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A K20 Center Research Brief

Career Exploration Through Experiential Learning: Design and Engineering

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Introduction

The authors situate their study within a well-documented national concern: While U.S. students perform relatively well in mathematics and science in elementary school, interest and achievement decline significantly by high school, particularly in preparation for STEM degree pathways. At the same time, enrollment in undergraduate engineering programs has declined, with especially pronounced gaps for Hispanic students, women, and other underrepresented groups.

Prior research cited by the authors shows that hands-on engineering activities, robotics competitions, and pre-college outreach programs can positively influence students' attitudes toward engineering. However, many existing programs offer limited exposure to university environments, narrow disciplinary focus, participation fees, or selective eligibility requirements that restrict access for economically disadvantaged students.

To address these gaps, the authors designed and implemented a week-long, no-cost, hands-on summer engineering camp. The purpose of the study was to examine whether sustained, immersive, and competitively structured engineering experiences delivered in real university laboratories could increase students' interest, confidence, and intent to pursue engineering fields.

Methodology

Research Design

The study used a descriptive, program evaluation design based on post-intervention surveys, daily student evaluations, and participant reflections. The design focused on examining participant perceptions, engagement, and self-reported outcomes following participation. The study did not include a comparison group or pre-test/post-test experimental controls.

Sample

Participant characteristics were as follows:

- 30 high school students
- Primarily juniors entering their senior year



- Average age of approximately 17 years
- Recruited from 12 area high schools in South Texas
- 19 of the 30 participants were Hispanic
- 50% of participants were female

Intervention Descriptions

The intervention was a five-day, full-day engineering camp titled Young Engineers of South Texas (YESTexas).

During the camp:

- Students worked in teams of three to four for the entire week.
- Participants engaged in seven total hands-on learning experiences:
 - Three one-hour technical engineering activities
 - Four three-hour engineering design projects
- Activities spanned five engineering fields: civil, electrical, mechanical, chemical, and environmental engineering.
- Instruction and facilitation were provided by:
 - 11 university engineering faculty
 - 15 graduate engineering students (as facilitators and chaperones)

Instruction occurred in actual university research laboratories, emphasizing teamwork, design, data collection, analysis, and competition. Each project culminated in a competitive evaluation or presentation.

The camp also included:

- Daily documentation and reflection sessions
- Information on college admissions and financial aid
- Faculty-student mentoring
- A final project competition and awards ceremony

Dosage

Technical activities:

- 3 total sessions × 1 hour = 3 hours

Engineering projects:

- 4 total sessions × 3 hours = 12 hours

Total instructional dosage:

- 7 sessions
- Approximately 15 instructional hours, not including orientation, documentation sessions, competitions, or informal mentoring time.



Data Analysis

Researchers analyzed:

- Daily oral evaluations
- Comprehensive post-camp surveys
- Student-written reflections

Survey results were summarized using descriptive statistics (counts and percentages). Analysis focused on changes in students' interest in engineering, perceived skill development, and satisfaction with camp components.

Results

Key findings showed strong positive outcomes:

- 80% of participants reported increased interest in engineering fields.
- 28 of 30 students stated that the camp influenced their desire to study engineering.
- 50% expressed interest in attending the host university, compared to 13% before the camp.
- Students reported improvements in:
 - Teamwork
 - Documentation and communication
 - Problem-solving
- 29 of 30 participants wanted to use skills learned during the camp in their high schools.
- Students valued:
 - Hands-on, real-world engineering tasks
 - Faculty and graduate student mentorship
 - Working in authentic university lab environments

These findings suggest that immersive, hands-on engineering camps can meaningfully influence students' confidence, skills, and motivation to pursue STEM pathways.

Application into Practice

Schools and districts can take the following action steps:

1. Partner with a local college or university to host camp activities in authentic lab spaces.
2. Design multi-disciplinary, hands-on engineering projects with clear goals, real-world relevance, and competitive elements.
3. Organize students into consistent teams to support collaboration and peer learning.
4. Recruit faculty, graduate students, or industry professionals to serve as facilitators and mentors.
5. Allocate approximately 15 hours of structured instructional time across a one-week program.
6. Remove participation barriers, such as fees, to increase access for economically disadvantaged students.



7. Build in daily reflection and documentation time to strengthen communication and metacognitive skills.

Work Cited

Yilmaz, M., Ren, J., Custer, S., & Coleman, J. (2010). Hands-on summer camp to attract K-12 students to engineering fields. *IEEE Transactions on Education*, 53(1), 144-151.
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