

# EDM Visualization Tool: Watching Students Learn

Matthew W. Johnson and Dr. Tiffany Barnes  
{mjokimoto@gmail.com} {TBarnes@uncc.edu}

Computer Science Department, University of North Carolina at Charlotte

**Abstract.** This poster describes a visualization tool for educators that allows the exploration of educational data. We display an entire classes sequence of actions to the user using a tree-graph. Our preliminary results suggest that EDM visualization tools are a promising area for future research in EDM.

## Introduction

This poster describes a visualization tool that allows educators to visualize the process in which students solved procedural problems, in logic, using an intelligent tutoring system. The purpose of this tool is to allow educators to be able to navigate, explore and gain insights about student performance. This allows educators to better understand the strengths and deficiencies of students, so that lectures or homework adjustments can be made to better aid student learning.

The field of InfoVis has much to offer educators and data repositories of educational data, like Carnegie Mellon's Data Shop. Fekete et. al. shows us that InfoVis is well equipped for exploring data to learn more, make new discoveries, and gain insight[3]. Card et al. defines the purpose of visualization to “amplify cognition” about data [2]. In our case amplifying an educator's cognition about the way their students solve problems, a main advantage Intelligent tutoring systems have over traditional homework methods.

## Related Work

This work is an extension of the work of John Stamper and Tiffany Barnes [6,1]. We extend their work to include an interactive visualization tool which centralizes and streamlines their data processing, and adds exploration and navigation interactions. In our visualization we made use of Shneidermans's seven tasks of visualization[5]: overview, zoom, filter, details-on-demand, relate, history and extract; often considered standard in information visualization.

Romero and Ventura surveyed EDM techniques in [4] “...information obtained from usage statistics is not always easy to interpret to the educators and then other techniques have to be used...Infovis techniques.” They also concluded that educational data mining tools require “good visualization facilities to make their results meaningful to educators and e-learning designers”.

## EDM Visualization Tool

The EDM Vis tool is a software tool that presents student work to educators in a simple way. First, students use a logic tutor where each 'state' of the user is recorded, along with each action, common in intelligent tutoring systems. Actions take the user from one state

to another. In the case of Tic-Tac-Toe an action would be placing your 'X' or 'O' piece on the board, the state would be the resulting configuration of X's and O's. These states and actions are then displayed as a tree-graph of nodes and edges respectively.

We use logic tutor data which stores the set of premises as a single state, in a root node. Consecutive states are generated based upon the actions that were taken by the student(s). The depth of each node represents the number of steps taken. Edge width is based on the frequency of students who performed the same action(s). Filtering and other interactions allow educators to observe trends, common mistakes and gain insights into their students' ways of thinking.

## Results & Future Work

The EDM Vis tool is still in development but unofficial results show we can gain insights about student progress. Our first insight was that only ten percent of students were able to find the shortest solution, or expert path. We also noticed problematic areas that we were not previously aware of. Next we will make a standard file format that can support data from the Data Shop at Carnegie Mellon, allowing access to more people and data. Also we will allow annotations to be made in the Vis tool which will export separate files, to be read into our logic tutor. This will extend the visualization tool to creation, allowing educators to gain insights then act using their new knowledge. Lastly, the EDM Vis tool is built for visualizing sequential data, so single step problems, like short answer questions, are unsupported. Developing other visualization tools to support other data types seems to be a meaningful avenue for future research.

## References

1. Barnes, T., Stamper, J., Toward automatic hint generation for logic proof tutoring using historical student data. *Proceedings of the 9th International Conference on Intelligent Tutoring Systems*, 2008. p. 373-382.
2. Card, S.K., Mackinlay, J.D., Shneiderman, B., Using vision to think. In *Readings in information visualization: using vision to think* (Eds.) 1999. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.
3. J.-D. Fekete, J. van Wijk, J. Stasko, C. North, The Value of Information Visualization, in *Information Visualization: Human-Centered Issues and Perspectives*, Springer, 2008, pp. 1-18.
4. Romero, C., Ventura, S., Educational data mining: A survey from 1995 to 2005 *Expert Systems with Applications*. July 2007. Vol. 33, no. 1, pp. 135-146.
5. Shneiderman, B., The eyes have it: A task by data type taxonomy for information visualizations. *Visual Languages*, IEEE Symposium, 1996. p. 336.
6. Stamper, J., Barnes, T., Lehmann, L., Croy, M., The hint factory: Automatic generation of contextualized help for existing computer aided instruction. *Proceedings of the 9th International Conference on Intelligent Tutoring Systems Young Researchers Track*, 2008. p. 71-78.