3rd WCPE World Conference on Physics Education
Hanoi, Vietnam, 13 - 17 December 2021
3RD WORLD CONFERENCE ON PHYSICS EDUCATION
Innovating physics education: From research to practice

Contribution ID: **94** Type: **Presentations in Wroclaw**

Two Teaching/Learning Sequences on Surface Phenomena based on Minds-on Experiments and Model-Based Reasoning

Monday 13 December 2021 11:20 (20 minutes)

Abstract. In this contribution we present some preliminary results of the trial of two teaching/learning sequences on surface phenomena for High School students. The sequences have been trialled with a sample of students divided into two groups. The first follows a traditional approach, based on the macroscopic model of surface tension. The second involves the students in a more innovative approach based on a mesoscopic model implemented in Smooth Particle Hydrodynamics simulations. Both approaches are based on active learning methodologies and make use of minds-on experimental activities. We discuss the effectiveness of the two approaches in promoting student description and reasoning skills.

1 Introduction

The comprehension of surface phenomena is important not only in physics but also in other scientific and technical fields. The traditional methods used to introduce the basic concepts related to this topic are often based on an approach founded on macroscopic description and sometimes on interpretations involving molecular interactions. These methods often prove to be not very effective in captivating student interest [1] and in favouring students'authentic understanding of the physical content.

Educational research has shown that a change in teaching pedagogy from mainly deductive to methods based on active learning supported by minds-on experiments and modelling can provide the students with means to increase their interest in learning. Moreover, it has been shown [2] that implementing models in computer simulations can be a very useful tool for students. It can allow them to easily control parameters relevant for understanding the mechanism of functioning at the basis of the phenomena they want to study and greatly promote model-based reasoning.

Models built at an intermediate scale (i.e. mesoscopic scale) are recognized in the literature as useful to effectively introduce concepts like surface tension in educational contexts [3]. These models have the advantages of the microscopic one, but they do not require a lot of computational resources to successfully run the simulations implementing the models.

2 Research Aims

This contribution aims to first discuss the structure of two teaching/learning sequences (TLSs) on aspects of surface phenomena, both based on active learning and supported by minds-on and modelling activities. We want also to present some preliminary results of the trialling of the TLSs about the development of reasoning habits based on building mechanisms of functioning and explicative models.

3 The Teaching/Learning Sequences

The Common aspect of both TLSs is the use of the "Predict –Observe –Compare - Explain"strategy in every phase, to facilitate the active and conscious participation of the students in building of knowledge.

However, one TLS is based on a purely macroscopic approach, focused on the description of the experimental results on the basis of forces acting at interfaces between media and energy. The second TLS relies on the introduction and computer implementation of a mesoscopic model of liquid. By using the simulation, the students can control some model parameters and compare the results of the simulations with the experimental results.

4 Conclusion

We first briefly introduce the general schema of the two teaching/learning sequences, highlighting their similarities and differences. Then, some relevant experimental and simulation activities are described. Finally, some preliminary results about the comparison of the learning outcomes of the two different teaching/learning approaches are presented.

References

[1] M. V. Berry, The molecular Mechanism of Surface Tension, Phys. Educ., 6 (1971) 79-84.

[2] M. Develaki, Using Computer Simulations for Promoting Model-based Reasoning. Sci & Educ 26, 1001–1027 (2017). https://doi.org/10.1007/s11191-017-9944-9

[3] U. Besson, L. Viennot, Using models at the mesoscopic scale in teaching physics: Two experimental interventions in solid friction and fluid statics, Int. J. Sci. Educ., 26 (2004) 1083-1110.

Authors: Dr BATTAGLIA, Onofrio Rosario (Dipartimento di Fisica e Chimica - Emilio Segrè); Ms TERMINI, Giulia (Dipartimento di Fisica e Chimica - Emilio Segrè); Prof. AGLIOLO GALLITTO, Aurelio (Dipartimento di Fisica e Chimica - Emilio Segrè); Prof. FAZIO, Claudio (Università degli Studi di Palermo)

Presenter: Ms TERMINI, Giulia (Dipartimento di Fisica e Chimica - Emilio Segrè)

Session Classification: Parallel 1 - Wroclaw

Track Classification: 11. Secondary school physics