The Re-Design of an Introductory Circuits Course Based Upon Student Demographics

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Presentation Outline

- Introduction
- Objective
- Circuits Course Format
- Circuits Course Modifications
- Hypothesis
- Method of Evaluation
- Results
- Conclusions

Introduction

- Tennessee State University is a historically black university in Nashville, TN
- College of engineering has 1000 students with 8 majors
- Performance of sophomore, junior, and senior students in an introductory circuits course
- Circuits and circuits lab is a 4 hour engineering science requirement for all engineering majors including architectural, civil, electrical, and mechanical

Objective

This comparative study attempts to identify factors that may influence student success in the DC circuit analysis course and exploit those to reduce attrition in the course and increase retention in engineering.

Circuits Course Format

- Course pre-requisites
  - Calculus IV
  - Physics II
  - Programming course
- Topics include
  - Ohm's Law
  - Thevenin's theorem
  - Operational Amplifiers
  - Mesh and Nodal Analysis (KVL and KCL)
  - First- and Second-order Circuits
- Projects
  - 2 PSpice
  - 1 Computer Design

Circuits Course Modifications

- Active learning classroom with collaborative and cooperative learning teams
- Teams formed by
  - student self-assessment and preference
  - Felder-Solomon index of learning styles
  - concept inventory performance
  - Pre-requisite grade
  - gender
- Teams submitted progress memos for the computer design project that walked them through the Bloom's problem solving methodology
- Periodic minute papers to gauge lecture effectiveness

Circuits Course Modifications, cont.

- Lectures on cooperative learning teams including
  - Tuckman stages of team formation
    - Forming
    - Storming
    - Norming
    - Performing
  - 5 cooperative tenets
    - positive mutual interdependence
    - individual accountability
    - promotive face-to-face interaction
    - teams skills development
    - regular group processing
- Course website including teaming and sample materials (http://www.tnstate.edu/cberry/ENGR2000.htm)

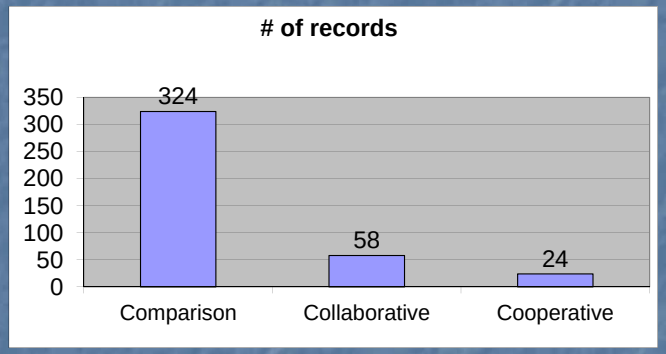
Hypothesis

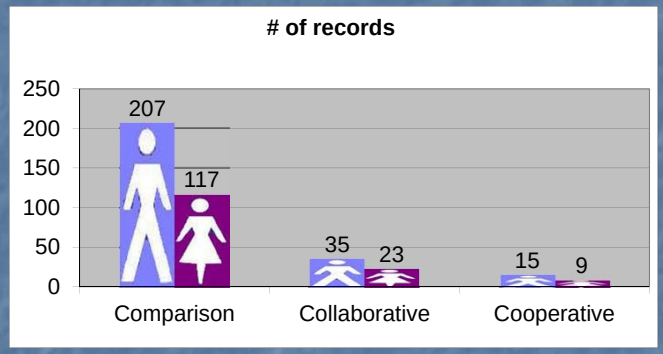
- The hypothesis is that the modifications to the course will increase student retention in the course, mean final grade point and reduce attrition in engineering overall
- Previous literature indicates that the best practice for engaging students in the learning process may include a combination of individual, collaborative and cooperative activities

