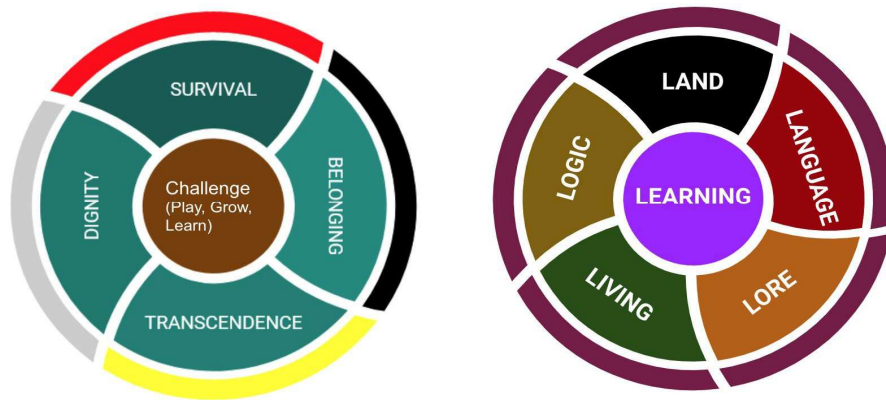


Mathematics for Multispecies' Flourishing: A case for kolams

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We have been developing the framework of Mathematics for multispecies' flourishing (Khan, 2020) which is an ethical and enactivist approach that recognizes the right of all species to flourish through the human study of mathematics and encourages respectful non-exploitative partnerships between humans and other species (Tran et al.,2020). The framework draws attention to essential inter-related values and needs such as survival, transcendence, dignity, belonging, and challenge and places/sources of learning that includes land, language, lore (story), living, and logic and builds off the species turn in anthropology and the post-humanist turn in the Humanities and Social Sciences more generally to decenter (but not devalue) human priorities in radical ways of knowing, doing and becoming in making kin with our other-than-human partners on this planet.

Figure 1: Our framework for multispecies' flourishing.



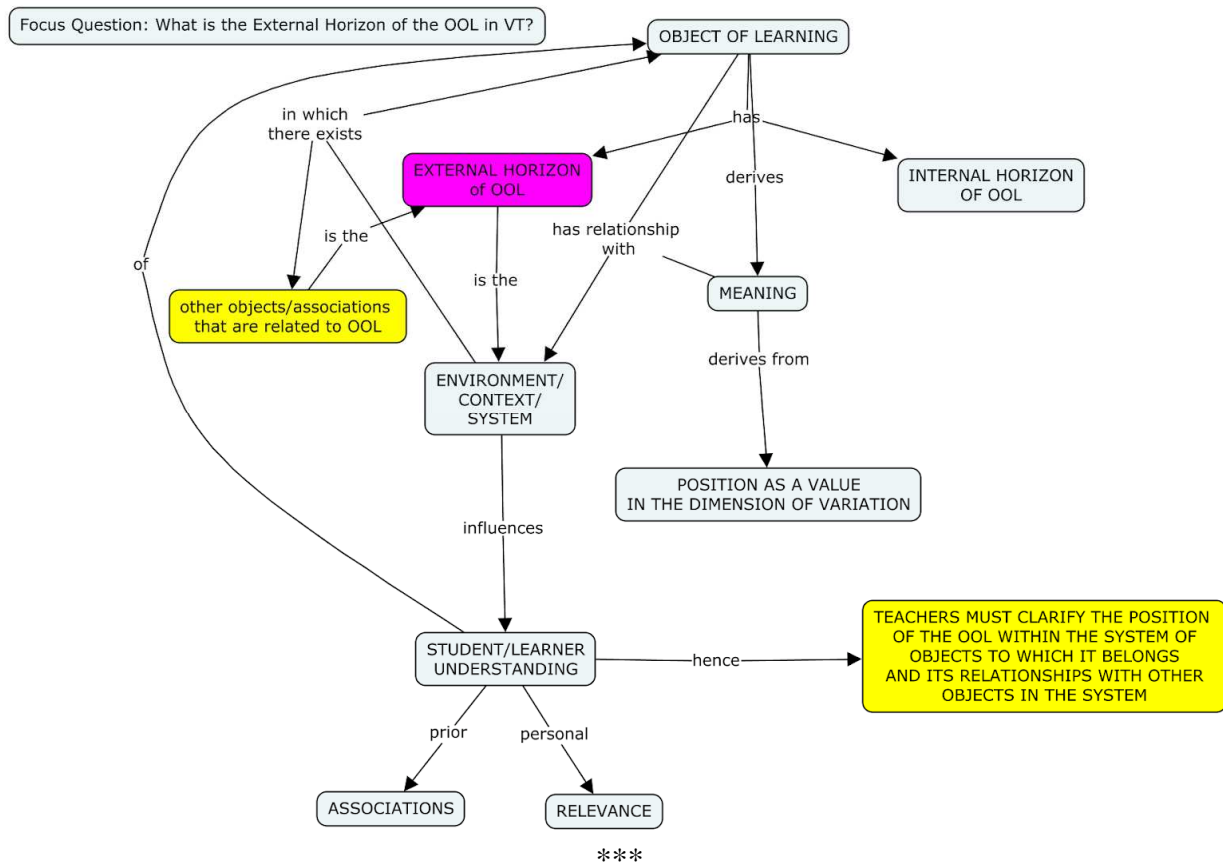
Kolams are traditional rice flour designs which are (typically but not exclusively) drawn by women on the house thresholds in Tamilnadu, India and world over by the Tamil diaspora during the early morning before sunrise. Kolams are drawn to invite the Goddess of prosperity into the homes and create auspiciousness/positivity in day to day lives and serves as a metaphor of harmonious cohabitation with nature. Kolam designs are geometrical and each Kolam begins as a small pattern with dots which are connected to each other through straight lines, loops and curves and which can be extended through recursive rules. The designs are geometric and spatial. According to Nagarajan (2020) kolams are part of a daily ritual act demonstrating reciprocal generosity between nature and culture. The intermittent sacrality of the practice reminds practitioners of their relationship and obligatory dependence upon the multispecies world and reveals the responsibilities therein as the rice flour used in Kolam drawings help in the nourishing of ants, birds, and others.

