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Pound, L., & Lee, T. (2022). *Teaching mathematics creatively* (3rd ed.). Routledge.

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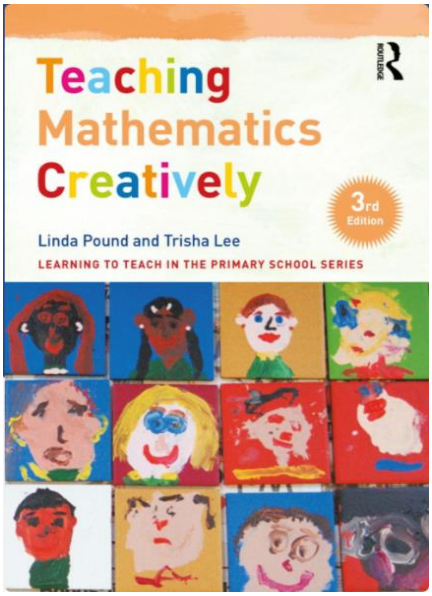

Research has consistently shown that mathematical skills predict future academic achievement (Duncan et al., 2007). While schools require that mathematics classes are taught in every grade level, the manner in which the subject is taught and learned varies greatly. Many schools and districts are making a push toward redefining and reconstructing math classes and the delivery of math content (Boylan & Townsend, 2017). In the third edition of *Teaching Mathematics Creatively*, authors Pound and Lee provide compelling evidence that teaching mathematics in a variety of creative ways is arguably the most critical factor for quality instruction and effective learning. In this edition, they present an inclusive and comprehensive guide for educators and teachers on how to create, develop, support, and extend creative math practices while integrating them in fun and effective ways.

Pound and Lee guide readers through creative math teaching practices that cross numerous social and academic constructs. The text is divided into 12 chapters, covering a broad range of topics like storytelling, narrative, investigation, visualization, spatial reasoning, embodied cognition, role play, drama, risk taking, the positive side to errors, philosophy of math, concrete math applications, and the use of virtual manipulatives and technology. Some chapters cover previous scholarship on specific topics, including how memorization is not success (du Sautoy, 2008), "Hard fun" (Papert, 1996), puzzles like "Puzzling Minds" (Tizard & Hughes, 1986), and games (Boaler, 2009).

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Each chapter follows a similar format with three sections. The first defines and articulates the purpose of that creative teaching practice. The second provides historical context for how policy, practice, or events have molded the contemporary education system and how these practices combat them. The third section challenges teachers faced with teaching certain mathematical topics and finding creative ways to implement effective teaching practices.

The volume begins with the essential question, what counts as mathematics? As the authors note, the definition and standard of what falls into this category has shifted among academics over the years. Many now consider informal forms or nontraditional expressions of knowledge to fall under the umbrella of doing mathematics. This shift away from heavily weighted and constant formal testing, assessments, and written exams to determine students' mathematical comprehension and capability is significant. According to the authors, this shift allows for creativity and student expression while still conveying students' understanding and providing students with opportunities to feel more connected and involved in their mathematical learning.

A great strength of the volume is the abundance of everyday examples of mathematics and ways to teach mathematical concepts presented in Chapter 2: e.g., judging how far you need to hit the ball in golf, how much time you need to cross the road safely, a chef judging cook times, or estimating how much shopping will cost or how much of a certain shopping item is needed to last for a specific range of time. Teachers are prompted to ask open-ended questions and encourage critical reflection, constant reviewing of work, giving specific feedback, capitalizing on unanticipated learning opportunities, varying learning experience to promote imagination, and allowing for collaboration.

The authors also include classroom anecdotes prefaced by contextual information. These sections are vital because, despite good intentions, adults and skilled teachers can often fall short or struggle to successfully integrate simple creative math tasks into the curriculum. For example, the authors feature the following scenario: the local authority dumped rubbish on the carpet for lack of storage and their room is now the dump. Each of four groups are given a fake amount of currency and they begin to sort and collect the rubbish by plastic, glass, and cardboard. However, since the groups were not able to get rid of all the trash, the class is fined. The students then must discuss and decide how to pay this fine fairly. While the teachers were teaching through role play and dramatic play with real life situations, the students were also learning about percentages, decimals, fractions, problem solving, and dealing with money.