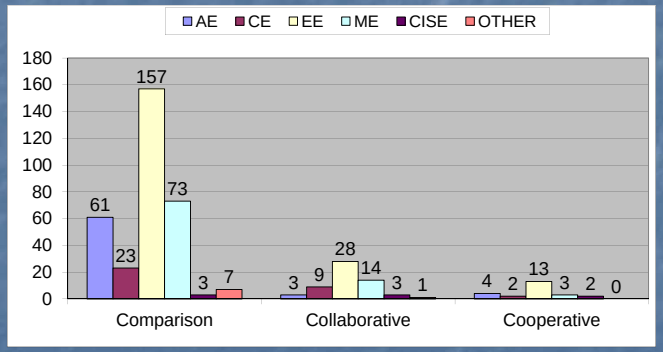
Method of Evaluation

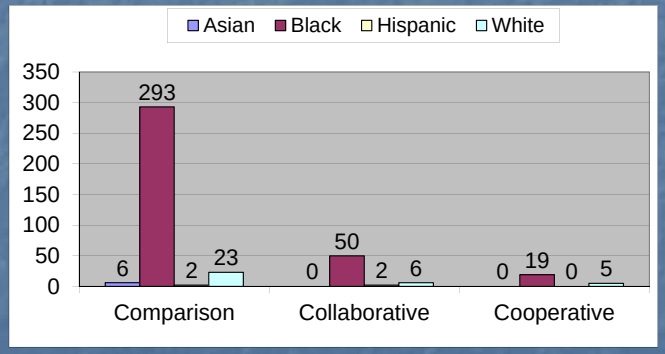
- Data was collected for the Fall 2000 through Spring 2003 semesters (comparison group)
- Data collected included final course grades, number of repeats, pre-requisite grades, race, gender, class, and major.
- The same data was also collected for the Fall 2003 through Spring 2004 courses (collaborative group) and Fall 2004 semester (cooperative group)
- The hypothesis was tested using SPSS 12.0.1 for Windows.
  - small sample size (approximately 400 students)
  - abnormal distribution of the data
  - non-parametric tests were used to identify significant differences
    - Mann-Whitney U
    - Kruskal-Wallis H
- Note that a significance level of 5% may indicate that some change in the course had a significant negative or positive influence on student performances

Results (Descriptive statistics)



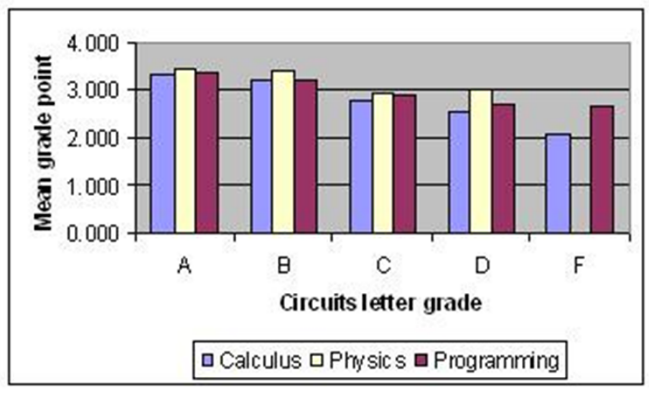






Results, cont. (Comparison Group)

- The majority of the students passed the course on the first attempt (215 out of 296). [28 withdrew]
- Of the remaining 81 students, 2 took the course 4 and 5 times without success.



- The attrition rate for this course was determined by finding all students who withdrew or received a non-passing grade (D, F). The overall attrition rate was found to be 33% for the course.
- On average the students took 1.35 attempts in order to successfully complete the course.

At a level of 5%, there does appear to be a positive correlation between prerequisite grade in all three courses and the final circuits grade. Figure 1 indicates this trend.

Results, cont. (Overall statistics)

Course Format	Male	Female	Overall
Comparison	2.04 (.609)	2.11 (.445)	2.06 (.421)
Collaborative	2.17 (.072)	2.14 (.318)	**2.15 (.041)**
Cooperative	**2.67 (.043)**	2.67 (.071)	**2.67 (.007)**

Course Format	Asian	Black	Hispanic	White
Comparison	2.17	1.99 (.202)	4.00	2.8 (.512)
Collaborative		2.14 (.138)	1.5	2.5 (.329)
Cooperative		**2.53 (.017)**		3.20 (.527)

Course Format	AE	CE	EE	ME	CISE
Comparison	1.83 (.781)	2.05 (.417)	2.12 (.133)	2.03 (.360)	4.00 (.200)
Collaborative	2.00 (1.00)	2.44 (1.00)	2.39 (.053)	1.79 (.203)	1.00 (.400)
Cooperative	1.75 (.967)	2.50 (.623)	**3.08 (.003)**	2.67 (.420)	2.00 (.333)

Conclusions and Future Work

- The statistical analysis indicated that at the 5% level, there was a significant improvement in the students overall mean grade between the cooperative learning course and the comparison course.
- There was also a significant difference between the collaborative course and the cooperative course.
- Although, student success in the circuits course was improved based upon attrition, it is still relatively high at 25%.
- Future work in the modification of this course would include qualitative as well as quantitative assessments of student success in the course.
- Some other possible sources of information would be to track all students completing the circuits course to graduation to determine the rate and persistence to graduation based upon the different course formats and final circuits grade.

Questions

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