Exploring Student Data Analytics: Four Initiatives in Engineering Education Research and Practice

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The Problem
Data governance and the capacity for data analysis can limit the use of these data for institutional improvement and research purposes.

The Purpose
This poster showcases some enablers of student data analytics and the insights thereby obtained from four projects within the Faculty of Applied Science and Engineering, University of Toronto. These enablers and insights can help enhance institutional practice and scholarship on postsecondary student experiences.

The Context
Postsecondary institutions collect information from their students via registration, the learning management system, and student surveys. These secondary data provide rich information about student experiences and outcomes.

Project #1.
NSSE-based data linking and analysis
Team leaders: Prof. Greg Evans and Dr. Qin Liu

Data Sources:
2017 and 2020 National Survey of Student Engagement (NSSE) data linked to Co-curricular Record, retention and graduation, and academic performance data.

Samples:
341 first-year students and 310 senior students (2017 data); and 371 first-year students and 231 senior students (2020 data)

Data Elements:
• 10 Engagement indicators
• Time spent on co-curricular activities, work, family care, and commuting
• Participation in high-impact practice
• Learning outcome indicators: perceived gains, CGPAs, 2nd-year retention, and graduation

Research Question: What persons can be identified from student data that measure students’ curricular and co-curricular experiences?

Insights Obtained:
• Four persons identified from K-means cluster analysis: Highly Engaged; Moderately Engaged; Externally Engaged; Disengaged (2017 first-year student data)

Project #2.
Multi-year survey data analysis
Team leaders: Prof. Greg Evans and Dr. Qin Liu

Data Sources:
• Seven years of Engineering Welcome Survey data (2016 to 2023, samples ranging from 510 to 1048 students)
• Nine years of First-Year Exit Survey data (2013 to 2023, except 2021, samples ranging from 154 to 363 students)
• Four years of Graduating Student Survey data (2017 to 2021, except 2020, samples ranging from 165 to 251 students)

Topics in Survey Questions:
• Student support and services
• Academic pathways
• Competency development
• Highlights and challenges in student experience
• Student demographics and background

Insights Obtained:
• A sense of community is increasingly important to first-year engineering students over the years.
• Managing academic workload is a persistent challenge for engineering students.

Project #3.
11-year enrolment and academic data analysis
Team leaders: Prof. Ariel Chan and Graeme Norval

Data Sources:
University and academic records of 11,227 engineering students who graduated between 2012 and 2022.

Data elements:
• Include course / program enrolment, co-op completion, minor certificate completion, cumulative GPAs, and grades of math courses.

Insights Obtained:
Engineering Welcome survey data in 2018, 2019 and 2021 combined

Correlational Analysis
Students’ perceptions of the engineering community

Opportunities for student data analytics:
Linking survey and administrative data offers opportunities to probe the relationships between student experiences and subjective versus objective learning outcomes.

Opportunities for student data analytics:
Multi-year survey data can reveal persistent patterns in student experiences and outcomes, and allow probing into matters specific to some minority students.

Opportunities for student data analytics:
Enrolment and academic records can illustrate student pathways within the Faculty, and the relationships between course / program enrolment patterns and learning outcomes.

Opportunities for student data analytics:
Disaggregation analysis of application, admission, and registration data can provide insights about potential inequality and inequity issues in the student admission outcomes.

Opportunities for student data analytics:
Data-driven analysis of application and admission data patterns in graduate engineering studies.

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Student Data Analytics
• Academic / institutional analytics, and learning analytics;
• Descriptive analytics, and predictive analytics.