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Question-Answer Teaching Method to Develop Student Understanding of Buoyant Force

There have been many studies in physics education research showing that students have difficulties with the buoyant force topic. One difficulty is that students do not understand that the buoyant force is the resultant force of the fluid pressure. This work designed a worksheet based on the question-answer teaching method aiming to help students understand the concept. This method asks students to answer a set of designed questions which consist of (i) the concept-guiding questions, (ii) the comprehension-checking questions, and (iii) the concept-applying questions. Students are required to express and discuss their own ideas with other students and instructors. The designed questions encourage and challenge the students to correct their misconceptions and understand the concept by themselves. A conceptual test (multiple-choice questions) was used to measure the improvement of a control group who learned by a traditional lecture ($N = 88$) and an experimental group who learned by this method ($N = 12$). According to the results, the pre-test and post-test scores of the experimental group are significantly different (p -value = 0.01). The normalized gains of the control group and the experimental group are 0.08 and 0.63, respectively. These findings show that the question-answer teaching method can be used to improve students' understanding effectively. In addition, after teaching, 7 out of 12 students in the experimental group understood that the buoyant force acting on an object results from the fluid pressure difference and that the force magnitude is equal to the weight of the fluid displaced, consistent with the Archimedes' principle. The method also helps students realize that the buoyant force does not depend on the depth or the type of the object, and sinking or floating depends on the magnitude of the buoyant force and the weight of the object.

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