Grounding Auxiliary Geometrical Constructions as Semiotic Articulation of Tacit Proprioception: The Case of Basic Posture in Balinese Dance

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Objective: Students Will Develop Geometric Reasoning Skills by Grounding Their Proprioceptive Dance Notions in Floor-Based Diagrammatic Resources

GRiD (Geometry Resources in Dance) responds to students' difficulty with geometrical reasoning by creating intuitive-to-formal "bridging tools" for constructing geometric proof (Abrahamson & Wilensky, 2007). GRiD offers semiotic resources to ground explicit proof structures in implicit perceptual structures serving the performance of cultural–historical dance forms.

Background: Recruiting an Ancient "Forgotten Sense" to Understand Geometry

Mathematical proof, a key competency in standards-based curricula (NCTM, 2000), remains an educational challenge (Hsu, 2017). Within geometry, studies implicate students' cognitive difficulty specifically in generating auxiliary lines to investigate latent properties of spatial structures (Palatnik & Dreyfus, 2018). From an embodiment perspective, this design-based research project explores the potential of dance as an activity context for geometry students to practice the ideation of auxiliary lines. Learning to perform movement forms often elicits the spontaneous mental generation of imaginary ecological Gestalts, *attentional anchors* (AA), that tacitly solve motor-coordination problems (Abrahamson & Sánchez-García, 2016). Yet, cultural norms surrounding the movement arts may not include discursive practices for articulating these covert auxiliary forms as overt semiotic constructions. GRiD seeks to capitalize on AA's by optimizing for their semiotic objectification (cf. Radford, 2013).

Design: From Attentional Anchors to Auxiliary Lines—The Case of Tapak Sirang Pada

We introduced a diagrammatic artifact—a gridded floor mat—into a Balinese dance lesson to evaluate whether it would afford the objectification of AA for Tapak Sirang Pada, a basic right-angled foot posture (see Fig. 1). A 10-year-old beginner dancer participated voluntarily in a pilot task-based semi-structured clinical interview. Micro-ethnographic analysis of audio–video data evidenced how the mat both elicited and objectified her tacit AA in proto-geometrical form: she marked a triangle that, she claimed, is her imaginary means of calibrating the posture. Once diagrammed, she could elaborate and extend her embodied argument by bringing to bear geometrical reasoning. Thus, GRiD materials enabled dance-based engagement in geometry discourse by objectifying and augmenting intuitively generated presymbolic notions as external constructions (Kirsh, 2010).

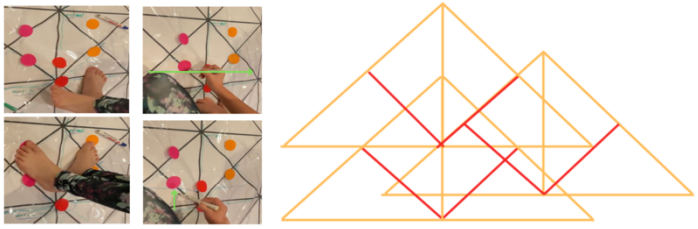

Figure 1. Performing a heel-to-heel right-angled Balinese dance posture serves as a pedagogical context to surface imaginary structures in the form of semiotic elements of geometry practice.

Conclusions

The GRiD project elaborates on the action-based genre of the embodied design framework (Abrahamson, 2014) by way of situating students' semiotic objectification of presymbolic notions within *culturally authentic* fields of promoted action. GRiD begins from an existing cultural–historical practice, Balinese dance, where participants have already developed attentional anchors to perform conventional choreographed forms, e.g., poses and gestures. As such, GRiD demonstrates how formal mathematical discourse can sprout from culturally diverse practices. While GRiD innovates a culturally–historically situated exemplar of embodied design, the project also creates an empirical context for future research into questions of epistemology and axiology pertaining to globalizing embodied mathematics pedagogy: How can we best empower students' cultural identity?

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