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DEVELOPING A WEB-BASED PLATFORM OF GEOMETRIC FLOWCHART PROOF LEARNING FOR MULTIPLE LANGUAGES

Mikio Miyazaki — Faculty of Education, Shinshu University, Japan — mmiyaza@shinshu-u.ac.jp

Taro Fujita — Faculty of Education, University of Plymouth, UK — taro.fujita@plymouth.ac.uk

Keith Jones — School of Education, University of Southampton, UK — d.k.jones@soton.ac.uk

Even though the teaching and learning of proof is universally recognized as a key element of mathematics curricula, it remains the case that students at the lower secondary school level can experience difficulties in understanding and constructing proofs (eg: Hanna & de Villiers, 2012). In order to improve this undesirable situation of proof learning in geometry, we have designed our web-based platform of geometric flowchart proof learning as a means of supporting students to understand and construct mathematical proofs in the introductory stage of proof learning.

Our platform uses flowchart proofs that shows a 'story line' of the proof; beginning with the kinds of assumptions from which the conclusion is deduced, and including the kinds of theorems being used, how the assumptions and conclusion are connected, and so on. As McMurray (1978) and others have suggested, flow-chart proofs can be introduced to students before they learn the more formal 'two column proof' format. We consider that the power of flow-chart proofs can be particularly enriched in 'open' situations where students can construct multiple solutions by deciding the assumptions and intermediate propositions necessary to deduce a given conclusion. The platform includes both open and closed problems (Miyazaki et al., 2011) involving the properties of parallel lines and congruent triangles. For more on the design of the tasks available within our platform, we provide more consideration of the pedagogical, pupil, and contextual components.

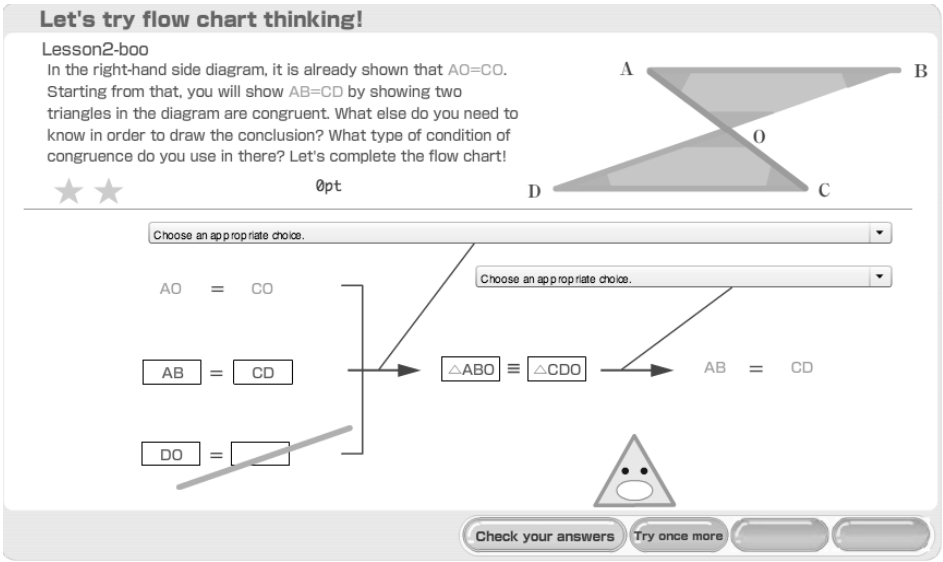

Figure 1: an example task

To make proofs accessible for as many students as possible, we utilise various technological ideas in the design of our platform. For example, it is constructed so as to be available via the Internet. By using Flash-based technology (Adobe system), which enables interactive actions on the web, students complete proofs by dragging sides,

angles and triangles to on-screen cells and our platform automatically transfers figural to symbolic elements. By this technology, we consider that students can concentrate on their proof construction rather than pondering 'what symbols do I have to use?', and so on. Given students sometimes make errors when tackling tasks, it is, of course, very important for learning that students are able to identify errors and refine their proofs to develop further their proof construction abilities. With our platform, students receive various types of feedback in appropriate orders based on the hierarchical structure of proof to promote analytical thinking when they click the on-screen 'Check your answer' button. The aim of this feature, of course, is to encourage students to use the feedback to adjust their proofs for themselves.

We originally developed the platform in Japanese, and have already translated it into English (in 2010) and into Chinese (in 2012). In producing the multi-language versions we hope that we have taken care of the characteristics of geometry in English and Chinese. Our research to date has shown that there is a potential to use our system to improve students' understanding of proofs in geometry. A further step is to consider the alignment with the mathematical content of the English and Chinese geometry curricula. In our poster we show our multi-language platforms and we hope you will experience and enjoy our web-based system.

Keywords: Flowchart proof, Web-based platform, Geometry, Lower secondary school, Multi-language

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