative assessment was only the first step and therefore we were committed to getting it right.

**ASSESSMENT DEVELOPMENT**

**THE IDENTITY RESEARCH CENTER ASSESSMENT (IRC)**

What later became the HBCU STEM Undergraduate Success Center (STEM-US) began in 2018 as a funded research planning grant. One of the outcomes of that research effort was an assessment instrument known as the Identity Research Center Assessment (IRC). The IRC was initially designed by Dr. Amy Salter, then a graduate student from Georgia State University. Dr. Salter was asked by the project head, Dr. Curg Muldrow, a biologist at Morehouse College to draft an assessment as part of his research on Scientific Literacy. Scientific Literacy was the primary outcome hypothesized to improve as a result of the virtual biology training modules developed by Muldrow. The web-based training platform had been used with entering Morehouse students and students at several public schools. The virtual modules provide students not only virtual biology lab experiences but also targets motivational skills, such as Growth Mindset.

Dr. Salter, whose training and degree was in educational statistics designed the instrument based on the variables that had been identified by Dr. Muldrow at that time.
and was based on several years of experience in implementing the Scientific Literacy intervention at Morehouse and in K-12 settings.

Prior to the submission of the HBCU STEM-US grant proposal, data was collected using this IRC instrument and was funded by a planning grant. The participants were drawn from 11 different HBCU’s. Once the Center grant was funded, Dr. Muldrow’s efforts shifted to dissemination of the Scientific Literacy platform and the data set was given to the Analytic Hub to use as initial baseline data. As a result of funding from the Center grant, Dr. Chris Graziul, a statistician and associate of Dr. Margaret Spencer was asked to analyze the IRC data (Graziul, Salter Talley, 202?) Below are his emailed comments with emphasis given to statements pertinent to this present writing.

Dr. Graziul writes:

“While the IRC Baseline Identity instrument provides novel insight into STEM identity among HBCU students, one of its major limitations is, ironically, its focus on students as the unit of analysis. By this we mean that students exist within a dynamic and constantly evolving system of relationships both prior to and during their time at HBCUs. To fully understand STEM identity in this population thus requires the ability to identify, measure, and analyze the multiple, sometimes overlapping sources of stress and support that contribute to students' interest in and capacity to realize STEM-oriented career goals.....”

“The contextual, interpersonal nature of these interactions suggests that, to study STEM identity cultivation at HBCUs, it is important to supplement traditional psychometric evaluations with additional evaluative tools and data sources capturing the range of actors and contexts impacting identity formation among HBCU students. These include (a) questionnaires distributed to STEM faculty whose goal is to understand both how faculty view their role as mentors as well as how institutions perceive their ability to support cultivation of STEM identity, (b) survey items whose goal is to capture students' prior experiences with STEM education as well as information about their learning environment, and (c) basic information about who is teaching STEM courses, their teaching load, and their availability to provide one-on-one support to students. Relevant information would also include STEM enrollment levels, formal/informal programs for supporting or encouraging”
STEM engagement, and the availability of additional supports external to the institution (e.g. proximate STEM graduate programs).

Based on the variables of interest that were targeted by Dr. Salter, the most meaningful PVEST-related constructs were not emphasized. (The meaningful PVEST-related constructs were later revealed by STEM-US consultant Dr. Stephen Culpepper using a customized algorithm). However, one interesting result of the IRC analysis was the identification of “latent factors” that identified three distinct types of individuals among the participant pool from 11 different HBCUs. Additionally, the data revealed that Morehouse students were outliers in the data set, indicating a distinct but unidentified difference in that subsample. Despite the intriguing nature of the analysis, Dr. Graziul asserted that the assessment could not capture enough information from the student participants alone. Therefore, initial findings from the IRC provided a new research direction for the Analytic Hub that called for examining student performance as a function of their personal characteristics within a learning context.

Two other considerations emerged: 1. the original IRC had not been designed to examine the possible relationship between Identity formation and grade attainment/academic behavior change 2. The presence of latent factors that existed between and among the sample pointed to the usefulness of Person Centered Analysis as a method of reaching the Analytic Hub’s research goals. Based on these conclusions, the assessment instrument that had been developed at VSU was considered to be more appropriate than the IRC. The VSU instrument was initially designed specifically to elucidate motivational characteristics associated with first semester GPA of students attending a HBCU. The original name was the “Personal Factors that Influence Academic Behavior” assessment (PIAB). The Hub’s original plan was for the PIAB to provide the foundation for a quantitative assessment that could be used Center-wide.

