

Playing in the Mathematical Sandbox

By Leah Twarog

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Professor Priscilla Bremser

Priscilla Bremser sat down in her 1974 AP Calculus class and looked around. Unlike most of her friends, she had chosen to take math as her AP course. Among a sea of guys, there were only three other girls in that class, and of course the teacher was male, like nearly all her upper-level math teachers. Shaking that thought from her mind, she pulled out her pencil and notebook and was soon lost in the enjoyment of her favorite subject.

When Middlebury College professor Priscilla Bremser was first dropped off at college by her father, he told her, "Now it's your turn to be selfish." She took these words to heart, focusing on the joy of learning throughout her college experience and eventually discovering her love for the pure, abstract side of mathematics. Reflecting on that experience over forty years later, she has realized how fortunate she was that her parents placed such an emphasis on education when she was growing up. While Professor Bremser was growing up, her mother was enrolled in college. Her mother slowly collected her credits, often sharing what she was studying with her daughter. Professor Bremser carried her mother's enthusiasm to learn through life. Because her parents understood its value, she was fortunate to be able to focus on learning what she wanted. Her parents had given her permission to lose herself in her studies, pursue whatever gave her joy, and let them carry the worries about the practical parts of surviving in life.

In some ways, she reflects, math is a massive sandbox for mathematicians to play around in. She talks about "play" when asked for her earliest memories of math; she remembers thinking about even and odd numbers as a young child. She could visualize that if her class walked two by two down the hallway, there must be an even number of them. Such ideas were fascinating to her, and as she grew she began to invest her time in more complicated concepts. Once a person decides what branch of math, or section of the "sandbox," that they want to invest time in, she explains, they can have fun with the numbers. As a college student, Professor Bremser decided she wanted to play around with number theory, algebra, and the overlap between the two. She loved how cleanly the math came out, always neat and organized in predictable patterns, and the satisfaction after the challenge of solving an unsolvable problem or proving an unproven theorem. She liked the escapist way that one can get lost in a math problem and the eureka feeling when it was solved.

While exploring her own thoughts about mathematics, Professor Bremser realized that she wanted to lead other students to that "aha" moment she loved so much. She spent time tutoring other college students and found that she greatly enjoyed helping others learn. She wanted to share what her parents had given her: an appreciation of knowledge as an invaluable gift. Her experience with teaching at Smith, a small liberal arts college, led her to pursue a career at Middlebury. She chose a college where emphasis is placed on quality education, as opposed to a research university like Johns Hopkins, where she attended graduate school. Professor

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Bremser preferred a supportive, peer-based teaching environment to a university focusing on research, where the value of a teacher would be judged more on their individual research output than on the education of their students. In her classroom, she places emphasis on collaboration and solving problems in groups. As a result, her research focus has shifted to mathematics education and how students learn and retain knowledge and information.

Professor Bremser's advice to girls who want to enter STEM fields is based on her own experiences and the mistakes she made along the way. She thinks she was too much of a loner and wishes she had found more of a support system. When she was a child, few of her friends were interested in math. Though she would occasionally discuss math with a few girls in her high school math classes, she remained more independent. Her advice to younger girls pursuing mathematics: "Lose the thought that you need to hide when you don't understand something." Historically, engineering, science, and math fields have a greater proportion of men. Because of that, girls and women often feel the need to act as though they don't need any help, since they don't want to satisfy someone's preconceived notions that men are better at math and science than women. When she got engaged in graduate school, Professor Bremser's advisor told her that she wouldn't need a job when she got married. This, along with a biased JHU research paper showing that boys were better at math than girls, caused Professor Bremser to feel discouraged and undervalued as a teacher, a thinker, and a mathematician. Nevertheless, she overcame the obstacles and continued to pursue her education and her career.

Looking back, Professor Bremser can see that what others think doesn't really matter, and that relying on peers or teachers doesn't make a person any less intelligent. Recognizing that you can learn from your mistakes is a critical piece of learning, as is collaboration and sharing ideas. She reminds us that at the end of the day, math, science, and numbers are just a fun sandbox to play around in, and the challenge is part of the fun.

Forty-five years after that high school calculus course, Professor Bremser left a mathematics conference to use the restroom. As she looked around the crowded room, she had been pleased to notice many more female presenters. Reaching the ladies' room, she saw a queue formed outside the door and remembered many years of empty women's restrooms. She listened to the other women discussing number theory and smiled to herself, glad for once to be stuck in a line.