Supporting Playful Mathematical Problem Solving With Puzzles: Variant Sudoku

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The development of mathematical problem solving skills has been long-recognized by a variety of stakeholders as critical for all learners (English & Sriraman, 2010; Pólya, 1945). Additionally, solving mathematical problems can be a playful, enjoyable, and beautiful process (Holton et al., 2001; Su, 2020; Williams-Pierce & Thevenow-Harrison, 2021). Yet, many students who might have become excellent mathematical problem solvers are pushed out of mathematics early on in their educational experiences and may experience mathematics anxiety or other negative emotions when they participate in undergraduate mathematics courses (Maciejewski et al., 2024; Pajares & Miller, 1994), and may struggle to experience mathematics in the playful way that mathematicians do (Bernier, 2024).

Puzzles have long been suggested as a means of introducing students to enjoying mathematics and to engaging in mathematical problem solving (Burton & Burton, 1980). In general, a puzzle can be construed as a game or fun activity with a correct solution or right answer (Kim, 2006; Salen & Zimmerman, 2004). Puzzles can also involve mathematical problem solving and playful mathematics, particularly if they invoke mathematical structures, ideas, and objects directly in their presentation. A popular example is sudoku, a genre of puzzle where the solver must use given information to fill each row, column, and 3-by-3 box within a 9-by-9 grid with each of the digits 1 through 9. Sudoku has been used to support students engagement in and learning about mathematics in a variety of contexts (Butler & Butler, 2007; Lorch & Lorch, 2008; Tengah, 2011; Wanko, 2010).

In recent years, a community of puzzle solvers and setters has developed around what is known as “variant sudoku.” Variant sudoku puzzles are sudoku puzzles which use additional rules and structures on top of the standard sudoku rules. For example, the “German whisper line” restriction indicates that adjacent in cells falling along a line must differ by at least 5. Under this condition, if two cells are joined by a line and one of them contains a 4, the other must contain a 9. These restrictions, combined with clever placement, allow the crafting of puzzles that provide few or no digits initially yet are still solvable through logical and mathematical reasoning. Moreover, these additional restrictions allow for the application of additional mathematical topics beyond those permitted in standard sudoku.

Our team is working to integrate variant sudoku into undergraduate mathematics coursework and to research that integration. Currently in the works is a study into the mathematical identity development of students who participate in variant sudoku solving and setting in an undergraduate honors course. Additionally, we are developing a design-based research project to craft open-access materials for a general education course centered around solving and setting variant sudoku puzzles. These projects are in early stages; as such, our poster will present information on the projects at their stage at the time of the conference. It will also include opportunities for attendees to participate in variant sudoku solving live.

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