

VARIeTy: Using Virtual and Augmented Reality in Engineering Technology to Improve Academic Success of African American Males and Females in Engineering Technology Programs at Augusta Technical College

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Abstract

VARIeTy work-in-progress explores Augusta Technical College's U. S. Department of Education Predominantly Black Institutions (PBI) Formula grant initiative to incorporate the immersive technology of virtual and augmented reality into introductory engineering technology instruction. The grant project has an overarching goal of improving student engagement and learning outcomes of first-time in college African American engineering technology (Electrical and Computer, Mechanical, and Nuclear) students, and all engineering technology students in general. Grant activities commenced October 1, 2021, and the grant team is presently taking steps to procure a contractor for the construction of a VAR lab. Additionally, the grant team is developing a program of study specific to dual enrolled students within the college's service area that will lead to a college credential at the Technical Certificate of Credit award level.

Purpose

The VARIeTy grant initiative seeks to demonstrate improvement in academic performance and student learning outcomes of first-time African American students in engineering technology (ET); to increase the number of African American females entering ET; create a VAR learning lab to enhance the introductory ET curriculum; and to increase dual enrolled students in ET programs at Augusta Technical College. The dual enrolled student goal is 30 by year five of the grant. The VARIeTy initiative received multi-year discretionary funding under the Department of Education's Predominately Black Institution (PBI) Formula grant program. The grant funding supports renovation, equipment and supplies, personnel, outreach and other activities within the scope of the goals and objectives.

Table 1. Metric to improve educational outcomes for African American students at Augusta Technical College.

Goal: To improve the educational outcomes for African American students at ATC					
Objective/Measure	Y1	Y2	Y3	Y4	Y5
1. Increase to 2.0 the average GPA of first-time African American students in ATC					
1a. Electrical and Computer Engineering Technology (ECET) [Baseline: 1.6]	1.6	1.7	1.8	1.9	2.0

1b. Mechanical Engineering Technology (MET) [Baseline: 1.1]	1.1	1.2	1.4	1.7	2.0
1c. Nuclear Engineering Technology (NET) [Baseline: 1.8]	1.8	1.85	1.9	1.95	2.0
2. Reduce the average ratio of male to African American female first-time students.					
Reduce to 10:1 the average of male to African American female first-time students. [Baseline: 13:1]	13:1	13:1	12:1	11:1	10:1
3. Construct A Virtual and Augmented Reality (VAR) learning lab to enhance the introductory Engineering					
Renovate unused office space and adjacent labs to create a larger space of ~924 sq. ft.	Construction	N/A	N/A	N/A	N/A
4. Increase dual enrolled student enrollment in Engineering Technology programs at ATC					
Enroll 30 Dual enrolled students in Engineering Technology programs at ATC by year 5 of the grant. [Baseline: 0]	0	5	10	20	30

Metaverse

Metaverse, the virtual and augmented reality realm is a fast-growing trending technology. The technology ‘traces’ back to 1992, a science fiction novel titled *Snow Crash*. [1] “*Snow Crash* formed the idea of the metaverse by combining ‘meta’ and ‘universe’, where all the characters lived an alternate life.” [1] The project team thought adapting the use of virtual and augmented reality (VAR) befitting to cultivate students of underrepresented populations’ self-efficacy in engineering technology and promote a sense of belonging. The fundamental premise of the metaverse is to live in alternate reality with open possibilities. VAR is already on the precipice of transforming “entire functions of industry to include sales, marketing, business operations and various technological innovations.” [1] The convergence of the “physical, augmented and virtual reality in a shared online space” is an ideal means to enhancing and increasing the efficacy of all who desire to enter STEM careers, particular engineering technology. The college hopes the VARiETy initiative will not only demonstrate positive academic impact amongst the targeted population, put also lay foundation to expanded use to include virtualization of classrooms by creating digital twins via avatars replicating a diverse study body. As noted by the head of Immersive Learning at Meta, “We want to create an ecosystem for learning in the metaverse.” [2] The ecosystem is designed to prepare the “future workforce to interact with these technologies, but also to build them.” [2] Educating model is transcending to a “tri-brid” model one that moves “seamlessly between online, in-person and simulated, without the limits of time, travel and scale.” [2] Greg Heiberger, associate dean of academics and student success at South Dakota State University noted, “I do hope that things like the socioeconomic divide and geography divide can potentially be bridged in education because of some of these new technologies like VR.” [2]

Educational Technology

Although many companies are embracing the metaverse, few intrinsically focus on the educational integration potential. The grant team selected the company Eduporium whose technology provided opportunity for African American students and other people of underrepresented populations to enter STEM careers in general and engineering and other technician positions. The initiative is to incorporate mixed-reality technology, a 21st century medium to prepare the 21st century workforce. The virtual and augmented reality learning lab provides robust skills immersion experiences within and beyond technical and educational subject matter, to include opportunity to develop and enhance students' empathy, efficacy and persistence.

Community Outreach

Community outreach programs are integral to this initiative too. Outreach efforts concentrate on encouraging African American students, particularly females to pursue ET as a viable career option. Currently, the outreach coordinator provides activities, events, and programs within the college's five-county service area, which includes rural communities. To-date, the STEM outreach coordinator visited middle and high schools with students enrolled in CTAE or equivalent pathways.

