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(G*) Creating Positive Learning Experiences with Constructive and Active Learning Approaches in Quantum Mechanics for Adolescents

Monday 6 June 2022 16:45 (15 minutes)

We, teachers, curriculum designers and educators, should encourage students'intellectual engagement and motivation and consider progressive and effective factors in their learning (Wentzel & Watkinz, 2016; Anderman & Dawson, 2011; Csikszentmihalyi, 1990, 1996; 1997; Shernoff et al., 2003). According to Dewey's theory of learning (1916), learners need to become active participants in their own learning processes; and the individuals'direct personal experiences in activities have a significant role in learning outcomes (Dewey, 1916). Thus, students must be provided with moments and opportunities through the teacher's teaching (both curriculum and pedagogy) that would respond to and fulfill all those constructive and progressive experiences in learning. Here, I raise a question: How can we support and provide learners with constructive and active learning opportunities and approaches to learning quantum mechanics? It is emphasized that for teaching and learning the most complicated and abstract concept in physics like quantum mechanics, not only students but also teachers, particularly science teachers without a physics background knowledge, require simplified and visualized educational instructional resources such as guided activities accompanied with simulations (McKagan et al., 2008; Zollman et al., 2002; Baily & Finkelstein, 2009; Yulianti et al., 2021; Faletič & Kranjc, 2021). Today, the effectiveness of the basic and classical simulations, visualized instructional resources, and simulation-based inquiry learning (de Jong, 2011; Mayer & Alexander, 2016; Day & Goldstone, 2009) in quantum mechanics is significant (McKagan et al., 2008; Zollman et al., 2002; Faletič & Kranjc, 2021; Baily & Finkelstein, 2009; Yulianti et al., 2021). For instance, wave-particle behaviour of light and quantum objects is not something that can be easily imagined and conceived by students from the actual experiment itself (Olsen, 2002; Duit et al., 2014; Müller & Wiesner, 2002). The results of my studies, practices, and observations from a science program for adolescents (designed and developed by myself in British Columbia, Canada) acknowledge the discussions and arguments. One of the reasons that adolescents could successfully progress their learning from waves principles to quantum mechanics is the significant effectiveness of the PhET simulations on both curricular resources as well as the pedagogical approaches utilized for students'physics learning (Yulianti et al., 2021; Faletič & Kranjc, 2021; Baily & Finkelstein, 2009; McKagan et al., 2008; Zollman et al., 2002). In brief, these approaches are strongly recommended and developed in teaching the fundamentals of quantum physics, guiding, engaging, and encouraging adolescents in learning quantum mechanics.

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