Figure 2: Traditional kolams using rice flour and practicing with sand drawing version.

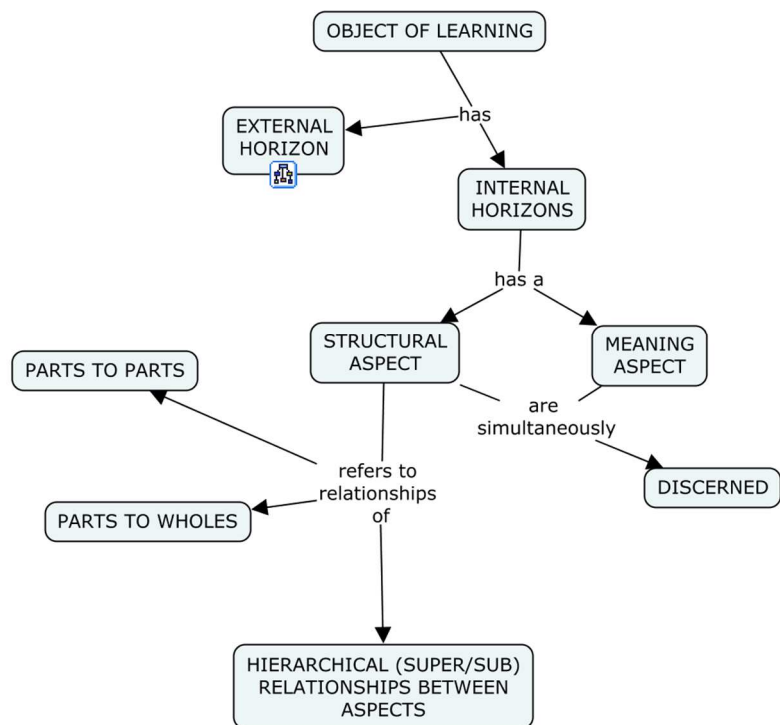


Kolams have been used in mathematics education starting from ethnomathematical and multicultural math frames. To avoid tokenism however, we argue a mathematics for multispecies' flourishing perspective is necessary. We will start by interrogating some of the literature on kolams in mathematics education (Ascher, 2002; Chahine & Subramanian, 2017; Chenulu, 2007) which typically draws on ethnomathematical or culturally responsive perspectives (D'Ambrosio, 1990). We will show, using the concepts of variation theory (Lo, 2012; Marton, 2014) that in these works the external horizon of the object of learning – the cultural context – is referenced and quickly put aside in order to focus on the internal horizon which are frequently mathematics concepts like symmetries, algorithms, or graphs (circuits).

Figure 3: Concept maps of external & Internal horizon of object of learning in Variation Theory



Focus Question: What is the Internal Horizon of the OOL in VT?