Although Dr. Muldrow has retired from Morehouse and from his position as director of the STEM-US Center, he continues his work with Scientific Literacy, along with colleague, Dr. Adrian Neely.

THE PERSONAL FACTORS THAT INFLUENCE ACADEMIC BEHAVIOR
Personal Factors that Influence Academic Behavior (PIAB) were first introduced as an inclusive term by then VSU graduate student, Stephen Scherer. The term represented the group of “noncognitive” or affective factors that are associated with academic performance. The PIAB assessment included validated scales that measured cognitive-emotional regulation, time perspective, mindfulness, and self-regulation (Scherer, Talley & Fife, 2017).

PVEST served as a foundational theory in the development of the PIAB assessment instrument. PVEST was used to limit the broad range of possible PIABs to those associated with identity and emotional development. Initial findings revealed that time perspective, emotional regulation, and mindfulness were core target areas that were associated with first semester GPA. Specifically, Scherer Talley and Fife, (2017) found that future time perspective, past negative time perspective (catastrophizing), and cognitive-emotional regulation were significant predictors of first semester GPA..

Subsequent findings from the PIAB assessment highlighted the important relationship between cognitive-emotional regulation and academic success. Banjoko, Fife, Davis, Morrison, and Talley (2020), found a positive relationship between maladaptive (i.e., self-blame, rumination, catastrophizing, and blaming others) cognitive-emotional regulation and self-handicapping for African American STEM students. Additionally, the adaptive skills (i.e., acceptance, positive refocusing, refocusing on planning, positive reappraisal, and putting into perspective) of cognitive-emotional regulation were not related to self-handicapping. Previous work at VSU had identified self-handicapping to be negatively correlated with GPA (Serpell, 2015).

By using PVEST as the theoretical framework, Banjoko, Fife, Davis, Morrison, and Talley (2020), also confirmed Spencer, et. al. (2015) thoughts on the association between coping strategies and academic outcomes. The assessment focuses on hypothesized protective and risk factors as experienced by the student. Spencer’s theoretical model pointed to areas in which interventions could be most effective in helping new students form adaptive instead of maladaptive coping strategies when faced with the stressors of college. In other words, the findings suggested that the role of an effective academic intervention was to augment a student’s perceived protective factors and mitigate the perceived risk factors. The combined findings also highlighted the nuances of affective factors and their complex relationship to academic behaviors and outcomes.
Beginning in 2018, VSU students have taken the PIAB as part of an introductory Biology course. The data set now includes responses from over 3000 students. Such a large data set allowed for the use of more sophisticated psychometric tools. The data was first analyzed using stepwise linear and hierarchical regression in order to determine significant predictors of first semester GPA (Scherer, Talley & Fife, 2017). This was followed by analysis using principal component factor analysis, linear regression and PROCESS modeling (Davis 2022) to examine the mediating or moderating effects of the identified characteristics and to assess STEM course performance trends. The model identified the effective use of Academic Skills and Self Efficacy (an individual's belief in their own capacity to reach a particular goal) as directly related to GPA. We also found that the effect of Adverse Childhood Experiences has a moderating role in first semester GPA. (The significant influence of negative childhood experience re-emerged in later analyses).

While these findings were impressive, they were only indicative of students at VSU who were taking a course in which the 315 item assessment was an actual assignment. In order to test for generalizability of the findings it was necessary to use the assessment instrument at other institutions. However, in order to do that the instrument had to be shortened. How to reduce the number of items in a way that was psychometrically sound became the next challenge.

**PSYCHOMETRICS OF THE STEM-US ASSESSMENT**

**USING PSYCHOMETRICS TOOLS TO REDUCE THE NUMBER OF SURVEY ITEMS**

One reason that the PIAB was so lengthy was that for each of the validated subscales used in the PIAB, the entire set of questions for that particular subscale had to be included. By removing particular survey items, the validity of the subscale was put at risk. That means that by removing individual items, it was possible to lose the connection to the variable of interest. What was needed was a way to shorten the assessment without cutting the link between the individual survey items and the variable that they were meant to identify. The strength of this connection depended psychometrically on means testing or the the average score that was provided by the surveyed students. However, it was possible to use another method, Bayesian Analysis. Bayesian analysis could focus on the probability of the item being associated with a specific criteria, set by the investigator. This probability testing could be done without reliance on the entire
subscale’s association with the variable it was designed to identify. However, Bayesian analysis is a more sophisticated statistical analysis than what is normally used and required a high level of analytic and statistical expertise.

