

"To Teach is to Learn Twice"

Do undergraduate science teachers improve their physics understanding by becoming Peer Leaders?

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Overview of Presentation

- Introduction and background to the project.
- Aims of the study.
- Methodology.
- Findings.
- Conclusions.
- Significance and implications.

Introduction

Physics Education Research (PER) has shown that students leave the physics classroom holding the same misconceptions about physics they had when they entered.

PER has shown that these misconceptions are often deeply held and are difficult to change.

The literature indicates that Peer Learning has advantages compared with traditional methods in producing conceptual change.

Background

What is Peer Learning?

- Teaching and learning strategy.
- Involves students working together to solve a problem, complete a task, create a product.
- Students responsible for their own learning and helping their team-mates learn.
- Tutor (Peer Leader) acts as a facilitator of the learning.
- Promotes critical thinking through discussion.

Background

What is a Peer Leader?

- Undergraduate teaching assistant
- Has direct experience of a particular course
- Role model
- Facilitates learning does not re-lecture

Aims of the study

Research questions

- Does becoming an undergraduate Peer Leader provide the necessary motivation for overcoming misconceptions in fundamental physics?
- Do Peer Leaders experience similar misconceptions after they have reviewed, organised, and taught the physics material?

Methodology

Methodology:

Mixed method.

Sampling:

3rd year undergraduate Science Teaching students (N = 11)

Recruited on a volunteer basis.

Previously taken physics module (Mechanics and Heat).

Method of data collection:

Questionnaires.

Author's own Mechanics and Heat conceptual understanding test.

Semi-structured interviews.

Conceptual Test

Type of test

- A module specific conceptual understanding test was developed.

Breakdown

- It contained three sections.
 - **Section 1:** Open ended everyday occurrences.
 - **Section 2:** Multiple-choice (FCI) Force Concept Inventory (Hestenes *et al.* 1992) selection, asked to reason out choices.
 - **Section 3:** Mathematical manipulation of physics problems.

Conceptual Test continued

Example question Section 1

Q9. We know that the Earth pulls on the Moon. Does it follow that the Moon also pulls on the Earth?

Conceptual dimension

This question is located in the conceptual dimension of Newton's 3rd law and addresses the subcategory 'continuous forces'.

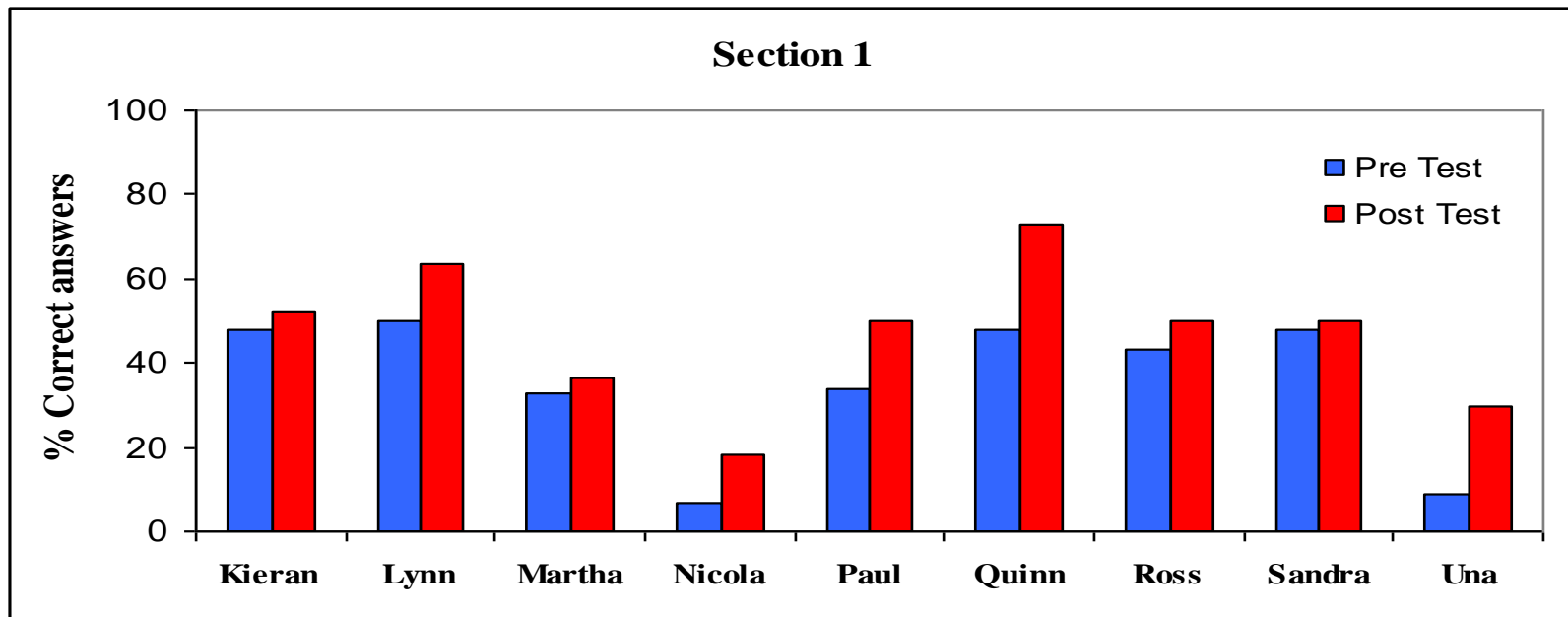
Misconceptions probed

Greater mass implies greater force - relating to action/reaction pairs.

