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Introduction to the Special Issue on Abductive Reasoning in Mathematics Education

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From a traditional perspective, induction and deduction have been discussed as key ways to generate new knowledge. On the other hand, Charles Sanders Peirce introduced the notion of abduction, distinct from deduction and induction, to avoid the pitfalls of empiricism and rationalism. Abduction is the process of forming an explanatory hypothesis on an observed surprising result (C.P. 5.171). Peirce emphasized that abductive reasoning is the only way of creating new ideas, and both epistemologists and educational researchers have attempted to tackle this notorious problem, the so-called learning paradox, from a Peircean perspective on knowledge generation (Prawat, 1999).

With mathematics educators' recent interests in semiotic approaches, there has been growing attention to the importance of investigating abductive reasoning in mathematics education research. Studies have attempted to clarify the forms and uses of abductive reasoning in students' mathematical inquiries in order to identify how students generate new mathematical ideas. Researchers also consider that investigating students' abductive reasoning may help to interpret and understand what occurs in mathematics classrooms. Thus, exploring abductive reasoning in mathematics education may provide a more helpful cornerstone in understanding how mathematics teaching and learning progresses.

This special issue of *EURASIA Journal of Mathematics, Science and Technology Education* aims to share current and future issues on abductive reasoning in mathematics education. In inviting the contributions for this special issue, we intend to offer the reader, original elements of reflection from a wide range of issues on abductive reasoning in mathematics education.

David Reid gives an overview of the discussion of abductive reasoning in mathematics education researches based on a meta-analysis of the state-of-the-art literature. He presents the origins of the concept of abductive reasoning and identifies the most significant approaches in mathematics education literature that refers to abductive reasoning. He then proposes a framework in which the different approaches taken in the research literature can be placed and compared.

Michael Hoffmann presents very fundamental issues regarding abductive reasoning. Hoffmann tackles two crucial questions related to knowledge creation from a Peircean perspective: Can diagrammatic reasoning indeed be conceived as a foundation of abductive creativity? What is the relationship between abduction and diagrammatic reasoning? To answer these questions, he clarifies the Peircean concept of diagram and diagrammatic reasoning and analyzes the significance of a consistent system of representation for diagrammatic reasoning. He then examines how diagrammatic reasoning and creation of abduction are related.

Three further contributions address how abduction is related to various contexts of mathematics learning. Bettina Pedemonte presents the role of abduction in the proving process of students solving a geometrical problem. She focuses on two types of rules in problem solving: strategic rules and definitory rules. She then compares two types of abductions that are related to these two rules, and analyzes the relationship between these two types of abductions and the deductive proof. Ferdinand Rivera examines elementary students' pattern generalization. He focuses on identifying multiple abductive actions in their pattern generalization, and shows how multiple abductions can be coordinated and how this coordination is related to pattern generalization. He also analyzes the relationship between elementary children's structural incipient generalizations and the natural emergence of their understanding of functions, especially the central role of abduction in such an understanding. JinHyeong Park and Kyeong-Hwa Lee investigate the abductive nature of mathematical modeling and the characteristics of mathematical inquiries triggered by mathematical modeling. They identify four characteristics of mathematical inquiries triggered by mathematical modeling based on an analysis of didactical and historical cases: abductive, recursive, analogical, and context-dependent.

Michael Meyer presents various task-design options that can be used to support students in discovering mathematical properties that refer to abductive reasoning. These task-design options are identified using intense

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scrutiny of the processes of discovering and verifying mathematical properties from a Peircean perspective on learning and knowledge creation. He also presents concrete examples of task design and empirical findings on the implementation of tasks.

From theoretical issues to more practical issues, these contributions in this special issue present state-of-the-art issues in abductive reasoning in the mathematics education research community. We hope that these offer an informative insight into the lively research on abductive reasoning in mathematics education.

REFERENCES

Peirce, C. S. (C.P.) (1931–1935, 1958). *Collected Papers of Charles Sanders Peirce*. Cambridge, MA: Harvard UP.

Prawat, R. S. (1999). Dewey, Peirce, and the learning paradox, *American Educational Research Journal*, *36*(1), 47-76.