Improving GeoGebra

GEOGEBRA AS A COMPONENT OF ONLINE COLLABORATIVE MATHEMATICS INVESTIGATIONS: PRESENT WORK TOWARD REALIZING A DREAM

Geoffrey Roulet

Faculty of Education, Queen’s University, Kingston, Ontario, Canada, geoff.roulet@queensu.ca

Abstract: GeoGebra provides a powerful environment for student explorations and problem solving. Wikis are an effective tool to support collaborative work. This paper discusses present efforts to combine these resources and produce an online environment for collaborative mathematics investigations.

Keywords: online, mathematics, collaboration, investigation

1. INTRODUCTION

Shifting views of mathematics learning over the past two decades have followed a couple of dominant themes: an understanding that children construct rather than receive their mathematical understanding, and recognition of the socially and culturally situated nature of mathematical activity (Cobb, 1994). These ideas, combined in a social constructivist (Ernest, 1998) view of mathematics, have driven significant international changes in the teaching and learning of the discipline (Black & Atkin, 1996, Romberg, 1992). Across jurisdictions new mathematics curricula call for students to engage in investigations and mathematical talk (NCTM, 2000) through which, classroom-based research has shown, they can collaboratively construct deep robust knowledge (Cobb, Boufi, McClain & Whitenack, 1997; Hufferd-Ackles, Fuson & Gamoran-Sherin, 2004).

Dynamic mathematical tools such as GeoGebra have been shown to effectively support students’ mathematical investigations and motivate the development and exploration of conjectured generalizations (Hoyles & Noss, 2009). Manipulation of mathematical objects on a computer screen when working in small groups, or on a large screen projection in a whole class setting, can become the focus for mathematical conversations. Adding a classroom network to link computers can enhance inter-group collaboration and support the development of collective understandings (Roulet, Mackrell, Taylor & Farahani, 2004; White, 2007). This mix of mathematical investigations, supporting dynamic tools, and inter-student collaboration becomes more complex when communication is extended beyond the classroom and over time in asynchronous mode.

Synchronous online communication tools such as text chat supported by a common web-based shared drawing board (Cakir, Zemel & Stahl, 2009) have been employed to support inter-student mathematical collaboration over distance. In asynchronous mode, web-based discussion boards have been used to
facilitate out of class interaction in university mathematics courses (Thomas, Li, Knott & Li, 2008), but as Nason and Woodruff (2004) observe, in general, online asynchronous collaborative learning environments do not support the simple exchange of mathematical ideas in symbol or image forms. To address this issue and incorporate computer-based mathematical tool support, Simpson, Hoyles, and Noss (2005) added file sharing to discussion board conversations. Participants, using supporting software, explored model building off-line and then shared ideas and their work via notes linked to uploaded files. The project report here is an effort to generate a similar system using GeoGebra and a wiki tool and thus make available a fully online, asynchronous computer-supported collaborative learning space (CSCL) (Lehtinen, 2003) for mathematics.

2. ASYNCHRONOUS ONLINE COLLABORATIVE MATHEMATICS

Research with pupils in Grades 7 to 10, working within the Math-Towers website (www.math-towers.ca), has shown that it is possible to develop an asynchronous collaborative mathematics space where students can develop collective knowledge (Roulet 2009, 2010, Taylor, 2005). Participants in Math-Towers are presented with a challenging mathematical problem and provided with a laboratory in which they find tools (manipulatives) to support exploration of the problem situation, tables for recording data, and a note pad where they can collect their ideas. In addition to these supports for individual investigation, there is a communication tool that allows students to share their emerging understandings of the problem. It is possible for any participant to share their mathematical work by attaching to a note a live copy of the exploration tool. Others, working on the problem, may take this attachment back to their laboratory and use it as a starting point for further exploration. In this mathematical environment classes together build a solution to the problem.

In Math-Towers the tools provided to participants are limited and specific to the particular problem being investigated. For each challenge new tools must be created by the site developers and participating students must work through a period while they learn to employ these supports for their investigations. GeoGebra, running as a server-based application, could provide a much more extensive set of tools for secondary school students working in an online environment similar to Math-Towers. The challenge, from a technical point of view, is how to support the process of a student sharing an instance of GeoGebra as he/she has left it with all others in the class.

3. WIKIS WITH TOOL SUPPORT

At the Faculty of Education, Queen’s University, within the CeDWorks project, we have combined MediaWiki (www.mediawiki.org) with a drawing tool. With this Flash-based extension, contributors to a wiki conversation can expand on their ideas by providing a graphic. Key to this application is the fact that the embedded graphic is not static, but is in fact available to others to manipulate and expand within pages or comments they may contribute (see Figure 1). We hope, in a similar manner, to embed instances of GeoGebra within wiki pages and thus provide a space where students can, over time, work collaboratively on mathematical problems.
3. The Plan

A server based application combining MediaWiki and GeoGebra would provide a space where a teacher could describe a problem in text and provide an initial GeoGebra window. Students could then contribute to a solution by adding linked pages that contained a revised GeoGebra window and in text provide commentary on the changes they made. A student, while studying the contributions of his or her collaborators, could at any point grab a GeoGebra instance that they viewed as productive, create a new linked wiki page, paste in the GeoGebra file and then use this as a starting point for further investigation, along with providing a text message describing their actions and thinking. Since this contribution could be inserted at any point in the conversation there would be the potential for branching and multiple investigation paths (see Figure 2).
Figure 2: Online collaborative problem-solving
Upon completion of a problem solving task the collaborators could review the record of the investigation or problem solution path retained by the wiki. A careful analysis of decisions made and their relative value in advancing the study could contribute to the development of meta-cognitive processes.

4. AN INVITATION

It is my hope that this description of our plans and the associated session at the First North American GeoGebra Conference will lead to discussion and refinement of the proposed design for a web-based tool combining GeoGebra and a wiki structure. In addition, I would hope for the formation of a group that will work together to realize a GeoGebra based online collaborative exploration space.

8. REFERENCES

MediaWiki [computer software]. Version 1.15.3. Available at: www.mediawiki.org


