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STUDENT-CENTERED, INTEGRATED APPROACH TO A FRESHMAN SCIENCE COURSE

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Traditional teaching methodologies and non-integrated contents of freshman physics courses are often inadequate in preparing students for coping with real-life challenges. To address this, we redesigned our two-semester introductory science course into active-learning format and with integrated contents, to equip the students with scientific knowledge and skills for contending real complex contemporary challenges. This course is one of the core curriculum courses taken by all freshmen students (>1000 per semester) regardless of their prospective majors. The aim of the course is to initiate curiosity and scientific thinking in students, and at the same time introduces some of the basic concepts of physics, chemistry, and biology and their interconnections. The new version of the course takes a modular structure designed around four open science questions closely related to everyday life: 1. "Are we alone in the Universe?", 2. "Is antibiotic resistance a big threat for the humankind?", 3. "Are humans causing climate change?", and 4. "Can we ever comprehend the workings of the brain?". Within these modules, basic physics concepts such as kinematics, dynamics, energy, electricity, magnetism, thermodynamics, and a brief introduction to quantum mechanics, are scattered throughout and discussed in various contexts. When designing, we adopted backward design model with students at our focus, and the learning activities are done in classrooms specifically designed for collaborative learning. Specially-trained graduate and undergraduate assistants facilitate discussions among students while they work on problem sets, which also benefits the assistants to become better educators, leaders, and learners themselves. Through such course design and integrated contents relevant to their lives, we emphasize on promoting teamwork, critical thinking, problem solving, and scientific literacy skills, valuable for all professionals of tomorrow. Moreover, since 2016 the course has been offered in a flipped format, in which students work on a preparation set (video lectures, readings, and quizzes) before coming to the class. This allows for more in-class activities and instructor-student interaction time, benefiting both parties. Such an innovative approach, including the core curriculum educational model, applied at such a large scale is deemed especially progressive in the region, and consequently, we have overcome a number of unique challenges specific to our students. We present the design, implementation, and example physics activities of the course, together with preliminary results of learning outcome comparison between traditional and non-traditional approaches using both quantitative and qualitative analyses. We find considerable increase in the attendance rates, which contributes to a change in the course grade distribution and general attitude. The qualitative feedback indicates positive impact on students' learning culture.

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