Chapter 80
Presenting Physics Content and Fostering Creativity in Physics among Less-Academically Inclined Students through a Simple Design-Based Toy Project

Nazir Amir
Greenview Secondary School, Singapore

R. Subramaniam
Nanyang Technological University, Singapore

ABSTRACT

One of the emphases of 21st century science education is in producing students who are creative and who can contribute to the economy. Physics affords immense scope in this regard. This study illustrates an instructional teaching approach to present the physics concepts of density and forces in liquids to kinesthetic students and, at the same time, offers an avenue to foster creativity among them through the fabrication of variants of a popular physics toy: the Cartesian diver. It was conducted during curriculum time in a physics laboratory. Results showed that the students were able to showcase their creative abilities through knowledge from physics in this design-based toy project. Students found the pedagogical approach suitable for learning physics content and also a fun way to showcase their creative abilities through knowledge from physics. They also developed positive attitudes towards studying physics after going through this project.

1. INTRODUCTION

In Sir Ken Robinson's lecture on the need to nurture creativity among students in order to meet the demands of the 21st century economy, he reminded educators that approaches to foster creativity among students is as equally necessary as teaching the subject content to them.

DOI: 10.4018/978-1-4666-7363-2.ch080

My contention is that creativity now is as important in education as literacy and we should treat it with the same status. Robinson (2006)

Examining the definitions of creativity in the works of Barlex (2007), Christensen, (1988), Guilford (1959), Robinson (2006), Spendlove (2005) and Torrance (1966; 1974), it is clear that it has to do with coming up with something original or novel and of value. The studies of Amabile (1982; 1988; 1996), Besemer (2010), Craft (2001), Cropley & Cropley (2010), Cziksentmihalyi (1998), Dacey & Lennon (2000), Feldman, Cziksentmihalyi & Gardner (1994), Rhyammer & Brolin (1999), and Vernon (1989) suggest that a way for physics teachers to promote creativity in the classroom is by guiding pupils through problem-solving contexts that are embedded in everyday life and which leverage on subject knowledge. The process of fostering creativity in physics amongst students can sharpen their skills in problem-solving, get them to be more inquisitive about how physics can be used to improve daily activities, and build up their confidence into thinking about how its use may value-add to the economy (Fisher, 2004, and Raviv, 2003). It could also instill the spirit of innovation among students and pave a path for them to be young inventors of our future.

In Singapore, students who do not perform academically well in the national Primary School Leaving Examinations (PSLE) are placed in the Normal Technical (NT) stream in secondary schools. While physics experiments in secondary school activity books published for NT students allow them to be engaged in learning physics through a hands-on approach, it is observed that many of these experiments lack instructional elements that would allow teachers to guide their students to showcase their creative abilities through knowledge from physics. A challenge is in crafting teaching approaches that are suitable to present physics content to these students while, at the same time, providing them with avenues to demonstrate their creative abilities through knowledge from the subject. The need to craft feasible teaching approaches to foster creativity among students during science curricula time in school cannot be at the expense of prescribed content, that is, it should be dovetailed with it. Teachers would buy-in to such teaching approaches if the activities are made appealing for students and carried out with the use of simple and inexpensive materials - in other words, it has to be a pedagogical approach that is feasible enough to be carried out in the classroom and one that NT students would find exciting and enjoyable.

Examining the literature, we find that little has been discussed about how teachers may adopt feasible classroom teaching approaches that foster creativity in physics amongst the less-academically inclined students during curriculum time. Teaching approaches to foster creativity in physics among these students, such as those in the NT stream in Singapore, may need to be different than those crafted for the more academically inclined students. This is primarily due to NT students' low levels of interest in studying physics when topics are not presented in ways that appeal to them and made relevant to their personal experiences (Amir & Subramaniam, 2009). Being predominantly kinesthetic learners, it is likely that such students can respond better to visual-spatial modes of learning rather than to visual-linguistic modes of learning (Ramadas, 2009). Findings from the works of Balchin (2005), Heacox (2002), Lee, Goh, Chia, et al. (2006), and Nunley (2006) highlight that from a teacher's viewpoint, approaches to foster creativity cannot be at the expense of presenting academic content to students.

Our observations show that apart from several schools sending only a handful of NT students to a few national science competitions, such as design-based science project competitions that are often carried out after school hours, little has been discussed on how avenues can be created for teachers to foster creativity in physics amongst NT students during science curriculum time. We