

Student Learning Perceptions and Performance in Introductory College Physics: Examining the Gender, High School Preparation, and Other Characteristics

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Abstract

The purpose of this study was to investigate the relationship between student performance in college-level introductory physics courses and various educational and background characteristics.

Findings from all six courses indicated that the participant's educational goal, high school senior GPA, father's educational level, and mother's occupation in the area of science, engineering, or computer technology, high school preparation in mathematics, biology, and the completion of additional mathematics and science courses were positively related to performance.

No significant performance differences were found between male and female students. However, there were significant gender differences in physics learning perceptions. Female participants tended to try to understand physics materials and relate the physics problems to real world situations while their male counterparts tended to rely on rote learning and equation application.

This study found that participants performed better by trying to understand the physics material and relate physics problems to real world situations. Participants who relied on rote learning did not perform well.

Conceptual Framework

Sadler and Tai (2001) documented that high school students with more rigorous preparation had higher grades in introductory college physics. They also reported that some students without a high school physics course often did well in introductory college physics under the condition of having more educated parents, having previously taken calculus, or taking an introductory physics in their sophomore or junior year in college.

Redish (1997) developed a 34-item Maryland Physics Expectation Survey (MPEX). It has been widely used as the pre-test and post-test instrument to assess the learning. However, the difference due to the gender was not reported.

Procedures and Design

- The researcher received the permission from the physics instructors to administer the survey in the classrooms, they agreed to the subsequent grade submission process.
- UND Office of Registrar served as a data clearinghouse to handle research information while protecting the confidentiality of the participants and instructors.
- The design and development of the survey package, research method, subsequent data collection and analysis, result reporting and data storage were approved by the UND Institutional Research Board.
- A total of 267 students, 161 males (60%) and 106 females (40%), participated from six introductory physics courses.
- 200 students were in algebra-based (75%) and 67 in calculus-based (25%).
- Four on ten in the algebra-based and one on ten in the calculus-based courses were women.
- Six specific research questions have been generated for this study. Descriptive Analysis and Inferential Analysis (Pearson Correlation, Multiple Regression, T-Test, Factor Analysis, were used to examine the research question.

Results

RQ1. Were student's demographic characteristics related to their performance in introductory college physics courses?

Pearson Correlation and Multiple Regression

Independent Variable	Dependent variable	All group (n = 267)	Algebra-based group (n = 200)	Calculus-based group (n = 67)
Gender	Physics performance	ns	ns	ns
Age		ns	negative corr	ns
Class		ns	ns	ns
Father's SEC job		ns	ns	ns
Mother's SEC job		positive corr	positive corr	ns
Father's education		positive corr	positive corr	ns
Mother's education		ns	positive corr	ns
Senior GPA		positive corr	positive corr	positive corr
Educational goal		positive corr	positive corr	ns
			positive multiple corr (21.8%)	positive multiple corr (28.9%)

Participant's educational goal, high school senior GPA, father's educational level, mother's SEC job were positively related to performance.

RQ3. Were learning perceptions of students associated with their performance in introductory college physics courses?

Pearson Correlation and Multiple Regression

Independent Variable	Dependent variable	All group (n = 267)	Algebra-based group (n = 200)	Calculus-based group (n = 67)
Rote factor	Physics performance	negative corr	negative corr	negative corr
Relating factor		positive corr	positive corr	ns
Comprehension factor		positive corr	positive corr	positive corr
Derivations factor		ns	ns	ns
Effort factor		ns	ns	ns
Practice factor		ns	ns	ns
		positive multiple corr (24.1%)	positive multiple corr (23.4%)	positive multiple corr (18.0%)

Students performed better by trying to understand physics and relate physics problems to real world situations while students who relied on rote learning did not perform well.

RQ5. Were learning preferences of students associated with their performance in introductory college physics courses?

Pearson Correlation and Multiple Regression

Independent variable	Dependent variable	All group	Algebra-based	Calculus-based
Study style preference	Physics performance	NS	NS	NS
Lab partner gender preference		NS	NS	NS

Participant's learning preference was not related to performance.

RQ2. Were high school mathematics/science preparation of students predictors of their performance in introductory college physics?

Pearson Correlation and Multiple Regression

Independent Variable	Dependent variable	All group (n = 267)	Algebra-based group (n = 200)	Calculus-based group (n = 67)	
Math	Physics performance	positive corr	positive corr	ns	
Biology		positive corr	positive corr	ns	
Chemistry		ns	ns	ns	
Physics		ns	ns	positive corr	
Additional Math & Science		positive corr	positive corr	ns	
			positive multiple corr (6.7%)	positive multiple corr (6.9%)	positive multiple corr (6.9%)

Participant's high school preparation in math, biology were positively related to performance.

RQ4. Were there differences between male and female students in the learning perceptions in introductory college physics courses?

Compare Means and T-Test

Independent Variable	Dependent variable	All group (n = 267)	Algebra-based group (n = 200)	Calculus-based group (n = 67)
Rote factor	Gender (male = 1, female = 2)	Male higher	na	na
Relating factor		Female higher	na	na
Comprehension factor		Female higher	na	na
Derivations factor		ns	na	na
Effort factor		ns	na	na
Practice factor		ns	na	na

There were significant gender difference in learning perceptions.

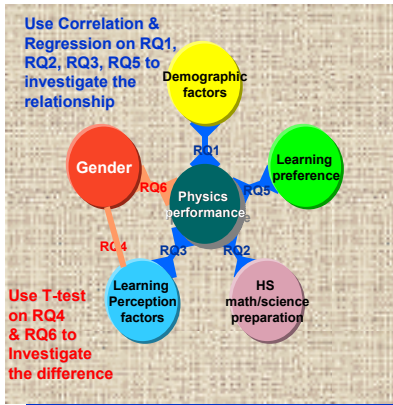
RQ6. Were male and female students significantly different on their performance in introductory college physics courses?

Compare Means and T-Test

Independent variable	Dependent variable	Compare means and t-test
Gender	Physics performance	NS (Not significant)

No significant gender differences in college physics performance.

Tests on Research Questions



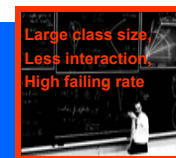
Limitations of the Study

- The validity of findings of the high school preparation and senior GPA, learning preference, and learning perceptions is dependent upon the accuracy of data provided by the volunteer participants.
- The number of participants was dependent upon the number of the students attending the class on the day the survey was conducted.
- Dropouts were not considered in this study, only completers of the course.

Next Steps

- Longitudinal study
- Study the students who withdrew from the class early
- Addition of qualitative study (observations, focus group)
- Examine the teaching strategies
- Examine the relationships between high school and college physics
- Addition of learning style study
- Collaborative study with other universities

Traditional Introductory College Physics



Implications

