Do worksheets make a difference in the 1st year physics? A study in Thailand

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Abstract

The worksheet is a particular technique used in various ways with the intention of helping promote note taking and achieving better student understanding. The aim of this work is to investigate the effectiveness of using worksheet in the topic of force and motion. We compared two cases; lectures using a worksheet in 2017 and not using a worksheet in 2018 at Mahidol University. The content was focused on drawing free-body diagrams and problem-solving using Newton's second law. The sample groups were around 894 first-year students. The examinations revealed an increase in student's competence when worksheets were used in 2017 compared with no worksheet in 2018. Our analysis using the SOLO taxonomy clearly shows an advantage in student achievement.

Introduction

In the first year of this study this pair of lecturers taught a cohort of science students at Mahidol University using a worksheet in an interactive style [1]. The worksheet was handed out first. The students were given time to attempt in-class practices on the worksheet. In the following year, teaching allocations were changed and two different lecturers taught the first semester physics course using PowerPoint slides. In this study, we compared two cases; lectures using worksheet in 2017 and not using worksheet in 2018.

Methodology

2017	2018
• The sample group is 288 first year science students. • The teaching method is lecture using a worksheet in a large lecture hall.	• The sample groups are 304 first year science students and 302 first year engineering students. • The teaching method is lecture using PowerPoint slides in a large lecture hall.

Teaching detail & Results and discussion

Lecture with interactive team teaching using worksheet — Science cohort (n=288)

- Theoretical variables on Mechanics and FBD drawing introduction
- **In-class practice of free body diagram**
- Newton's 2nd Law equations introduction
- **In-class problem solving practice**

Lecture using PowerPoint slides

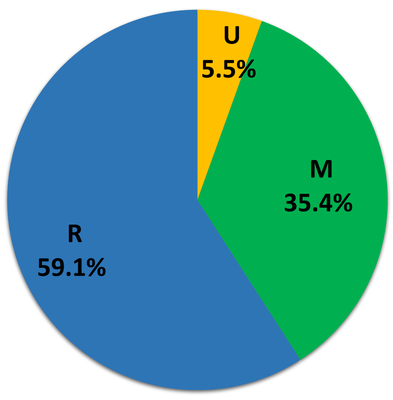
Science cohort (n=304)

- Introduction of theoretical variables on Mechanics and FBD drawing and Newton's 2nd Law equations on PowerPoint slides
- **Pre-worked examples shown on the slides**

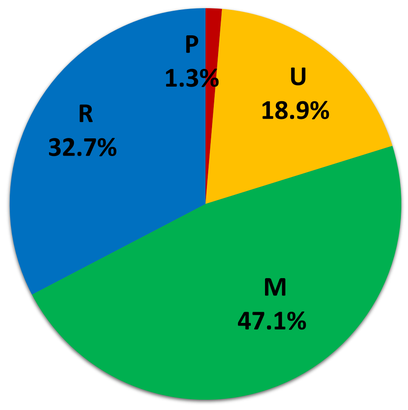
Engineering cohort (n=302)

- Introduction of theoretical variables on Mechanics and FBD drawing and Newton's 2nd Law equations on PowerPoint slides
- **In-class brief practice of free body diagram**
- **Worked example done live on the slides during lecture**

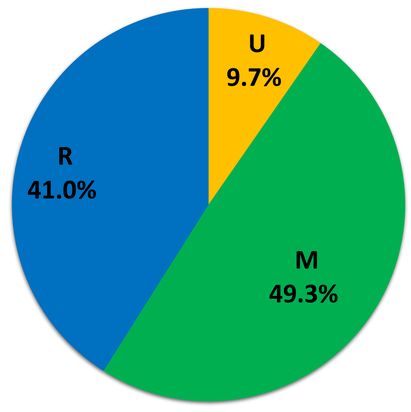
Science Cohort 2017



Science Cohort 2018



Engineering Cohort 2018



SOLO level [2]	Explanation
Relational/Extended Abstract (R)	Understanding of physics behind question. Errors, if any, are mainly in use of language or expression.
Multistructural (M)	Use of Physics concepts, but these were either not primarily related to question, or incomplete.
Unistructural (U)	Real world links with tendencies of naïve beliefs. Some mention of unrelated biology or chemistry references.
Prestructural (P)	Random responses that made little sense.

The students have experienced a different intensity of active learning which may have influenced their competence in drawing free body diagrams and in problem solving. In the 2017 science cohort, 59.1% of students performed at the Relational level which was higher than the two cohorts of science and engineering students year 2018 who attained levels of 32.7% and 41.0% respectively. As the results show, more in-class practices using the worksheet resulted in higher examination scores than using PowerPoint slides.

Conclusion

In short, our study on Newton's 2nd Law incorporating free body diagrams suggests that teaching by using worksheets has been more effective than PowerPoint slides with a small amount of in-class practice, which is more effective than using PowerPoint slides only.

Acknowledgements

This work was made possible by the attentive support from the SUPER group. We are grateful for their valuable supervision, creative guidance and encouragement throughout the study. We would like to also thank the lecturers of Mahidol University who kindly support the data collecting process from the beginning to the end of the semester.

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