With construction of a 40-student capacity VAR immersion lab, the VARIETY initiative will implement summer exploration camps for middle and high school students with priority given to students of underrepresented populations. The goals of the summer immersion camp are to pique interest in ET at the college, cultivate efficacy, explore scientific ways of thinking, and use technology to make learning fun. In addition, learning community efforts are underway that utilize the college's current student success resources.

Table 2. Outreach activities.

Technical certificate of completion

Activity	Objective	Attendance	Evaluation (# of Participants)
Information Sessions	Discuss VAR in ET, TCCs, Dual Enrollment	3	
Classroom Visits (Middle, High)	Present, Interactive STEM activity	2	47
Participation at Community Events	Representation	2	120
School-sponsored Parent Nights	Presentation, Q&A	0	0
Summer Immersion Camp (Middle School)	VAR immersion, Robotics, other STEM hands-on activities	0	0
Summer Immersion Camp (High School)	VAR immersion, Robotics, other STEM hands-on activities	0	0

The final link of the VARIETY initiative is creation of an engineering technology ‘connection’ pathway for secondary students (who have not chosen a specific ET pathway) to dual enroll and earn a technical certificate (TCC) with an expanded fundamental foundation approach. The STEM Tech micro-credential is under development with approval expected by fall term 2023. Its approach provides a polytechnic approach with focus on knowledge, skills, and techniques necessary for success in any ET program at the college, technical apprenticeship, or internship for ET technicians. Mixed-reality technology is woven into this TCC with a major educational outcome of students deciding on a specific program of study, apprenticeship, or internship available at the college. The STEM TCC aims to remove the guesswork in selecting a career path like “automated machine learning for *autoML* aims to eliminate the guesswork” of decision making with algorithms in designing models. [2] As with *autoML* that has been around for about a decade, researchers are still working on its automation, VARIETY is attempting to provide another aspect of expanding the pipeline of a talented diverse workforce. [2]

Table 3. STEM technician technical certificate of completion competencies.

Competency	Number Of Courses	Credit Hours	Mixed-Reality Incorporation (%)	Lab
Plant Mathematics	1	3	50%	No
Problem-solving Techniques	6	21	80%	Yes (5of6)
Oral & Written Communication Skills	6	21	60%	NA
Information Literacy (comprehension, synthesis, inquiry)	2	6	40%	NA
Computing efficacy to Virtual/Augmented Reality	3	10	50%	Yes

Data and measurement tools

The Science and Engineering Indicators Report (2022) discusses the “missing millions needed to reduce the talent gap”. [4]

Table 4. The Missing millions in STEM needed to reduce talent gap.

Category	2020	2030
Women	23%	41%
Hispanic or Latino	6%	17%
Black or African American	4%	17%

American Indian or Alaska Native	1%	2%
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In 2019, the knowledge-and technology-intensive (RTI) showed industries employ 18% of the US STEM workforce or 5.7 million STEM workers. [4] A large percentage, millions are missing from this keystone workforce. “Only 22% women and 16% underrepresented populations are included, and majority industries depend on foreign-born talent, making up 26% of their S&E (science and engineering) workers in 2019.” [3]

Assessment tools are under development. The team will utilize demographic surveys, pre- and post-assessments (summer immersion camps and TCC), and other qualitative measures.

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Conclusion

Using virtual and augmented reality in engineering technology is an approach deemed a unique mechanism to improve the academic success of African American students in ET (as well as all ET students) at the college. The current cumulative grade point average of African American students in ET is below 2.0 and below the overall cumulative grade point average of all ET students. However, the implementation of the mixed reality technology will benefit all students within ET at the college. Key grant outcomes are construction completion of VAR learning lab, increase the average cumulative GPA to 2.0 of first-time African American students in ET, reduce the ratio of African American males to females in ET to 10:1 and have 30 dual enrolled students in ET programs by year five of the grant.

References

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Biographies

KIM W. GAINES has an MS in Electrical Engineering and is the current PBI Formula Grant project coordinator for Augusta Technical College, Augusta, GA. She is an instructor in the Electrical & Computer Engineering Technology Department and teaches the engineering technology, instrumentation and process control courses of the associate's degree program. She is an active member of ASEE's Engineering Technology Division.

CALEB P ALLEN has a degree in Computer Programming, obtained through Augusta Technical College. He was a former distance education specialist and now holds the position of VR/AR Lab Tech. He has been a fixture in VR since its conception. Personal Computer (PC) building and customization are his passion and now he can use that passion in his current job.

JOHNICA MITCHELL has a Master of Science degree in Applied Mathematics with a concentration in Combinatorics and Optimization. She is the associate vice president for Research and Technology at Augusta Technical College. In this role, she leads data democratization efforts by developing visualizations for the college's data dashboard. Further she leads the grant procurement and management processes for the College's U. S. Department of Education Predominantly Black Institutions Competitive and Formula grant programs. Johnica has served in adjunct and full-time faculty positions at the technical college and university level. She also has greater than 10 years' experience in various administrative roles to include Dean of an off-campus instructional site, Director of Academic and Student Affairs at an off-campus instructional site, and AVP for Strategic Initiatives.

SHIRLEY WALKER-HERRINGTON has a Bachelor of Science in Business Administration Management, Troy University. She earned an Associate of Applied Science from Augusta Technical College and is employed at the college as the STEM Outreach Coordinator. Mrs. Herrington plays a vital role in recruiting students for the college's Engineering Technology program pathways. Her enthusiasm for students' success has been a passion for over 20 years. She has a strong community presence within her sphere of influence.