An Investigation into Persistence and Nonpersistence of Second and Third Year Engineering Students

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Recommended Citation
Ball, Kimberly E., 'An Investigation into Persistence and Nonpersistence of Second and Third Year Engineering Students' (2019). Interdisciplinary STEM Teaching & Learning Conference. 27.

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An Investigation into Persistence and Non-persistence of Second- and Third-Year Engineering Students

By: Kim Ball
“Quiet Crisis”

“We simply cannot sustain an economy based on innovation unless our citizens are educated in mathematics, science, and engineering.” – Bill Gates

“Quite Crisis: The steady erosion of America's scientific and engineering base which has long been the source of American innovation and our rising standard of living (Is America Falling Off the Flat Earth, 2007)
2nd and 3rd Year Nonpersistence

Research Questions:

- Which factors are associated with students’ persistence in engineering during their second and third years in school?
- Why do some students persist in engineering while others comparable on the same factors do not persist?
- What can institutions do in order to increase persistence in engineering programs?
Theoretical Framework

• Tinto’s Model of Institutional Departure (1993) - Students must integrate into:
  – Formal academic systems
  – Formal social systems
  – Informal social systems

• Many researchers today categorize these systems into two distinct factors:
  – Individual factors
  – Institutional factors
STEM and Engineering Nonpersistence: Individual Factors

- GPA
- Gender
- Ethnicity
- ACT/SAT math grades
- Work 20+ hours / week
- Inadequate high school preparation
- Overwhelmed
- Effort not worth it
- Poor study skills
- Failure of courses
- Don’t seek help (tutor)

- Sense of loss and failure
- Disappointment in field
- Unprepared for rigor
- Unprepared for time commitment
- Low motivation
- Too few role models
- Feelings of not belonging
- Easy to transition to new major
- Financial concerns
- Perceived discrimination
- Peer relationships
STEM and Engineering Nonpersistence: Institutional Factors

- Takes longer to graduate
- No career counseling
- Poor academic counseling
- Poor relationship between student and advisor
- Poor relationship between student and professor
- No institutional support
- Weed-out culture (gateway courses)
- Curriculum – structure, sequence
- Inadequate advising
- Poor mentoring
- Poor teaching
- Too few role models
- Time commitment not mentioned
- Don’t encourage social interaction between students
- Unwelcoming culture
- Isolated in field
Mixed-Methods Approach

• Quantitative
  – Descriptive Analysis
  – Predictive Discriminant Analysis
    • Individual and Institutional variables

• Qualitative
  – Interviews and documents
  – 10 students who have not persisted and 10 students who have persisted.
Site for the Study

• A mid-size Southern research university that is ABET (Accreditation Board for Engineering and Technology) accredited
Graduation and Nonpersistence Rates - MSU Engineering Students
(Data provided by MSU’s Office of Institutional Research)

% Graduated to Date by Year ≈ 47%
% Nonpersisters 1st year ≈ 28%
% Nonpersisters 2nd and 3rd year ≈ 20%
Quantitative Portion

• Population:
  – Engineering undergraduates who began as a freshman in summer or fall 2014, separated into three groups:
    • Students who did not persist to Fall 2015 (First year nonpersisters)
    • Students who left engineering Spring 2016 – Summer 2017 (Second- and Third-Year Nonpersisters)
    • Students who persisted through Fall 2017 (Persisters)
  – 714 students
  – 552 males (77%) & 162 females (23%)
  – 577 white (81%), 79 black (11%), and 58 other ethnicity (8%)

• Data provided from:
  – Mississippi State University’s Office of Institutional Research
Year 4 Classifications

Fall 2017 Classification Data

- Engineer Persisters: 59%
- First Year Nonpersisters: 24%
- Second and Third Year Nonpersisters: 17%
Year 4 Classifications

Classification in Fall 2017

- Engineer Persisters
- First Year NonPersisters
- Second and Third Year NonPersisters

Legend:
- Red: Left University
- Gray: Other Major
- Brown: Engineering Major
GPA Classifications

Final GPA as an Engineering Major

- 2.5 or lower
- 2.5 < GPA < 3.6
- 3.6 or higher
ACT Math Score Classifications

- **ENGINEER PERSISTERS**
  - 25 or lower
  - 25 < GPA < 30
  - 30 or higher

- **FIRST YEAR NONPERSISTERS**
  - 25 or lower
  - 25 < GPA < 30
  - 30 or higher

- **SECOND AND THIRD YEAR NONPERSISTERS**
  - 25 or lower
  - 25 < GPA < 30
  - 30 or higher
HS GPA Classifications

High School GPA

SECOND AND THIRD YEAR NONPERSISTERS

FIRST YEAR NONPERSISTERS

ENGINEER PERSISTERS

- 3.0 or lower
- 3.0 < GPA < 4.0
- 4.0 or higher
## Discriminant Analysis

<table>
<thead>
<tr>
<th>Classification Results</th>
<th>Predicted Engineer Persisters</th>
<th>Predicted Second and Third Year Nonpersisters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Engineer Persisters</td>
<td>96.2%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Actual Second and Third Year Nonpersisters</td>
<td>7.5%</td>
<td>92.5%</td>
</tr>
</tbody>
</table>

Variables Input into the Analysis:
- Math ACT Score, High School GPA, Grade of A, B, or C in Calculus 1-4
- Grade of A, B, or C in Physics 1-2, Number of D’s and F’s in Calculus 1-4
- Number of D’s and F’s in Physics 1-2, Number of A’s – F’s in Engineering Courses
- Final GPA as an Engineering Major
Second- and Third-Year Engineering Persistence Model

**Pre-College Factors**
- ACT Math Score
- High School GPA

**College Academic Factors**
- Engineering GPA
- Number of A’s, B’s, C’s, D’s and F’s in Engineering Courses
  - Grade of C in Calc 1
  - Number of D’s and F’s in Calc 1
  - Number of D’s and F’s in Calc 2
  - Grade of A, B, or C in Calc 3
  - Grade of A, B, or C in Calc 4
  - Number of D’s and F’s in Calc 4
  - Number of D’s and F’s in Phys 1
  - Number of D’s and F’s in Phys 2

**Persistence**
- Year 4 Engineering Student
Qualitative Questions

See Handout
Questions or Comments?

Feel free to contact kim.ball@msstate.edu
References


