

# A Dashboard to Evaluate Student Engagement with PhET Simulations

Diana LOPEZ-TAVARES, Carlos AGUIRRE-VELEZ

*CICATA, Polytechnic National Institute, Calzada Legaria 694, Mexico City, 11500, MX*

Katherine PERKINS,

*Department of Physics, University of Colorado Boulder, Boulder, Colorado, 80309, USA*

**Abstract.** Student engagement with interactive simulations is affected by the types of prompts and activities teachers choose to couple with such simulations. In this work, the design of a dashboard is presented that aims to show teachers useful information to help identify the level of student engagement their activities generate with PhET Interactive Simulations. The dashboard uses a click tracking map to show student interaction with the simulation for individual students and the aggregated information of an entire group. Further information pertaining to click data, the sim interface elements used, and the time of use are also considered in the design of the dashboard.

## 1 Introduction

The PhET Interactive Simulations<sup>1</sup> project at the University of Colorado at Boulder develops interactive simulations (sims) for Science and Math education. Several research studies on learning have revealed connections between student engagement and learning results [1], [2]. Investigations suggest that an interplay exists between the level of guidance used and the amount of student engagement observed [1], [3], [4]. This result suggests that a combination of open questions and specific guiding questions used in a sim class activity can produce a high level of engagement while still keeping students focused on the learning goals of the activity. In large classes and homework activities with the sims, teachers have difficulty knowing if their students were engaged with the sim and if the students are following an anticipated path for the activity. For this reason, we have decided to develop a tool that helps teachers to identify the level of student engagement with the sim during activities.

For accomplishing this task, we address the following question:

What visualizations and information should be presented in a dashboard that will allow teachers to evaluate the level of engagement that different prompts produce in a PhET sim centered activity?

## 2 Methods

The data for the dashboard will be captured using sims instrumented for data collection. The instrumentation strategy allows data such as student clicks and time of interaction to be captured. The dashboard design proposed is in Fig. 1 Left. This design has the following characteristics:

1. A choice between the interaction of a whole group or an individual student
2. A click tracks “heat map” using colors to show interface areas with more and less clicks.
3. A time line that can be adjusted to see the evolution of clicks.
4. When the cursor is placed over the sliders in the sim screenshot, the average value of the

---

<sup>1</sup> website <https://phet.colorado.edu/>

- magnitude the slider was set to during use is displayed.
- When the cursor is placed on the heat colored parts of the sim screenshot, total clicks and the average of clicks per student are displayed.
  - Displays the rate of clicks/time and the graph of total click/time (Fig. 1 Right).

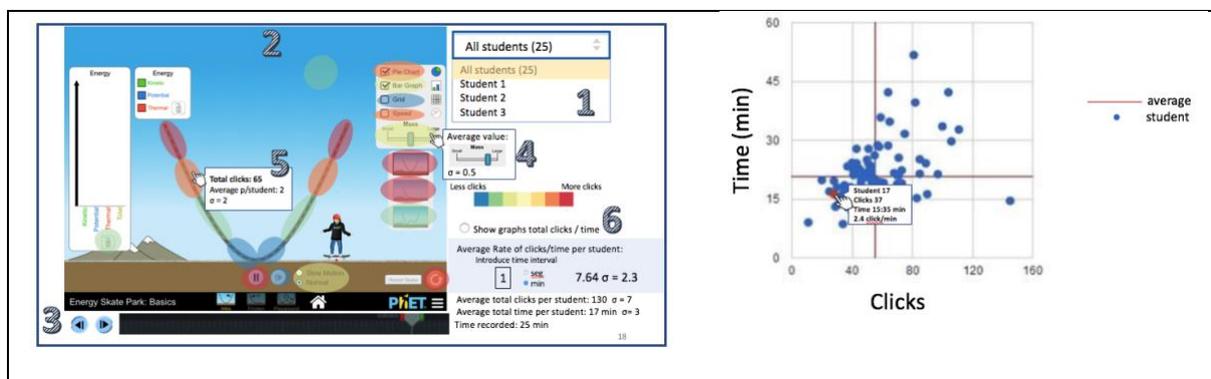


Fig 1. Left: Dashboard design proposed. Right: Example of a clicks vs time graph.

After development of the dashboard, data from real classes will be collected to inform user-acceptance testing. This data will be presented to the teachers to test the dashboard's effectiveness in helping them identify the level of engagement as well as gather their opinions about potential refinements and improvements.

### 3 Conclusions

To effectively reflect upon, prepare, and remediate issues with sim-centered lessons teachers need tools that allow them to analyze the behavior and engagement of their students. The use of dashboards in educational services is not new, but most of them are focused on Learning Management Systems, Massive Open Online Courses, and Intelligent Tutor Systems [5]. Interactive simulations are different from these services in the nature of the types of data produced via student interaction and its interpretation. In this research, we show a dashboard proposal that could help teachers to visualize the engagement of their students. These results are important for the design of written activities to accompany simulations, and for understanding factors that support student practice in scientific inquiry.

### 4 Acknowledgements

The authors would like to acknowledge the contribution of Sam Reid for the data collection, analysis and dashboard development. The PhET team for their support and the Conacyt and IPN for their funding.

### 5 References

- [1] N. S. Podolefsky, K. K. Perkins, and W. K. Adams, "Factors promoting engaged exploration with computer simulations," *Phys. Rev. Spec. Top. - Phys. Educ. Res.*, vol. 6, no. 2, 2010.
- [2] Great Schools Partnership, "Student Engagement Definition - The Glossary of Education Reform." 2014.
- [3] J. M. Chamberlain, K. Lancaster, R. Parson, and K. K. Perkins, "How guidance affects student engagement with an interactive simulation," *Chem. Educ. Res. Pr. Chem. Educ. Res. Pr.*, vol. 15, no. 15, pp. 628–638, 2014.
- [4] W. K. Adams, A. Paulson, and C. E. Wieman, "What levels of guidance promote engaged exploration with interactive simulations?," in *AIP Conference Proceedings*, 2008, vol. 1064, pp. 59–62.
- [5] K. Verbert *et al.*, "Learning dashboards: an overview and future research opportunities," *Pers. Ubiquitous Comput.*, pp. 1–16, 2013.