**////Title: Teaching Physics through Kinaesthetic Learning Activities**

**////Standfirst:**

Explaining complex physical phenomena to students in simple and relatable ways can be challenging. This is particularly true for abstract concepts or phenomena that can only be observed using advanced equipment. Dr AJ Richards,an Assistant Professor of Physics at the College of New Jersey, has been exploring the potential of Kinaesthetic Learning Activities – multi-sensory teaching strategies involving hands-on experiences – to convey abstract and microscopic physics more effectively in the classroom.

**////Main text:**

Research shows that a lack of engagement with scientific subjects can cause students to drop out of higher-education courses in Science, Technology, Engineering and Mathematics – or ‘STEM’. Educators worldwide have thus been trying to devise more engaging strategies to teach STEM subjects.

Explaining complex or abstract concepts in engaging and relatable ways, however, is not always easy. This is especially true in the field of physics, as many physical phenomena are either entirely abstract or only observable using advanced equipment.

Dr AJ Richards, an Assistant Professor of Physics at the College of New Jersey, has been experimenting with different techniques that could increase his student’s engagement and enhance their understanding of microscopic, macroscopic, and abstract physical phenomena.

In an article in the journal *The Physics Teacher*, he highlights the educational value of Kinaesthetic Learning Activities as a way to teach physics to students completing high-school or undergraduate STEM courses.

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Kinaesthetic Learning Activities require students to physically experience concepts that they learn about in class. For instance, students could be asked to move back and forth in front of a motion detector to reproduce physical patterns described by their instructor. Alternatively, they might be asked to physically act out the way in which ions and electrons behave inside electrical conductors and insulators.

In contrast with conventional teaching methods, which merely involve a teacher verbally explaining concepts, Kinaesthetic Learning Activities allow students to reason about abstract concepts in a practical way and experience what they are learning first-hand. This can enhance their understanding of curricular material, while also promoting active learning, which has been shown to enhance knowledge retention.

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While the term ‘Kinaesthetic Learning Activities’ includes a broad range of practical classroom exercises, Dr Richards focuses on activities that require students to take on the role of physical objects or reproduce physical phenomena through body movements.

In his paper, Dr Richards emphasises the advantages of these activities over traditional lecture-based teaching strategies. For instance, he says that they can raise student participation and engagement during classes, while also re-energising students after hours of lectures.

Kinaesthetic Learning Activities can also promote collaboration within the classroom, as such activities often require students to work as a group, communicating with their peers while trying to collectively tackle the problem posed by the instructor.

In addition to conveying physics concepts in a more engaging way, these activities are a useful way for educators to assess the students’ understanding of material covered in class. While the students complete an activity, instructors can gauge what concepts the students are more familiar with and which ones they do not fully grasp.

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Dr Richards outlines three Kinaesthetic Learning Activities that could be easily implemented by other physics instructors. The first is an activity that can be used to improve students’ understanding of the three most common states of matter: solid, liquid, and gas.

During this group exercise, students are asked to gather in a cluster, either in a clear space within the classroom or another open space. The instructor explains that each student represents a molecule in a specific substance, such as water. Subsequently, the students are asked to move and arrange themselves in different ways within their environment, to visually represent the three different states of matter.

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The second activity can be used to explain how particles move during the propagation of two different wave types, namely transverse and longitudinal waves. This exercise shows why longitudinal waves can propagate easily in all materials, while transverse waves travel easily through solids, but struggle to move through liquids and gases.

During the activity, up to ten students form a line in front of the classroom facing the same direction, parallel to one of the walls in the room. Initially, they are asked to simulate molecules in a solid material by firmly grasping the shoulders of the student in front of them, to represent strong intermolecular bonds.

Subsequently, the teacher simulates the two different types of ‘wave disturbances’, by firmly pushing the last student in the line forward to reproduce longitudinal waves or rotating their torso to demonstrate transverse waves.

The students are then asked to arrange themselves to represent molecules in a gas by merely placing their hands *near* the shoulders of the student in front of them, to represent negligible intermolecular bonds. The instructor then repeats the two actions simulating the different wave types. The activity is followed by a discussion of what the students experienced.

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The final Kinaesthetic Learning Activity introduced by Dr Richards can help students to visualise how to divide vectors into different components and implement vector addition techniques. This activity requires large protractors and measuring tapes, so it works best when carried out in a gymnasium or large outdoor courtyard.

At the beginning of the exercise, a teacher hands out two 2D displacement vectors to different groups of students and asks them to find the resulting vector by adding the two displacements. To accomplish this, each group needs to walk out the displacement vectors in succession and measure the distance between their initial and final position.

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As they do not require expensive materials, the three activities proposed by Dr Richards could be easily implemented by instructors teaching physics in high schools, colleges and universities worldwide. In addition, he encourages physics instructors to develop their own Kinaesthetic Learning Activities that can be used to convey abstract concepts in creative and engaging ways.

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This SciPod is a summary of the chapter ‘Teaching Mechanics Using Kinaesthetic Learning Activities’, from *The Physics Teacher.* <https://doi.org/10.1119/1.5084926>

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