A "HUMAN" TEACHING METHOD FOR PHYSICS

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ABSTRACT

In order to enliven the environment of the physics classroom and deepen the understanding of physics concepts, we propose a "human" teaching method that uses the students' bodies themselves as the sole medium to approximately recreate major physical processes. In concrete terms, participants play definite physical roles and assume definite physical functions. All participants form a group and perform the demonstration, thereby recreating major physical processes. We use "surface tension" as an example to illustrate this teaching method. This technique increases the interest factor in physics teaching, thus stimulating students' exploratory enthusiasm while cultivating cooperation and team spirit. Therefore, this method is conducive to improving students' collective creative abilities.

Subject headings: physics teaching – surface tension

"University Physics" is a general foundation, requisite lecture course, consisting mainly of a "purely" theoretical curriculum. In the classroom setting, students are generally unable to personally conduct experiments as a means of understanding the knowledge they have learned. Although some schools have offered "Experimental Physics" in order to remedy this shortcoming, the effectiveness of these courses is still inadequate. Teachers may be able to demonstrate certain physics experiments within the "University Physics" classroom, but students can only observe these without being able to personally participate, thus, similarly lacking an immersive sense of reality. In the "University Physics" classroom, teachers and students generally do not bring any teaching tools with them aside from the required teaching materials. How can physical processes be recreated in situations lacking supplemental teaching equipment? Similarly important, how can the "University Physics" classroom environment be made less "pure" and more dynamic?

In order to simultaneously solve the two problems mentioned above, we propose a "human" teaching method for physics. This so-called "human" method refers to a physics teaching method involving the use the participants' bodies themselves as the sole medium to approximately recreate major physical processes. In concrete terms, participants are made to play definite physical roles

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and assume definite physical functions. All participants form a group to carry out the demonstration, thereby recreating major physical processes.

Below, we use "surface tension" to illustrate this type of teaching method. On board "Tiangong-1", "Shenzhou-10" astronaut Yaping Wang demonstrated that water droplets are spherical in zero gravity[1]—a result of surface tension. We will now describe how to use the "human" teaching method to explain the causes of surface tension (only zero gravity will be considered here). Specifically, each participant represents a molecule (shown as circles in Figures 1 and 2), with their arms representing the attraction between molecules (there is no need to concretely demonstrate repulsion between molecules here). In the preparatory stage (Figure 1), some participants hold hands to form a boundary layer with an arbitrary shape (representing the boundary layer between water and air, as shown by the five-sided shape in Figure 1). The inner portion is filled with participants representing water molecules, while a small number of participants are scattered on the outside, relatively distant from the boundary layer. In the demonstration phase (shown in Figure 2), the participants on the inside experience symmetrical constraints from their surrounding participants and are in a state of equilibrium. As the outer participants are too far away, those participants on the boundary layer are more easily pulled inwards by the inner participants and, in the process of being pulled inwards, the participants on the boundary layer must continually hold each other's hands tightly. As a result, the boundary participants will form a circle (as shown in Figure 2), and each member will experience a pulling force from their neighborsłthis pulling force is surface tension. In a dense configuration with a constant number of participants, the circumference of the boundary layer will be at its shortest, illustrating the tendency of liquid boundary layers to reach their minimum as a property of surface tension. In the classroom, we used a two-dimensional "human" molecule configuration to substitute a three-dimensional structure; if we generalize the above result to create a three-dimensional situation, then the surface area of a liquid tends to reach its minimum as a property of surface tension and surface tension arises as a result of joint interactions between the boundary layer and inner molecules.

This teaching process not only enabled students to comprehend the essence of surface tension, more importantly, it also stimulated their exploratory enthusiasm and cultivated cooperative team spirit, which are all conducive to improving creative ability. "human" teaching methods use participants as the sole medium of demonstration to conveniently and directly recreate key physical processes. Additionally, it also arouses students' enthusiasm for learning physics and strengthens cooperation and teamwork abilities. In the future, we will further build upon and promote teaching experience in this aspect.

The author (W.-P. Liu) acknowledges the support from the Scientific Research Foundation of the Civil Aviation University of China (09QD15X).

