Can training for ethics in STEM benefit the workforce?

Studies suggest that to achieve academic improvement for academically promising students, there is a requirement for study skills development supplemented with social support programmes. It has also been shown that increased retention and overall academic success can be achieved by placing focus on emotional development alongside academic curricula. More specifically, students taking science, technology, engineering and mathematics (STEM) majors can benefit from combined academic support, social or emotional support, and exposure to an interdisciplinary curriculum. Additionally, a focus on ethics in STEM has been shown to foster analytical skills with a verbal focus, and dilemma-based problem solving has been shown to increase students’ understanding of fairness and equality.

THE E-STEM PROGRAMME

In response to this evidence, the ethics in science, technology, engineering and mathematics (E-STEM) programme has been developed to offer a modular approach for capacity development. The ultimate goals of the project are to increase the number of students pursuing STEM fields, increase retention in STEM majors, and ensure more students go on to enter the STEM workforce.

The programme, which was funded by the National Science Foundation (NSF), began in 2014 at Gwynedd Mercy University, Greater Philadelphia. Dr Michelle Kulp McEliece leads the programme alongside colleagues Dr Christian Hellings and Tara White Hines.

A significant portion of the NSF grant supports scholarships for students pursuing a STEM major of biology, computer science, or mathematics at Gwynedd Mercy University. The scholarships are designed to increase the number of students undertaking STEM degrees at the university by reducing the associated financial burden. E-STEM is also open to students that have not been awarded scholarships, and it has attracted talented students with demonstrated academic success, and improve student retention rates.

E-STEM ACTIVITIES

In addition to scholarship aid, the E-STEM programme also supports students through various community events focusing on science, ethics, and practical application.

- Peer mentoring based in collegiate development theory includes team building, study support, mentor-mentee sessions, and counselling training. The programme also includes social events which are designed to promote team building and stress management.

Dr Kulp McEliece, who earned her Ph.D. in molecular biology from Lehigh University, is an Associate Professor of Biology at Gwynedd Mercy University. She and her team devised the E-STEM programme with three major goals in mind.

STEM RECRUITMENT INITIATIVES

E-STEM aims to increase enrolment in STEM subjects at their institution by 10% by providing scholarships to academically talented students with demonstrated financial need. Each student must meet citizenship, major, and GPA requirements to be accepted into the programme, and they must submit an application with letters of recommendation and an essay. Dr Kulp McEliece and her team are focusing on students interested in pursuing bachelor degrees in Gwynedd Mercy University’s three STEM programmes: biology, computer information sciences, and mathematics.

A promotional campaign has been developed to accommodate E-STEM’s recruitment goal, and a major objective of the programme is to implement at least three new recruitment activities to reach an increased number of academically talented students interested in STEM professions. Activities which accomplished this objective include the distribution of marketing materials, promotion of E-STEM at University Open Houses, outreach by the university’s admissions department and direct correspondence with accepted students.

INCREASING STEM RETENTION

The project also intends to increase degree completion rates by 90%, while preparing STEM students for the workforce. E-STEM students are given exposure to supportive services with ongoing training in ethics. E-STEM implements joint and split cohort activities designed to accommodate new and continuing E-STEM students, peer mentor training and in-person and online one-to-one conversations between participants and the academic coach. In addition, E-STEM students are given exposure to career options in STEM and they receive personalized advice from programme directors and/or designated E-STEM faculty members.

BOOSTING STEM STUDENT SUCCESS

E-STEM also aims to ensure that at least 85% of E-STEM students are employed or enrolled in a graduate programme within two years of graduation. E-STEM aims to ensure that at least 85% of students are employed or enrolled in a graduate programme within two years of graduation.

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- Recruitment initiatives
- Promotion of E-STEM at University Open Houses
- Outreach by the university’s admissions department
- Direct correspondence with accepted students
- Supportive services with ongoing training in ethics
- Joint and split cohort activities
- One-to-one conversations between participants and the academic coach
- Exposure to career options in STEM
- Personalized advice from programme directors and/or designated E-STEM faculty members

The pillars of the E-STEM programme were a combination of science, ethics, and practical application and their subsequent interactions.
The E-STEM programme provides high academic advantages at low operational costs.

In leadership activities, Monthly ethics sessions are held where discussions range from generalised ethics education and its importance to activities designed to help students understand their own ethical principles. The primary focus has shifted year-to-year to cover training on how to dissect ethical questions, support for decision-making, and the deconstruction of real-life ethical scenarios such as authorship disputes and data sharing.

OUTCOMES OF ETHICS IN STEM

Outcomes of the E-STEM programme are measured qualitatively via surveys, interviews, and focus groups, and quantitatively via surveys, university data, and national data. Data from the programme suggests that it has been effective in increasing ethical awareness in its participants. It also shows that the cohort model has benefitted participants and that every E-STEM alumnus is now employed or in a graduate programme.

In 2018, the division saw a 21% uplift in applications from the previous academic year, and an average of 30.5% students indicated that the E-STEM scholarship was a factor in their attending or continuing at Gwynedd Mercy University. E-STEM achieved a 78.6% fall-to-fall retention rate for scholarship recipients, and participant satisfaction rates are consistently high across each completed year of the programme, with 100% of respondents indicating perceived value of the mentorship relationship.

Student success rates have been proven to be positive. Normative scores of E-STEM students and students attending Gwynedd Mercy University are indicated to be statistically significantly higher than the national average. Self-reporting indicates "STEM-employment readiness improvement" and "increased ethics capacity," which suggests that E-STEM is contributing to workforce needs. This is particularly evident in biology and information technology in the Greater Philadelphia region.

PRELIMINARY CONCLUSIONS

The E-STEM programme has been shown to provide high academic advantages at low operational costs and is a model that could be applied to numerous academic programmes. Dr Kulp McEliece and her colleagues have also found that the development of cohort identity has been crucial to the reported increase in academic achievement.

E-STEM graduates are shown to display higher moral and ethical development scores than their comparative peers, and it is evident that the programme promotes employment preparedness, academic retention, and self-reported value.

Looking more broadly, the programme has strengthened relationships with local schools and employers. In addition, E-STEM’s strong focus on ethics education also serves as a model for similar institutions in the region and beyond. For more information visit www.gmercyu.edu/academics/e-stem-program