

Anti-racism, Inclusion, Diversity and Equity in Database Curriculum Through Group Research Projects on Historical, Social and Ethical Database Related Topics

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Introduction

The purpose of this work in progress research paper is to present a redesign of a sequence of four courses in order to provide scaffolded learning experiences related to anti-racism, inclusion, and equity (ARIE) for undergraduate students in an information technology program. This redesign is essential for equipping students with ARIE skills in engineering disciplines, as highlighted by the Joint Statement issued by the American Society for Engineering Education and the European Society for Engineering Education [1]. These skills are vital for fostering a more diverse and inclusive environment within the field of technology, enhancing students' ability to navigate and contribute to diverse workplaces, and promoting social responsibility and ethical leadership. We propose a synergistic redesign that integrates ARIE topics with the influence of role models within the course framework. Our goal is twofold: to introduce ARIE concepts through personal engagement with course-related topics and to strategically incorporate role models to enhance student understanding and motivation. Our team hypothesizes that by incorporating these principles into a STEM course, students are not only equipped with technical proficiency but also develop the critical ability to evaluate the wider societal impacts of domain-specific knowledge. In each targeted course, the revision introduces a sequence of group assignments, class discussions, and presentations that explore historical, ethical, or social issues related to the course topics with a focus on anti-racism, diversity, inclusion, and equity in the discipline. While the proposed changes are implemented in database-related courses, the learning methods, activities, and assignments are designed to fit a large spectrum of engineering and computing courses, with the goal of being easily customizable to other engineering domains. The redesign is implemented in a sequence of four courses starting with a required core course and continuing with main courses in the Database and Programming Concentration of the BS in Information Technology program, consistently the largest program in the university with over 2,000 students enrolled. A unique aspect of this redesign is that six diverse adjunct faculty are involved in the project bringing their own unique perspectives, experiences, and ideas to the project. Also, from a professional diversity perspective, which is very important for the students, the redesign team includes instructors with experience in academia (instructional, tenure line, instructional 2-year college), industry, and government.

Purpose of the Study

In their recent report titled 'Advancing Antiracism, Diversity, and Equity Inclusion (DEI) in STEM Organizations: Beyond Broadening Participation,' the National Academies advocate for increasing minority representation in science, technology, engineering, math, and medicine

(STEMM) fields. They also highlight the need for systemic changes aimed at providing better support for minority groups. The focus is on not only facilitating entry into STEMM education but also fostering environments that enable career advancement within universities, industries, and other STEMM workplaces [2]. This aligns with findings from numerous other research studies, all of which point to the critical need for promoting anti-racism, equity, and inclusion in higher education, particularly in STEM disciplines [3], [4], [5].

Despite the efforts of educators and researchers, there remains a notable gap in the available research concerning how ARIE activities can positively impact the learning experiences of students in STEM classes [6]. This study aims to address this gap by exploring the effectiveness of such activities in enhancing student learning experiences within STEM education.

The purpose of this research is to create supportive learning opportunities for undergraduate students, fostering their abilities in areas such as anti-racism, inclusion, equity, and diversity within engineering fields. The project seeks to develop and implement an anti-racist and inclusive framework tailored to the database curriculum within the Department of Information Sciences and Technology (IST), which can be easily adapted in other courses and STEM departments. It is expected that the students who complete dedicated incremental activities in a sequence of four targeted courses will go through a series of transformative practices and be prepared to successfully combat systemic discrimination in STEM-related fields.

To achieve this goal, the project outlines the following key objectives:

- Introduce ARIE concepts through interactive engagement with course-related topics.
- Strategically embed role models within the instructional framework to enrich student understanding and motivation in course topics.
- Enable students to identify, analyze, and articulate issues pertaining to anti-racism, inclusivity, diversity, and equity within the context of database topics.

By actively engaging with the course material, students will explore the nuances of ARIE principles and their application in engineering domains. Moreover, the integration of role models will motivate students by providing concrete instances of how these concepts come to life in real-world situations.

As the final step in their learning process, students will develop ARIE-related research projects tailored to the subject matter. This could involve exploring how biases manifest within database structures and developing methodologies to mitigate such biases. Additionally, it may entail investigating how database systems can be optimized to promote equity and inclusivity, such as ensuring fair representation and accessibility for diverse user groups. Moreover, the research projects may involve analyzing datasets to identify patterns of systemic discrimination and devising strategies to address these disparities effectively. Through these initiatives, the project seeks to foster a deeper understanding of ARIE principles within the context of database design.

and management, ultimately contributing to the advancement of more equitable and inclusive technological systems.

The ARIE-related research project encompasses the integration of three distinct research modules, outlined as follows:

- Module 1: Professional Role Models
- Module 2: Cultivating Occupational Identity
- Module 3: ARIE Research Project

This paper will primarily focus on our work in progress for Module 1.

