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To the MACAS Scientific Committee,

Below is my revised proposal for the MACAS 2025 conference in Moncton, August 18-21, 2025.

Title: Embracing a Circle of Mathematics and the Arts to Integrate Arts-based Activities in Undergraduate Math Courses

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Presentation: in person

Type of Communication: practical examples of interdisciplinary teaching and learning

Proposal

We can visualize a circle of mathematics and the arts as a way to express their interconnectedness. Art can be used to demonstrate mathematical concepts leading to a deeper and broader understanding of the math. Math can be used to motivate aesthetic choices when creating art. There are analogies between the processes of making art and doing math. Both can involve play, variations, patterns, symmetries, problem solving, relationships, and creativity. We ask questions about what is possible and what is not. We seek ways to build bridges between what is abstract and what is concrete, between theory and practice. As a teacher of many different undergraduate math courses, I am always looking for innovative ways to help students. Embracing a circle of math and art by integrating arts-based activities is one way.

The objective of this paper will be to share observations, challenges, and opportunities from incorporating arts-based activities in undergraduate mathematics courses. This focuses on two different contexts. One context is a first year course

Mathematical Concepts II. The course is for non-math majors and is required for students going into an Elementary Education program. The course involves various ways to involve art through in class examples, assignment activities, and a final project that can be arts-based. The other context is a third year course Modern Geometries that is typically taken by math majors. In Fall 2024, the students had to do a final project under the theme of tilings. This final project included a digital exhibit.

There are many benefits to including arts-based components in undergraduate math courses. The activities involve a different set of skills than typical assignments and tests. Students who are sometimes considered "weaker" can thrive while "stronger" students are challenged in new ways. It helps the teacher see different strengths in their students. The assessment of arts-based components is different from typical math assignments and tests. It has been both a challenge and opportunity to develop suitable rubrics that emphasize creativity, depth, communication, and enthusiasm. I am trained as a mathematician, not as an artist. I consider myself a novice when it comes to art. One surprising benefit has been for me to experience the struggles of being a novice to help me empathize with the struggles that many math students have. I also feel that one of the most important roles of a teacher is to model being a learner. I must get out of my comfort zone to do arts-based activities. Real learning happens outside of our comfort zones. I can model what this looks like and how we can handle it.

In the first-year course Mathematical Concepts II, art connections are seen throughout the course. One of the main themes of the course is to find a way to connect the Parthenon to the Sierpinski triangle fractal. This involves spiralling though topics like the Golden Ratio, the Fibonacci sequence, Pascal's triangle, and fractals. We see the Golden Ratio in the first class and spiral back to it several times, adding more depth to the students' understanding. I often use hands-on activities to facilitate the learning. On the first day, students do a measurement activity to see that the ratio of their height to navel is close to the Golden Ratio. I once heard a student say that they had never used an actual measuring tape and that was a revelation for me. I realized how important it was for them to actually do things in the real world and not just abstractly. Assignment activities include making a Fibonacci spiral and using Play-doh to transform a donut to a coffee cup. The final project of the course is a way for students to connect math with

something meaningful to them. Some students choose to involve art. Projects have included animations, poetry, stained glass, songwriting, and digital art. The students in this course are not math majors, and many do not see themselves as mathematical thinkers or they have math anxiety. The projects help them to see that they can think mathematically in a way that is meaningful to them.

The second context is the third-year course Modern Geometries. This course covers topics such as Euclidean geometry, spherical geometry, hyperbolic geometry, fractals, and topology. I have included a final presentation for many years but the most recent time I taught the course (Fall 2024) I tried something new. I decided to include an art exhibit as part of the final presentation. With the discovery of the aperiodic monotile in 2023, the theme for the projects was tilings. We played with the monotiles in the first class. We spiralled back to tilings throughout the term. Students created art pieces (sketches, crocheted blankets, mosaic tilings, etc) and these were virtually displayed in the art gallery of my university. This was a challenge in terms of setting it up and figuring out how to assess but hugely rewarding for the students and myself.

The interconnectedness of math and art offers many opportunities for studying and learning mathematics and for expressing mathematical creativity. The circle of mathematics and the arts is dynamic: we can use art to deepen our understanding of mathematical concepts and the practice of doing mathematics, and we can use math to inspire and influence artistic creations. Moreover, we can reach deeper levels of understanding and broaden the connections as we spiral around between math and arts. I look forward to sharing more details to encourage others to consider integrating arts-based activities into their math curricula.