Findings

Pre and Post Test Results

Total Test	(Wilcoxon, N = 5, z = -2.032, two-tailed p = 0.042)	significant difference
Section 1	(Wilcoxon, N = 9, z = -2.312, two-tailed p = 0.021)	significant difference
Section 2	(Wilcoxon, N = 9, z = -0.351, two-tailed p = 0.726)	no significant difference
Section 3	(Wilcoxon, N = 6, z = -2.201, two-tailed p = 0.028)	significant difference



Findings

Pre and Post-delayed Test Results

Total Test	(Wilcoxon, $N = 5$, $z = -2.023$, two-tailed $p = 0.043$)	significant difference
Section 1	(Wilcoxon, $N = 6$, $z = -2.366$, two-tailed $p = 0.018$)	significant difference
Section 2	(Wilcoxon, $N = 9$, $z = -0.491$, two-tailed $p = 0.624$)	no significant difference
Section 3	(Wilcoxon, $N = 6$, $z = -0.524$, two-tailed $p = 0.600$)	no significant difference

Number of Misconceptions: Section 1

pre to post	(Wilcoxon, $N = 9$, $z = -1.055$, two-tailed $p = 0.291$)
pre to post-delayed	(Wilcoxon, $N = 9$, $z = -1.581$, two-tailed $p = 0.114$)

There was no significant difference between the number of misconceptions pre to post test or pre to post-delayed test.

Qualitative analysis of the Conceptual Test

‘Yes, there is a pull on the Earth by the moon but it is weaker than the gravitational pull by the Earth on the moon.’ (Paul, pre Q9)

*‘The Earth has a magnetic attraction which pulls the Moon towards it’
(Sandra pre Q9).*

Interview Findings

The conceptual tests and the semi-structured interviews provided evidence that the Peer Leaders have a naïve view of force as a property of objects.

The interviews also provided evidence of a change in the Peer Leaders conceptual understanding as they worked through the questions in the interview.

Interview Extract

Interviewer (I): *In a game of baseball a baseball is hit with a baseball bat. Does the speeding baseball possess force?*

Quinn (Q): *Yes.*

I: *What is a force?*

Q: *A force is an interaction.*

I: *Between two objects. When the ball hits the baseball bat, describe the interaction.*

Q: *The bat is going to push on the ball and the ball is going to push on the bat.*

I: *Okay, equal and opposite. When the ball is speeding away, does it possess a force?*

Q: *Well, I suppose it doesn't.*

I: *You're not very sure. It doesn't? What would you have said? It has a mass and it has acceleration so it has a force. Is force an object?*

Q: *No, it's not.*

I: *What is it?*

Q: *It's an interaction.*

I: *Between two objects. Okay, what does the baseball have?*

Q: *Oh yeah okay. So the force is applying. The way I was thinking was the baseball is going to be hit. It's going to be falling at some point, it's going to be decelerating.*

Findings

All the Peer Leaders (N = 11) stated that;

- becoming a Peer Leader improved their physics knowledge.
- they enjoyed being a Peer Leader and that they had a positive experience.
- they felt that the students also benefited.
- preparation time took longer than expected.
- they would take part in the programme again.

Conclusions

There was a significant difference ($P < 0.05$) in the Peer Leaders test scores.

There was no significant difference ($P > 0.05$) in the number of misconceptions from pre to post to post delayed.

For the Peer Leaders simply doing the course work tutorials sheets did not seem to have an impact on their misconceptions.

The results indicate that getting the Peer Leaders to reflect on their pre, post and post delayed responses to the Conceptual test is an effective method of confronting and altering their misconceptions about Newton's laws, specifically Newton's third law.

Studying the Peer Leaders physics understanding and concepts is not the only factor which can affect their conceptual change. Affective and social aspects such as their approaches to teaching and learning physics can have an impact

Significance and Implications

Preliminary findings suggest that the Peer Learning method employed is effective in providing beneficial teaching and learning opportunities to Peer Leaders.

Initial investigations suggest that the Peer Leaders did experience a change in their conceptual understanding of physics.

The author felt that the process of providing the Peer Leaders with feedback but also challenging them about their understanding was the final step in the Peer Leader process.

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