LEARNING WITH VIRTUAL MANIPULATIVES

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Short description of the Workshop Groups: organizers, aims and underlying ideas

Manipulatives have been used in mathematics classrooms for many decades: they can transform how students engage with mathematical ideas by making abstract relationships more visual, by teaching creativity and problem-solving skills, and by allowing students to explore and discover.

Similarly, virtual manipulatives have greatly increased in popularity in recent years – especially for remote learning. They can mirror the effects of their physical counterparts, and even support more complex interactions that are not possible in the physical world.

One such library of virtual manipulatives is Polypad.org, developed by Mathigon. It's completely free to access, and has been used by millions of students and teachers all around the world. Polypad contains many different types of manipulatives, and allows students, teachers and researchers to quickly save their work and collaborate with each other. Teachers can even create interactive "worksheets", assign them to one of their classes, and later review students' auto-graded responses.

In this workshop, we will explore a wide range of virtual manipulatives: from the popular numbers bars, fractions bars and algebra tiles to more unusual ones like prime factor circles, multiplication grids, spinners, non-transitive dice, balance scales, exploding dots, polyominoes, Rekenreks, Kolam and Tantrix tiles, fractals, buckets of zero, or tangram.

We will share a brief summary of existing research into virtual manipulatives, as well as many different examples and activities how manipulatives can be used in the classroom to engage students in deep mathematical thought: with topics ranging from simple arithmetic to advanced number theory. We will also show participants how they can use the free tools we have developed at Polypad to conduct their own research studies.

Most importantly, we want to hear participants' thoughts, ideas and experiences. In small groups, we want to aggregate a library of teaching ideas for virtual manipulatives and come up with innovative ideas for new manipulatives to build in the future. Every week, we are adding new tools and features to Polypad, and we regularly collaborate with educational researchers to create new tools they need.

We've also collected a huge database of students' interactions with our Polypad manipulatives. We want make some of this data publicly available for research, and want to understand which data and formats would be most interesting or useful.

Workshop Organizer

Philipp is the founder and CEO of Mathigon.org, an award-winning platform for learning mathematics that has been used by millions of students all around the world. His goal is to build the "Textbook of the Future", to make online learning more interactive and engaging than ever before. Mathigon contains personalised courses, virtual manipulatives, games, activities, lesson plans and more. It has won numerous awards and has been called "a mathematical wonderland" in The Guardian.

Philipp previously studied mathematics at Cambridge University and mathematics education at the UCL Institute of Education, and he worked as a software engineer at Bloomberg and Google.

Planned structure:

Planned timeline	Planned activity	Working format
10 minutes	Introduction and research summary	Lecture
20 minutes	Using manipulatives: existing websites, tools, activities and resources	Interactive lecture: participants can follow along on their own devices
10 minutes	Using Polypad to conduct research studies	Lecture
15 minutes	Participants share their experience and thoughts on using/researching manipulatives	Open discussion
20 minutes	Come up with specific ideas for classroom activities, new types of manipulatives or research projects using manipulatives	Break out into smaller groups
15 minutes	Student data: what is most interesting for researchers? What data formats to use?	Open discussion

Venue requirement:

No requirements. Participants will need access to a laptop or tablet in order to participate.