Research Context

We developed and introduced an anti-racist and inclusive framework in a sequence of four database related courses. The sequence starts with a core course IT214: Database Fundamentals, which is required for all the students in the program. After completing IT214, students continue with the remaining three courses in the Database and Programming Concentration (DTP) of the BS in Information Technology (BS IT) program. It includes IT314: Database Programming and IT414: Database Administration, two main database related courses in the program, and IT390: Rapid Development of Cloud Applications. IT390 is a project-based course that combines programming and databases on the cloud. These last three courses are part of the DTP concentration, the second most selected concentration (75 out of 638 students who declared concentrations in Spring 2023). However, students from other concentrations can choose one of the database concentration courses to fulfill their degree requirements.

The revision introduces a sequence of research group assignments, class discussions and presentations that explore historical, ethical, or social issues related to the course topics with a focus of anti-racist, diversity, inclusion, and equity in the discipline.

Student Population

This research is intended to impact undergraduate students enrolled in four database courses at George Mason University in the Spring 2024 semester. The participants were part of the BS IT program in the College of Engineering and Computing. The students were enrolled in in-person and online sections of the targeted courses: IT214: Database Fundamentals (around 20 sections per year with around 800 students), IT314: Database Programming (3-5 sections; 120 students), IT390: Rapid Development of Cloud Applications (2 sections 40 students), and IT414: Database Administration (1 section; 30 students).

Another goal of the redesign is to address differential success in the course as observed in preliminary data. The table below summarized the number of students enrolled in BS in Information Technology program by ethnicity and gender in Spring 2023 [7]:

BS Information Technology	Total	Female
Total Students	1,877	538
African Americans	259	66
Hispanic Americans	206	51
Two or more	68	17
Native American	2	1
Pacific Islander	2	0

The following table shows differential concentration enrollment rate per gender and ethnicity in Spring 2023 [7]. There are visible differences for females (4%), African Americans (3%) and mixed races (4%) as compared to the general population.

Category	Program #	Concentration #	Program %	Concentration %
Total Students	1877	75	100%	100%
Female	538	19	29%	25%
African American	259	8	14%	11%
Hispanic American	206	8	11%	11%
Two or more	68	2	4%	+0%

Another differential success is related to the graduation and retention rates for first-time students, 4 years after entry (2018 cohort) [8] The data shows a differential failure for African Americans and mixed races.

Category	DROP %
All Students	21.5%
Female	14.0%
African American	35.0%
Hispanic American	20.0%
Two or more	60.0%

While this data is not linked to the proposed courses, in Spring 2022, IT214 has a DFW rate of 28% and IT 314 has a DFW rate of 16%. Our long-term goal is to find ways to reduce DFW rate

and we will investigate in the future how the proposed intervention contributes to such a reduction.

Proposed Intervention

In this initial study we created, and we are evaluating the first module of the proposed intervention, in which each participant student will select a professional role model and explain based on which aspects/criteria identifies with the selected role model. This module was selected based on a careful consideration of various aspects: *inclusion* (the topic is adequate for all students), *diversity* (the selected role models might be from a diverse background with the only restriction to be relevant to the course and allows the students to identify on various criteria), *equity* (while some students have the natural social context to identify such role models on their own, there are students who lack such social context and therefore will not be supported from the benefits of having a role model, therefore, through this assignment we try to level the field for everybody), and *anti-racist and anti-discrimination* (providing the opportunity and encouraging the students to select representative role models based on their own identity and values and also opening the door for discussions related to the representation in the field of various categories of people, how to mitigate the lack of role models for some students and the impact that such a situation will present).

The module is designed for asynchronous delivery but allows for both in-person and virtual discussions being adaptable to various teaching styles and class delivery modalities. It is divided into three main parts: (1) understanding the usefulness of professional role models for the individuals in the field; (2) collaborative exercise to identify a role model; and (3) self-reflection and presentation of the selected role model.

For the first part, we performed an extensive search for materials discussing the advantages of role models for college students. We analyzed the materials with a group of students and identified two readings that show the advantages of having a professional role model, the difference between a role model and a mentor, and some guidance on how to find the role model, in a concise and clear manner. Each article is followed by a formative mini test (5 questions) to emphasize the main concepts in the reading. The test can be taken several times. Questions are selected randomly from a pool of relevant questions. The feedback for wrong answers provides links and quotes from the original article, encouraging the students to learn from their mistakes. This way the experience is positive and allows the students to learn the essential concepts without pressure.