Fortunately, for us, Dr. Stephen Culpepper was available as a consultant to the STEM-US Center. Culpepper had developed an algorithm that could do just what was needed. Dr. Culpepper, was then an associate professor in the Department of Statistics at the Beckman Institute for Advanced Science and Technology University of Illinois at Urbana-Champaign and editor of the Journal of Educational and Behavioral Statistics. In his initial analysis, 786 VSU students provided data from 318 survey items sourced from 10 validated scales. His algorithm linked individual items to the most probable association with our outcome measures. We identified first semester GPA and withdrawal from VSU during the first semester as the outcome criteria. The algorithm identified 70 items out of the 315 that were associated with 3 constructs; academic skill set, self-confidence and self-agency. In addition, low math anxiety was also identified as a protective factor and all of these were correlated with high first semester GPA.

A Bayesian exploratory factor model showed that the model predicted 6.9% of the variability in observed GPA. While not conclusive, the findings indicated that a profile of a successful student could be produced by the pattern of student responses associated with those students that had a high first-semester GPA, (see Fig 3). We considered this characterization of academic success to be grounded in the theoretical model provided by PVEST and therefore, the results were used to inform the intervention targeting entering students. These research-informed efforts continue at VSU and will be to the topic of the next White Paper.

NEW FINDING: ALGORITHM GENERATED PROFILE OF SUCCESSFUL STUDENT

It is not a sound psychometric practice to assume that the same characteristics that were associated with high performing VSU students would be true for all HBCU students. To confirm generalizability for the assessment, Dr. Culpepper suggested that we give the same 300+ survey to students from other HBUC’s. While this was the next logical step it was not practical, especially since many of our external faculty partners were not trained in social science research. Thus the decision was made to encourage the use of the assessment by first making it shorter and second by providing external partners incentives to engage in the research. We embarked on both tasks as part of a
comprehensive research strategy that began to look beyond the student to the learning ecosystem. As stated earlier, this larger comprehensive research strategy that involved faculty communities of practice will be detailed in White Paper #003.

Profile

![Graph](image)

**Figure:** Profile of students with high first-semester grade point average.

Fig 3 From: Culpepper, S.A. (November, 2020) Understanding the link between the PIAB and academic outcomes, HBCU STEM-US Center Presentation. These unpublished findings show a negative association with math anxiety and a positive correlation with self-confidence, self-efficacy and self-agency in our sample.

While it was not an acceptable practice to randomly delete survey items, it was acceptable to use an expert to link the test items to a theory and then use the theory-derived associations to limit the number of survey items. This plan of action was executed in 2021 when Dr. Margaret Spencer, author of PV EGV, along with her associate Dr. Christopher Graziul identified the much smaller list of survey items generated by the Algorithm as Risk or Protective Factors. Thus the current version of the STEM-US...
Quantitative Assessment Instrument continues to generate data that is conceptually linked to PVEST.

**NEW FINDING: FAMILIES OF PROTECTIVE AND RISK FACTORS**

At the 2022 Psychometric Short Course, Dr. Samuel West used Psychometric Networks to illustrate the influence of protective and risk factors. Network exploratory analysis of the same sample dataset used to reveal a successful student profile now revealed “families” of items that were most associated with specific risk factors (i.e., negative childhood experiences and maladaptive self-criticism) and protective factors (social support and perseverance)

![Protective Network Diagram](image-url)
Fig 4 From: Kuno, C.B. West, S.A., Talley, C.P. (2024) Using Psychometric Networks to inform a campus intervention in prep. The Protective Network revealed a positive correlation between Africentric coping skills and first semester GPA.

Risk Network

Fig 5 The Risk Network indicated that having a family member with a mental illness and having experienced food insecurity were negatively correlated with first semester GPA.

Despite the fact that these findings were associated with college undergraduates, the intervention activities of Project Knowledge at Petersburg High School directly benefited from the findings. Intervention activities were further enhanced. Additional metacognitive
and relaxation activities were introduced to augment the protective factor of Afrocentric coping mechanisms. In addition, an after school meal was provided along with increased programming on mental and emotional well-being since the risk network revealed factors were associated with food insecurity and a history of familial mental illness,

**VALIDATION OF THE STEM-US QUANTITATIVE ASSESSMENT INSTRUMENT AND NEXT STEPS**

Finally, validation of the STEM-US Center Assessment was completed by Dr. Damon Bryant from Morgan State University (MSU). MSU is the only HBCU with a graduate program in psychometrics. Assisted by MSU colleague, Avis Jackson, a co-director of the Analytic Hub, Dr. Bryant has greatly contributed to the HUB’s research effort with his focus on the assessment instrument data and desire to utilize Artificial Intelligence (AI).

