Pull, feel, and run
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1. Kinesthetic learning of forces
Kinesthetic learning activities as a teaching technology may have a central role to play in contemporary physics teaching [1]. Kinesthetic learning activities have students enact physical objects and student actions are linked to interactions between objects [2]. Here, we seek to characterize learning opportunities which occur and learning environments that unfold when teaching with kinesthetic learning activities.

Using a socio-semiotic perspective [3]. We look for signs that particular image schemata [4] are active, and we make inferences about the interplay between individual image schema and social interaction [5]. Thus we are interested both in individual behaviour and social interaction.

2. Signs and affordances of kinesthetic learning activities

![Figure 2](image2.png)

Figure 2: We use a steady camera, distributed audio recorders and to gather data. We search the recordings for characteristic student behaviour. One example is the shifting patterns of engagement with content and being playful.

![Figure 3](image3.png)

Figure 3: Student use the activities to bridge bodily understanding with physics understanding. We look for signs in speech and gesture that relate to the enactment of the kinesthetic learning activities. For example, how gestures/speech acts are developed as discourses/metaphors that bridge between physics and bodily experience.

![Figure 4](image4.png)

Figure 4: In a given context, students may enact the kinesthetic model with differences to the way illustrated in Figure 1. Such differences may profoundly influence the experience (for example, how it feels) and the physics (for example, where the force attacks).

3. Three characteristics of kinesthetic learning situations

![Figure 5](image5.png)

Figure 5: Students develop bodily understanding of forces through internal and external dialogue. Scan QR-code on the right of each of Figures 5-7 to watch Video 1-3.

![Figure 6](image6.png)

Figure 6: Differences in enactment lead to opportunities for learning: In Video 2, students enact addition of forces by pulling a third student sitting in a box.

![Figure 7](image7.png)

Figure 7: Students 'oscillate' with different pacing between playful/chaotic behavior and more focused work throughout kinesthetic learning activities. Seemingly playful activities can be part of focused engagement.

Selected Literature

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