



HAL
open science

Considerations on teaching methods to deepen student argumentation through problem solving activities

Tsutomu Ishii

► **To cite this version:**

Tsutomu Ishii. Considerations on teaching methods to deepen student argumentation through problem solving activities. Konrad Krainer; Nada Vondrová. CERME 9 - Ninth Congress of the European Society for Research in Mathematics Education, Feb 2015, Prague, Czech Republic. pp.222-223, Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education. hal-01281114

HAL Id: hal-01281114

<https://hal.science/hal-01281114>

Submitted on 1 Mar 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Considerations on teaching methods to deepen student argumentation through problem solving activities

Tsutomu Ishii

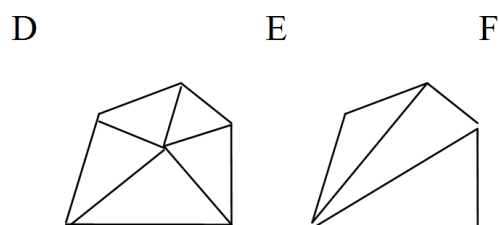
Bunkyo University, Faculty of Education, Koshigaya, Japan, benishii@koshigaya.bunkyo.ac.jp

In this research project we evaluate the Toulmin model to analyse students' mathematical arguments (Toulmin, 2003). We use this method to analyse a teaching episode in which the sum of the interior angles in a five-cornered polygon was discussed. This episode took part in a mathematics lesson in junior high school, Japan. The analysis highlights students' difficulties to understand ideas of their peers, and how these led to an improved level of discussion.

Keywords: Argument, problem solving, Toulmin's model, argumentation, $180(n-2)$.

THE AIM OF RESEARCH

Teachers promote problem solving in a mathematical lesson. In the beginning of the lesson the teacher introduced the topic to initiate a discussion. In order to achieve the purpose of the lesson, it is necessary for the teacher to evaluate students' arguments correctly. However, it can be difficult to understand students' arguments. The purpose of this research is to examine if the Toulmin model (Toulmin, 2003) helps to gain a better understanding of students' mathematical arguments.



G If the number of angles is set to χ $180(\chi - 2)$

Figure 2

THE METHOD OF RESEARCH

I chose the Toulmin Model as a tool to analyse students' arguments. Toulmin claims that arguments typically consist of six parts: claim (C), data (D), warrants (W), qualifiers (Q), rebuttals (R), and backing (B) (Hitchcock & Verheij, 2006). A typical Toulmin diagram to describe an argument may look as follows:

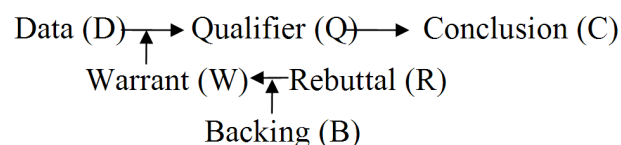


Figure 1: The Toulmin Model

EPISODE

The episode which I describe here took part in a mathematics lesson in the second grade of junior high school in Japan. The topic of this lesson was the sum of the interior angles of a polygon. The teacher's aim was for students to develop the fact that the sum of the inside of an n -cornered polygon is $180(n-2)$.

Individual solutions and preparation of the argumentation are summarized in the following diagrams or comments from students D-G (Figure 2).

Figure	Triangle	quadrangle	equal form
The sum of angle	180	360	540

The discussion leading to this result began with an explanation given by student H. Then student G explained his view which is opposed to H's. His argument showed that H was wrong. From this result the following points can be deduced why the mistake occurred and how correct evidence can be concluded. Student D's figure illustrates a misconception caused by the fact that an additional angle has been constructed in the centre of the pentagon. As student E's figure shows, all the angles are included in the polygon. Therefore this figure illustrates the general formula.

THE CONCLUSION OF RESEARCH

We use the Toulmin Model to describe the arguments of students H and G, as illustrated in Fig 3 and Fig 4 below.

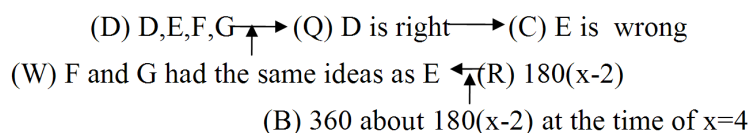


Figure 3: Student H's argument described by the Toulmin Model

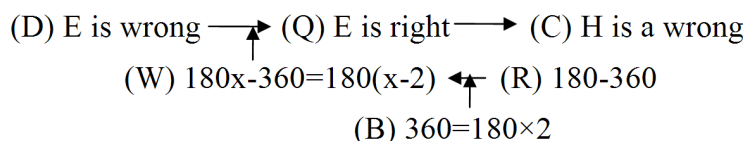


Figure 3: Student G's argument described by the Toulmin Model

H was not able to understand the solution of D correctly. The difficulty to understand the other students' ideas was emphasized in our analysis. And since H misunderstood, G felt excited. Although feeling controlled the understanding to become a new driving force was decided in the restorative. As a result, the quality of arguments improved remarkably.

REFERENCES

- Hitchcock D., & Verheij, B. (2006). Introduction. In D. Hitchcock & B. Verheij (Eds.), *Arguing on the Toulmin model: New essays in argument analysis and evaluation* (pp. 1-23). Dordrecht, The Netherlands: Springer.
- Toulmin, S. (2003). *The uses of argument: Updated edition*. Cambridge, UK: Cambridge University Press.