Dr. Bryant’s work on the validation of the STEM-US Assessment was necessary to ensure that the assessment items were actually measuring the psychological construct as defined by the originators of the original scale. His use of a one-dimensional differential item functioning (DIF) analysis revealed that the scale’s items were consistent in their link to their PVEST-inspired designations. Using ordinal logistic regression on each of PVEST dimensions, the analysis examined the composition of assembled items from the pre-existing scales. Overall results suggested that there was measurement equivalence across a number of PVEST labelled items. A Multidimensional DIF analysis suggested that more of the items showed evidence of measurement equivalence across the PVEST framework when conditioning on several subcomponents versus only one composite. The conclusion from the analysis is that operational definitions intentionally developed around the PVEST framework, do adequately measure the constructs and demonstrate some level of measurement equivalence.

As part of the Hub’s Psychometric Community of Practice, Dr. Bryant has submitted an NSF grant proposal to further refine the STEM-US Assessment. The proposed grant activities seek to develop a hypothetical characteristic profile of a successful HBCU student from several HBUC’s. In order to deploy the full assessment at several candidate HBCU’s, this proposal seeks funding to improve and increase the most useful assessment items using linear equating methods under the nonequivalent groups with anchor test (NEAT) design. The specific aims of the proposed work will be: (a) create a set of automatic item generators to support PVEST constructs, (b) generate pools of items that
can be assembled into parallel forms, which then can be administered across different HBCUs, and (c) establish measurement equivalence of generated items by administering the forms across a HBCU network of participating schools.

**CONCLUSIONS**

The ultimate benefit of having a profile of a successful first semester student would be the possibility of tailoring academic interventions to a specific target audience and eventually, with the help of AI, making predictions based on certain personal factors. The findings obtained from the assessment are already informing campus-wide activities at VSU and activities beyond the campus.

We now know that VSU entering students with high first semester GPA are more likely to:

- envision their end goal and future self and see their current activities as contributing to the end goal
- adopt, practice and maintain sound academic skills and be flexible when their current practices are not producing the desired result
- build self-confidence by identifying success at multiple points, not just final grades and also
- take ownership of their education by assuming responsibility for their learning.

There is much left to learn about how to cultivate these and other strengths in all of the students that attend VSU. There are many challenges. For instance, we know from our data that a significant number of incoming students have experienced childhood hardships. The stress of the first semester may be enough to trigger coping responses that may negatively impact academic performance. Findings such as these have fueled the movement toward a more relational brand of student-centered teaching/learning. The goal will be to provide supportive relationships between faculty and students with student-centered pedagogy and also between upper class students and entering students through intrusive mentoring. Most importantly the target of an impactful PVEST-inspired, ecologically valid intervention will be the student’s own perception of
themselves. In that scenario, the intervention will provide a safe space for self-reflection and introspection. The intervention will support trusting, nonjudgmental relationships which will allow for admitted vulnerabilities and mistakes on the part of student, mentor or faculty member. Finally, the intervention will provide the tools needed for students to take full responsibility for their own learning, experiences for mentors to see themselves as leaders and teachers to fully embrace the noblest of professions.

ASPIRING FOR ECOLOGICAL VALIDITY

It is hoped that this writing will spur a new era of academic intervention research. One that will utilize Person-Centered Analysis to develop impactful interventions that can be replicated across institutions and scaled to meet the needs of our students. It must also be sustainable at a time when generous funding associated with COVID-19 may be coming to an end. What is just beginning is the generational aftermath of COVID. This educational tsunami is related to the documented learning loss that has afflicted an entire generation of K-12 students. Now, more than ever we will need interventions to be more effective and most impactful. This research goal will not come quickly nor can it come from a few isolated studies. This effort will require collaborations across multiple institutions and also sustained funding. The research described here began in 2014 and has been continually funded. Yet, these findings would not have been possible without resources and support from the HBCU STEM Undergraduate Success Research Center.

Project Knowledge is now informing Relational Learning, Mentoring and Teaching efforts across the VSU campus that will reach several hundred students. PK also has also birthed demonstration projects in one Virginia high school with plans for another in North Carolina. Yet, the work is not done. More research is needed in our pursuit of understanding and ecological validity. This pursuit that can be aided by AI but AI requires big data.

The Hub’s goal for a multi-institutional data repository won’t be met on my watch. Others will need to create the methods and structures to support and sustain such a large scale effort. However, the HBCU STEM-Undergraduate Success Research Center has shown what is possible when HBCU faculty come together committed to a common vision and a willingness to work together, with faith, to attempt what hasn’t been done before.

After all, that is what HBCU’s have done since we began.