Importantly, Pound and Lee emphasize the key concept of learning through play. According to the authors, this is often overlooked in math classrooms due to misconceptions by practitioners who deem primary

school students as too young or not knowledgeable enough to grasp abstract concepts or make inferences. In contrast, the authors suggest primary school children can attach concrete figures with corresponding symbols to solve mathematical problems. For example, in Chapter 6, they underscore previous work by Hughes (1986) that notes counting-words hold meaning in certain languages. For instance, the word "moon" can represent "one" or the figure "1", and "eyes" can represent the quantity "two" or symbol "2". Once children make that connection, they can then extend the same understanding of "one" and "two" to different experiences. The authors provide a higher-level example of this later in the chapter, with an algebra story about Cinderella. A portion of this story line was represented by "1C + 1FG > 1SM + 2US…", which translates to "1 Cinderella and 1 Fairy Godmother are greater than 1 Stepmother and 2 Ugly Sisters".

Later chapters of the book highlight why some "best practices," such as subject specific teaching rather than cross-curricular teaching, using high-level mathematical terminology, and having definite right and wrong answers are insufficient. Furthermore, the authors place emphasis on specific activities in the classroom that could be used as a model or as inspiration for problem solving stories, communicating and thinking mathematically in STEAM, utilization of music and art, and seeing architecture, construction, and even origami or jewelry making as math. These chapters also discuss how math extends beyond the classroom (i.e., math is all around us) and offer fun ways to use buildings, playgrounds, mazes, and labyrinths as math problems. These creative math activities are helpful for teachers interested in facilitating math learning outside of traditional classes, such as on fieldtrips or during homework, or for parents who want to highlight and reinforce math concepts at home. Individual book chapters can be used for quick fixes or ideas, or wholly for a deeper understanding within and across domains.

As schooling systems evolve, there is a real push for learning as described in this book. Using alternative and informal methods of observation and assessments for teaching and learning, such as examining mathematical expression through art, teachers can observe through the lens of student-object or student-creative content interactions rather than assessing standards. The authors suggest schools provide administrators and teachers with professional development and training for these methods, which could lead to deeper and richer student learning and enhanced academic outcomes. They provide references to studies, reports, books, websites, and videos for readers to investigate on their own, putting quality research and resources directly into the hands of practitioners.

Some of the book's examples involve real-world scenarios, situations at home, or parental implementation that would be difficult to put into effect for a full curriculum. The hard-to-execute activities may serve more

as useful tips to point out at home rather than to supplement or teach a lesson. Additionally, for certain tasks, resources such as mathematical tools, art supplies, technology, or space for exploration, are required. While this may be discouraging for teachers who lack access to materials, the authors remind readers that limitations are not necessarily a bad thing, as they spur new creativity and inspire new ideas that adapt to varying environments. Several tips and tricks as simple as word choice, making the problems about student interests, and having open ended questions to promote dialogue and collaboration may be integrated into curriculum to make it more inclusive and interesting. While some content and activities target specific age groups, like year 4 students; many of the creative ideas presented by the authors can be extended and adapted to other age groups.

Primary school years are the building blocks for the rest of a student's education, and it is crucial for teachers, schools, and parents to embrace creative teaching practices that inspire learning. Yet many teachers may need help to fully understand creative mathematics learning. In mathematics teaching and learning, creativity involves making connections, seeing unexpected relationships, visualizing, imagining possibilities in problem solving, exploring ideas, questioning, challenging, and reflecting critically on ideas, actions, and outcomes. While the major takeaways of this book are for primary school teachers, the tools in *Teaching Mathematics Creatively* would benefit educators at varying stages of their careers, whether for quick fixes or ideas, or a deeper understanding within and across domains.

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About the Reviewer

Julianna Washington is a former middle school and high school math and coding teacher, partnering with Teach for America for two of those years. Now a Ph.D. student and graduate research assistant, Julianna works to understand and develop the relationship between technology and student learning in Math and STEM (Science, Technology, Engineering, and Math). Her research includes the effects of technology, specifically virtual reality (VR) and augmented reality (AR), game-based learning, and embodied learning (such as video games and motion-based projects) on student learning and comprehension.