The goal of the second part is for the students to brainstorm about potential role models, offering opportunities for clarification, inspiration, and self-discovery for the students. The students are offered an initial pool of personalities in the domain that may serve as potential role models for the students. This might be a short list with a few personalities provided as examples or might be

a detailed list with a large representation. In our intervention, we had a few students (research assistants) who identified a large pool of personalities in the database and programming area (the main subject of the courses involved). For each personality, a short biography, highlights of their career to generate interest, and a list of references about that personality were included (over 20 personalities). Browsing through this list allows the students to see the extensive diversity of the researchers in the field. While the students are provided with this list, they are also encouraged to find other role models and look not only at the personalities in the field but also at professionals in the fields that they know. The initial list will be further developed based on the feedback received. It is important to remark that we have a curation procedure in place, and we will add new examples to the list, for instance, examples identified by the students. If a student reports that they did not find relevant examples in our list, but they provided a new one, we will analyze and consider for addition the new example provided.

After the students identify a potential role model that inspires them in the course's domain (e.g., databases or programming), each student will describe this role model on a discussion board and indicate the main criteria on which the selection was based. A moderated discussion will take place with feedback from the instructor and other students. The second part ends with a short assignment serving as self-reflection for the role model identification process. In this assignment the students will summarize their activity on the discussion board.

In the last part, the students will create a short one-page report describing their role model and lessons learned from this module, with the role of a personal reflection on the topic. The assignment requires them to identify a role model and briefly describe that person. Students must articulate their selection of a role model, detailing the reasons for their choice and how the chosen individual inspires and motivates them. Finally, they should identify a personally relevant aspect and explain its significance, detailing how it aids in their identification with the chosen role model. The report must end with a list of references used.

While the role model module is mainly intended to introduce concepts related to ARIE to the students, using guided discussions in part two of the module, there is also a direct benefit for the students with respect to the subject matter. For instance, a historical role model will teach them more about the history of the domain and link the learned concepts with the contributions of the selected role model. Or, a contemporary role model working in the fields, will help students to understand the importance and relevance of the subject matter in real life.

Experimental Design

The role-model module will be integrated in 8 sections of the 4 target courses and offered as a bonus point assignment, toward the end of the course over a period of 3 weeks. The students are free to choose whether or not to participate in the experiment. They will have alternative bonus point assignments if they decide not to participate. The module is offered to 216 students.

The students will also complete a survey at the end of the module to capture their opinion about the effect of the module on the student perception of their professional identity with the domain of study and the effect on their motivation.

Hypotheses, Data Collection and Analysis

The main hypotheses that we are studying is: “Does the professional role model module increases student’s motivation, engagement, course activity, and course result?”

We are collecting the following data for the students participating in the experiment:

- Activity and grades in the role model module.
- Course activity, cumulative grade and weekly grades during the course, including the final course grade.
- Answers to the end of module survey.

We are planning to study various correlations between the answers provided in the survey and the course activity.

Conclusion

This paper presents work in progress, describing in detail a proposed intervention for including the selection of a professional role model in the curriculum of a given discipline. A pilot experiment is under way, and we will have partial results available during the conference.

Our long-term goal is to show that selecting a professional role model and analyzing it from the students’ own perspective will increase student identification with the domain of study, their motivation and engagement and will contribute to better overall participation in the course. We hope to observe an impact on DFW rate and to reduce differential success.

References

- [1] ASEE, SEFI Joint Statement on Diversity, Equity and Inclusion
https://diversity.asee.org/wp-content/uploads/2020/05/ASEE-SEFI_DEIStatement.pdf.
- [2] National Academies of Sciences, Engineering, and Medicine. (2023). *Advancing antiracism, diversity, equity, and inclusion in STEMM organizations: Beyond broadening participation*.
- [3] Wilson, J., Townsend, T., Hargraves, R. H., Butler, S., & Allison, K. (2022). Anti-Racism, Equity, and Inclusion at Urban Institutions: An Introduction to the Special Topic Issue. *Metropolitan Universities*, 33(2), i-xiii.
- [4] Blonder, B., Bowles, T., De Master, K., Fanshel, Z., Girotto, M., Kahn, A., Keenan, T., Mascarenhas, M., Mgbara, W., Pickett, S., Potts, M., and Rodriguez, M. (2022).

Advancing Inclusion and Anti-Racism in the College Classroom: A rubric and resource guide for instructors. https://zenodo.org/record/5874656#.ZFGyoezMJb_.

- [5] Cronin, M. R., Alonzo, S. H., Adamczak, S. K., Baker, D. N., Beltran, R. S., Borker, A. L., ... & Zavaleta, E. S. (2021). Anti-racist interventions to transform ecology, evolution and conservation biology departments. *Nature ecology & evolution*, 5(9), 1213-1223.
- [6] Bing, V. M., Hendrickson, J., & Nicholson, W. (2020). From diversity to inclusion: Challenges and opportunities at an urban community college.
- [7] Student Enrollment By Program, Online: <https://oiep.gmu.edu/data-analytics-research/enrollment/enrollment-by-program/>.
- [8] Comprehensive undergraduate retention and graduation rates, Online: <https://oiep.gmu.edu/data-analytics-research/retention-and-graduation-rates/comprehensive-ug-ret-and-grad-rates/>.