A perspective on Interactive Lecture Demonstrations as a computer supported collaborative learning (CSCL) activity

S. Raj CHAUDHURY, Sarah CANATSEY, Phillip J. WARD

Innovation in Learning Center, University of South Alabama, Mobile, AL 36688, USA

Abstract. Active learning designs that leverage the power of information and computer technologies (ICT) can vary tremendously in how they engage students – individuals, small groups or whole class. Interactive lecture demonstrations (ILDs) are instructor-led activities which engage the whole class and are designed address students' mental models of core concepts in the discipline. The use of ICT allows for real time experiments conducted using sensors, simulations and even data analysis as the core of the activity. In this perspectives paper, we analyze the features of traditional ILDs through the lens of the field of computer supported collaborative learning (CSCL).

1 Introduction

Active learning environments where technology plays a significant role in mediating interactions between students, the content and the instructor have been the focus of study in the field of Computer Supported Collaborative Learning (CSCL). One lens employed by CSCL researchers to describe technology enhanced active learning environments is through the enactment scripts [1] and the concept of orchestration [2]. In this perspectives paper we describe the elements of a traditional physics Interactive Lecture Demonstration (ILD) and its simulation counterpart following the model of Sokoloff and Thornton [3] in terms of a typical script and the orchestration necessary for an effective ILD experience.

2 Interactive Lecture Demonstrations (ILD) scripts

While there is extensive physics education research literature on the underlying conceptual misconceptions that physics ILDs are designed to address, we treat in this paper, the ILD as an active, whole class engagement construct that utilizes computer technologies to rapidly gather and display real world data. The script helps instructors design an effective lesson based on a topic that can be demonstrated to the class. The most well-known script was developed by Sokoloff and Thornton [3].

Sokoloff and Thornton's script has become a common structure for interactive learning demonstrations. The main parts of the script include – 1) instructor explains and runs the demonstration without result data, 2) students record their initial predictions, 3) students engage in small group discussion, 4) students record final predictions, 5) instructor facilitates discussion on predictions, 6) demonstration is carried out with data results, 7) class discussion on the actual results, and 8) instructor offers conceptual insight into the phenomenon. Having a clear vision on how to facilitate steps 7 and 8 are essential for the students to gain an understanding of the material that they will retain [3].

Crouch and colleagues [4] studied the learning impacts from using ILDs in the classroom. Specifically, they looked at learning impacts between a demonstration without the prediction and demonstrations with the prediction component. The results from that study showed that demonstrations without a prediction component were only as effective as no demonstration at all. This appears to indicate that the prediction step is necessary in this script. The study also

examined the effectiveness of the group discussion component in learning. While the results showed a slight increase with the addition of this part of the script, it may not warrant the extra time needed to hold small group discussions during the prediction step if time is an issue. Whereas the prediction step may take only two minutes, the small group discussion could add another 10 minutes to the lesson [4], an important item to consider in how the activity is managed, as described further below.

3 Orchestration within ILDs

Orchestration is a concept refers to how a teacher manages, in real time, multi-layered activities within the context of the constraints of a real-life teaching scenario [1], [2]. Many pedagogical scenarios integrate individual activities (e.g. reading), teamwork (e.g. problem solving) and class-wide activities (e.g. lectures). Activities can be computer-based, or not, face-to-face, or online. In this paper we describe an application of orchestration as necessary to successfully carry out ILDs and their accompanying script. The management aspect of orchestration requires multiple coordination efforts which take place during the learning experience. Time management, classroom management, group management, and workflow management are components of an ILD which must be regulated [2]. Orchestration also requires the instructor to manage activities which are not part of the learning scenario; activities range from those intrinsic to the ILD script to activities which are extrinsic to learning [1]. These can be as mundane as allowing sufficient time to distribute and collect response sheets to as complex as maintaining optimal settings for lab equipment.

While the traditional ILD script in physics addresses demonstrations carried out with laboratory equipment such as carts and air tracks, the source of the ILD can be computer based. In our paper we shall describe the orchestration necessary to conduct an ILD with the Moving Man simulation from the PhET collection [5]– with the script being almost identical to the traditional one using real equipment.

4 Conclusions

We offer a fresh perspective on a twenty year old active learning strategy that is widely accepted as effective within the physics education community by incorporating the lens of computer supported collaborative learning. Educators will be encouraged to define additional scripts for other effective active learning scenarios and use as a success discriminant the type of script and orchestration necessary.

References

[1] Dillenbourg P., Jermann P. (2007) Designing Integrative Scripts. In: Fischer F., Kollar I., Mandl H., Haake J.M. (eds) Scripting Computer-Supported Collaborative Learning. Computer-Supported Collaborative Learning, vol 6. Springer, Boston, MA

[2] Dimitriadis, Y., Prieto, L. P. and Asensio-Pérez, J. I. (2013). The role of design and enactment patterns in orchestration: Helping to integrate technology in blended classroom ecosystems. Computers and Education, 69496-499.

[3] Sokoloff, D. R., and Thornton, R. K. (1997). Using Interactive Lecture Demonstrations to Create an Active Learning Environment. The Physics Teacher, 35. 340. doi: 10.1119/1.2344715

[4] Couch, C., Fagen, A. P., Callan, J. P., & Mazur, E. (2004). Classroom demonstrations: Learning tools or entertainment? American Journal of Physics, 72(6). 835-838.

[5] University of Colorado. (2017). Moving Man Simulation. Retrieved at March 1, 2018, from the website https://phet.colorado.edu/en/simulation/moving-man