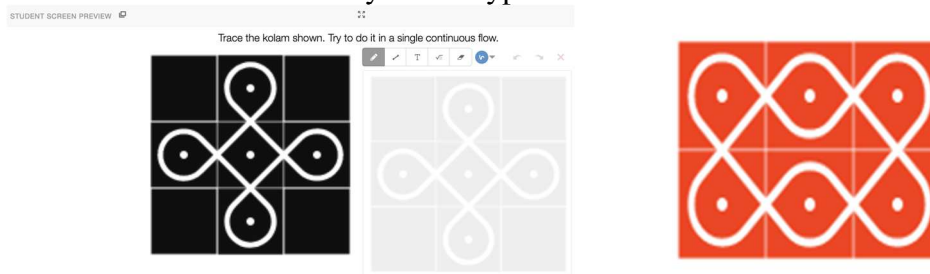


We then revisit and resituate kolam drawing in mathematics education through a perspective of being for multispecies' flourishing (Khan, 2020; Nagarajan, 2018) and argue that the external and internal horizon of the object of learning need to be continuously placed in relation to each other, and doing so serves as a pedagogical pivot (Ellsworth, 2014) that keeps the cultural and ecological significance always close at hand and in mind even as one deepens the mathematical exploration or appreciation. This we believe is essential in seeking to partner with communities in order to bring expertise into the multicultural classroom via mathematics especially in a multicultural nation like Canada. We will each discuss examples and connections we have made with this practice as an Indian graduate student, as an Asian-Canadian graduate student and as a Trinidadian instructor in issues based mathematics courses through personal narrative.

We note that equitable and culturally responsive instructional practices have created a demand by teachers for materials and resources that they can frictionlessly incorporate into their classroom practice. However, with only superficial grounding in the cultures and practices and loose connection to practitioners, these run the risk of appropriation, tokenization, misrepresentation or replicating racist caricatures of cultures (Lao, 2021) and sexist/patriarchal positionings of cognitively demanding work. Our work responds to our wonder, “how do we create opportunities for passionate immersion and meaningful engagement with other cultures in ways that privilege a mindset of partnership and kinship over one of resource extraction and capitalization?”

Our approach acknowledges the humanistic aspects of the MACAS' project, but gestures beyond in these plantation times of percolating precarities, to invite, as partners, our multispecies kin. The study of kolams through the lens of multispecies flourishing offers an exemplary case-study for the keeping together of mathematics, art and sciences and planetary well-being. Our work connects to the themes of theoretical investigations, curricular approaches, interdisciplinarity, math of ordinary situations, intercultural dimensions, and critical issues in STEAM education. We will share two ways to engage learners online with kolam drawing and creating through Teacher Desmos and polypad tiles.

Figure 4: Screenshots of Desmos activity and Polypad tiles.



References

- Ascher, M. (2002). The kolam tradition: A tradition of figure drawing in southern India expresses mathematical ideas and has attracted the attention of computer science. *American Scientist*, 90(1), 56-63.
- Chahine, I. C. & Subramanian, U. (2017). Mathematics on thresholds: Kolams. *Mathematics Teaching in the Middle School*, 23(2), 176.
- Chenulu, S. (2007). Teaching mathematics through the art of kolam. *Mathematics Teaching in the Middle School*, 12(8), 422-428.
- D'Ambrosio, U. (1990). The role of mathematics education in building a democratic and just society. *For the learning of mathematics*, 10(3), 20-23.

- Ellsworth, E. (2004). *Places of learning. Media, architecture, pedagogy*. Routledge.
- Khan, S. K. (2020). After the M in STEM: Towards Multispecies' Flourishing. *Canadian Journal of Science, Mathematics and Technology Education*, 20, 230-245.
- Lao, D. (2021). California High School teacher on leave after offensive Native American depiction. Global News <https://globalnews.ca/news/8288153/native-american-depiction-riverside-high-school/>
- Lo, M. L. (2012). *Variation theory and the improvement of teaching and learning*. Acta Universitatis Gothoburgensis. <https://gupea.ub.gu.se/handle/2077/29645>
- Marton, F. (2014). *Necessary conditions of learning*. Routledge.
- Nagarajan, V. (2018). *Feeding a Thousand Souls: Women, Ritual, and Ecology in India- An Exploration of the Kolam*. Oxford University Press.
- Tran, T.T., Khan, S. K. & LaFrance, S. (2020). Mathematics for Multispecies' Flourishing: Make kin with Vietnamese Bánh Chung. *Journal of the Philosophy of Mathematics Education*, 36, 49pp.