Chesapeake Section of the
American Association of Physics Teachers
Fall 2022 Semi-Virtual Meeting
October 22, 2022 in Falls Church, VA

Contribution ID: **19** Type: **demo (15-minute)**

STEAM—Teaching Space Weather Studies

Saturday, October 22, 2022 3:00 PM (15 minutes)

1. Introduction

Direct learning approach commonly used by Physics teachers does not really improve student ability to develop self-understanding as well as environment awareness [1]. In direct learning, especially used to teach Physics at senior High School, teachers give an explanation about the material, followed by examples of exercises, and end with students working on exercises. However, other learning strategies may hold an important role to improve conceptual understanding. Research-based active-learning instruction in physics involves students in their own learning more deeply and more intensely compared to that with traditional instruction [2]. The methods are very diverse sharing three common features: (1) they are explicitly based on research in the learning and teaching of physics; (2) they incorporate classroom and/or laboratory activities that require all students to express their thinking through speaking, writing, or other actions that go beyond listening and the copying of notes, or execution of prescribed procedures; and (3) they have been tested repeatedly in actual classroom settings and have yielded objective evidence of improved student learning. Simple observational experiments using no special educational technology includes the use only of paper and pencil, yet still engage students in learning activities that are demonstrably more effective than traditional lectures and homework.

A large body of peer-reviewed research indicates that typical learning gains for the majority of students on qualitative, conceptual physics questions, when engaged in "traditional"instructional activities, are around 10–15 percentage points on standard diagnostic exams [3]. This represents the pre-to-post-instruction gain, and corresponds to correcting 20% of incorrect pretest responses). By contrast, research-based active-learning materials and methods produce gains up to and often more than double that amount on similar questions. For example, in a recent study [4], a sample of more than 3000 students from ten universities showed gains from active-learning instructional materials to be more than four times those obtained through standard instruction. The active-learning methods also generally produce gains on traditional, quantitative physics problems that are equivalent or superior to gains observed with traditional instruction.

1. Purpose

The aim of this paper is to explore other teaching modalities that would be more effective for student understanding and match a more diversified learning style.

1. Case Demonstration

Learning style differences have been attributed to student modality strengths (i.e. sensory channels that receive and give messages)—the visual, auditory, and kinesthetic [5]. Last year's presentation "STEM —Teaching Space Weather Studies"matched to a student's auditory learning style is adapted for this year's presentation "STEAM—Teaching Space Weather Studies"which is matched to a visual learning style. Whereas STEM adjoins science, technology, engineering and mathematics and applies academic concepts to hands-on, real-world activities, STEAM uses the same integrated approach but with a nod to arts education that captures visual learning. Last year's auditory presentation was secondarily enhanced by visuals and charts; visuals (i.e. Powerpoint slides) were ordered correctly with respective narrations. In reverse, this case demonstration asks students to match visuals randomly ordered with their corresponding narrations. The primary modality is visual with figures and charts but secondarily enhanced with narrative per auditory modality. Student matching is facilitated with slides having relevant clues embedded that correspond to textual narrations. Reading textual narrations and critically evaluating the observed slides afford students the opportunity to learn subject matter through concrete experience (i.e. matching slides selected to corresponding narrations) and abstraction. As noted in Guild and Garger (1985), "While every person is able to use both sequential and random ordering, we each have a tendency to prefer and to operate most frequently and most successfully with one kind of ordering"(p.38).

Successful completion of this study module introduces students to the next module that explores space weather beyond Earth's ionosphere and magnetosphere onward to the Moon's exosphere where the upcoming Artemis mission will find formidable with unfiltered risks.

References

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on senior high school students. International Journal of Emerging Technologies in Learning (iJET), 14(19).
[2] Meltzer, D. E., & Thornton, R. K. (2012). Resource letter ALIP–1: active-learning instruction in physics. American journal of
physics, 80(6), 478-496.
[3] Hake, R. (1998)..Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses,"Am. J. Phys. 66, 64–74.
[4] Thornton, R., Kuhl, D. Cummings, K., & Marx, J. (2009). Comparing the force and motion conceptual evaluation and the force concept inventory. Phys. Rev. ST Phys. Educ. Res. 5, 010105]
[5] Guild, P. & Garger, S. (1985). Marching to Different Drummers. Alexandria, VA. Association for Supervision
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Session Classification: Afternoon Session 2B (Chair: Maria Gordon, Zoom Monitor: Elena Kuchina)