REFERENCES

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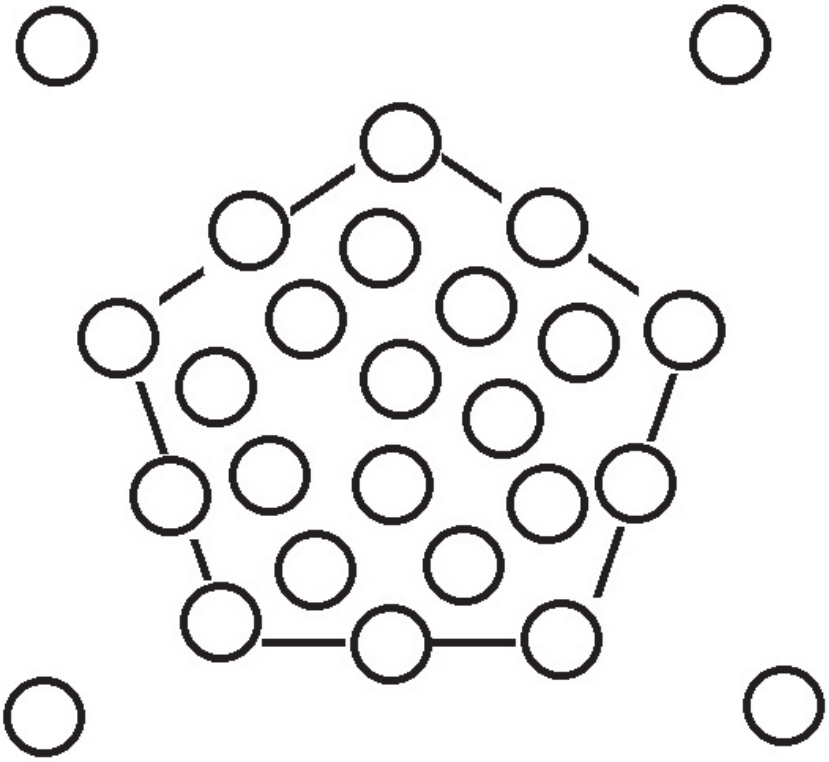

Fig. 1.— Preparatory Stage of a Two-Dimensional “Human” Surface Tension Demonstration

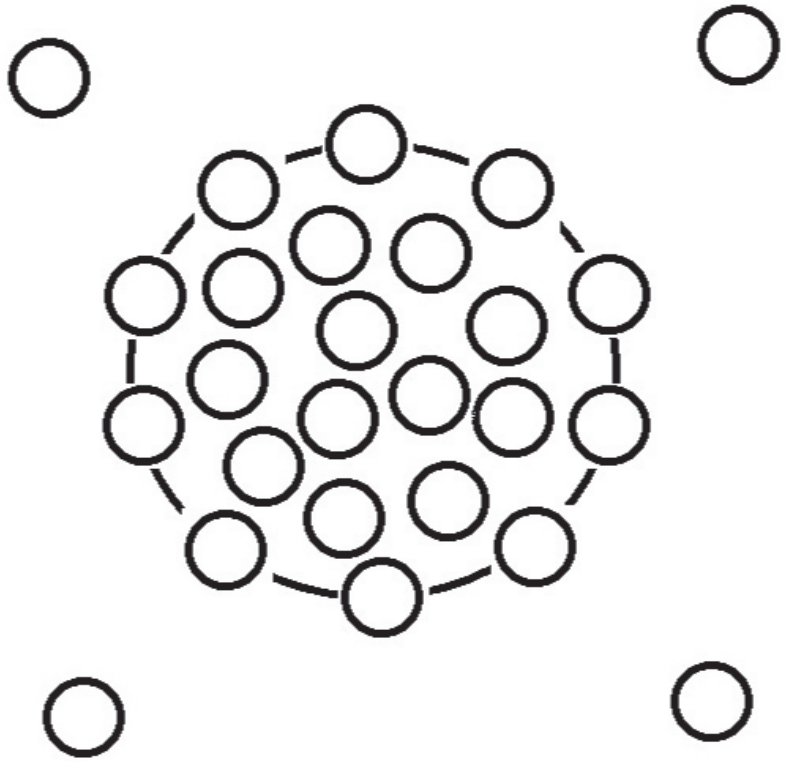

Fig. 2.— Final Result of the Two-Dimensional “Human” Surface Tension Demonstration