Analysis of Pedagogy and Content for a TCNJ Summer Bridge Program

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Abstract

The Summer Scholars Program, a five-week bridge program for historically marginalized STEM students, aims to improve overall persistence and success. This research aims to understand the relationship between faculty pedagogy, class content presented to students, grades, and persistence in STEM. This research aims to accomplish these goals through analysis of materials for a module of the summer bridge program via the development of a coding scheme for qualitative data, the construction of a quantitative database, and use of statistics to investigate the research goals. This poster presents the methodological details from which this research group intends to answer these questions surrounding persistence, pedagogy, and content.

Introduction

- The persistence of students in STEM majors is a major area of focus not only in sociology but at an institutional level.
- At TCNJ a group in which STEM persistence can be improved is pre-college EOF (Education Opportunity Fund) students. These students are conditionally accepted to TCNJ with scholarships for academic support and fully matriculate into TCNJ after the successful completion of a 5 week, resident summer scholars program. Through this program students receive not only credit towards their undergraduate degree, but work to develop the skills necessary to promote the highschool to college transition.
- This research focuses on the pedagogy and content of one class of the TCNJ Summer Scholars program in order to better understand increased persistence associated with students in the program. This research aims to detect differences between faculty cues and practice in student learning.This research aims to help translate this persistence to the TCNJ Summer Bridge Program and STEM majors as a whole.
- Specifically, this research focuses on an Astrodynamics Module taught by Dr. Angela Capece and presented in summer 2018.

Astrodynamics Module Structure

- 4 hours per day, 5 days a week for 2 weeks total.
- Teaches physics and computer science coding to students in relation to astrodynamics with the ultimate goal of modeling the transiting of a spacecraft from earth to a mars orbit.
- Program enriched with tutoring sessions for students along with workshops on topics such as time management, and mindfulness.

Quiz Question: A model rocket has an acceleration of 37 m/s^2 during launch. The rocket fires for 2.5 s before it runs out of fuel. What is the rocket's velocity at this time in miles per hour. (1 mile = 1.609 km)

- Lecture 3; Introduction to kinematics (position vs time); slides 2 - 4
- Lecture 3; Slide of equations students need to know (position, velocity, acceleration); slide 9
- Lecture 3; Slides detailing graph of acceleration and velocity; slide 14, 15
- Lecture 3; Concept question slides involving acceleration/ position; slide 17
- Lecture 3; In class problem on velocity, position and acceleration; slide 5
- Lecture 3; group problem on velocity, time, and acceleration; slide 11
- Homework 3; Question on force and velocity
- Tutor session 2; questions on graphs of position and velocity, initial speed and velocity, and speed and acceleration
- Lecture 3; 9:00 am, Paragraph 1 - Introduction to acceleration
- Lecture 3; 10:37 am, Paragraph 1 - Students worked in lab on problems involving acceleration

Figure 1) Example of coding scheme used for content analysis of a quiz presented to students in the Astrodynamics Module. Content is coded by time seen in lesson and by type of content. Purple = slides/ visual presentation, Blue = In class problems (to be handed in), Red = Group problems, Teal = Tutor sessions problems, Pink = Field Notes of class discussion/ interaction.

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Methods

- Researchers were provided with course content from the Astrodynamics summer module including:
  - Exams
  - Quizzes
  - Homework
  - Tutor Problems
  - Lecture Slides
  - Field notes of class
  - Post-summer and Post-first year interviews with students

Pedagogy

- Analysis of pedagogy began with coding of class field notes in Atlas.ti, a qualitative analysis software program, in order to categorize instructional behavior and student behavior. Codes were based on COPUS (Classroom Observation Protocol for Undergraduate STEM). Examples of codes include:
  - Verbal Cue
  - Verbal Feedback
  - Practice Opportunity
  - Building Rapport
  - Positive Reinforcement
  - Demonstration
  - Lecturing
  - Concept Application
  - Engaged Discussion
  - Lab Work
- Instructional behavior and student behavior was then compared to student feedback in interviews in order to relate instructional behavior to feelings of student belonging and development of metacognition. Metacognition is the awareness and understanding of one's own cognitive activity or thought processes. These high-order thinking skills allow students to acknowledge how they are learning and what can be done to improve their learning.

Content

- Analysis of content began with categorization of where materials on exams/ quizzes were covered.
  - See figure 1. for coding scheme example
- Analysis of student cognition began with categorization of how covered material was presented to students. Categorization was as follows:
  - Displayed on board/ slides with discussion
  - Displayed on board/ slides without discussion
  - Group work/ Example problem
  - Outside of class reinforcement
  - Mentioned verbally, no written content
- Categorization was then translated into a useable database from which statistical tests can be ran.
- Future statistical analysis includes:
  - Analysis of modes of content presentation in relation to student grades
  - Analysis of grade improvement for material covered on both quizzes and exams

Discussion

- In the future, this research aims to use statistics in order to better understand the ways in which attitudes and material presented to students translates to understanding and eventual persistence in STEM.
- This research also aims to pull from the large amount of collected data present from the TCNJ Summer Bridge Program in order to widely analyze themes in relation to attitudes and materials presented for all STEM major summer classes.
- Additionally, this research is of interest in areas outside of the persistence of students in STEM because of the methodology from which large amounts of qualitative data is being connected to quantitative exam scores and eventually will yield quantitative results.