The Development of Teaching Material of Physics Introductory for Biology with Science, Technology, Engineering, and Mathematics (STEM) Approach

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The Development of Teaching Material of Physics Introductory for Biology with Science, Technology, Engineering, and Mathematics (STEM) Approach

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Abstract. In higher education, many concepts in physics are applied in various disciplines that explain the development of the theory they learn; one of them is Physics Introductory. Natural Science Students, such as Biology and Chemistry, unwittingly use many essential concepts of Physics. However, the learning process in this course generally only explains concepts in Physics without relating them to the needs of interdisciplinary knowledge. As a result, interdisciplinary students feel that Physics is meaningless and not applicable. This raises the perception that causes them not interested to learn Physics. In fact, the concepts contained in this course are very important for the development of their knowledge. This research will try to rearrange the materials in the Physics introductory course linked to the Biology concepts. The development of teaching materials uses the Research and Development (R & D) method. This paper will discuss theories and publications that support the importance of interdisciplinary integrated learning. Furthermore, the development of teaching material and its effectiveness will be discussed in our future publication.

Keywords: STEM, Integrated Learning, Physics Introductory

1. Introduction

Physics is one branch of natural science whose materials are widely applied to various branches of science. Medicine, computer science, and engineering are some branches of science that use concepts and calculations in Physics both advanced and straightforward concepts (Keevil, 2012; Maris, Sosonkina, Vary, Ng, & Yang, 2010; Serway & Jewett, 2018). Even in some branches of natural science, Physics is a fundamental basis in the development of the knowledge they are studying (Frankel, 2011; Koonin, 2018).

Generally, students of the branch of natural sciences, especially in the first year, will take the Basic Physics course as one of the prerequisite courses. However, some research shows that the learning outcomes in the Basic Physics course are not as expected, especially on Newtonian concepts. (Hisham N Bani-Salameh, 2016; Hisham N Bani-Salameh, 2016).

The selection of material that is suitable for fundamental physics courses will give positive perceptions to students so that they will be motivated to explore concepts in Physics in accordance with their field

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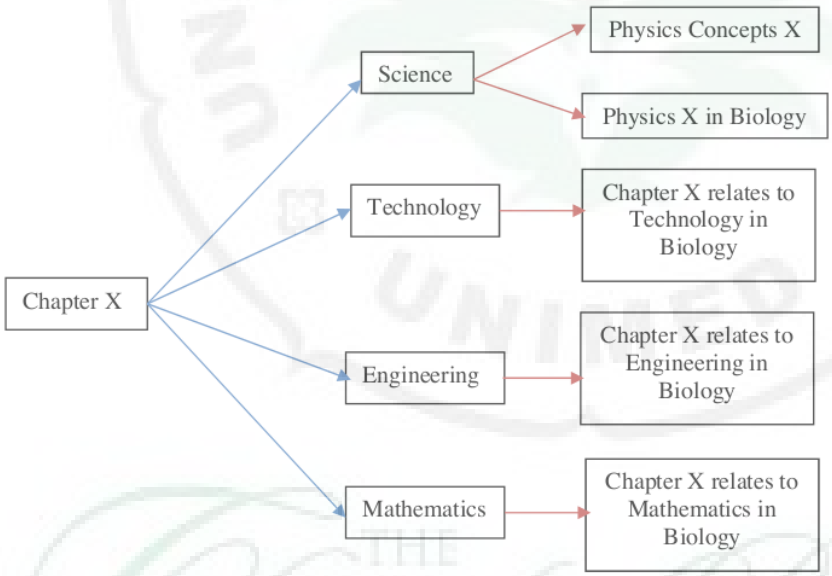
of science. This concept will also have an impact on increasing their learning outcomes (Handhika, Cari, Soeparmi, & Sunarno, 2016; Harlow et al., 2014). The combination of teaching materials and the right methods will make the learning process in basic physics courses applicable and meaningful as part of lifelong learning (Geller, Turpen, & Crouch, 2018). This paper will explain a preliminary study of General Physics teaching materials for Biology-based Sciences, Technology, and Engineering (STEM).

2. Methodology

The research includes development research with the understanding of research and development (R&D) development. The teaching material developed in this study is the Basic Physics teaching material for Biology.

Teaching materials developed include eight main chapters which will be redeveloped based on sub-chapters which contain explanations and applications of the interrelationships of concepts contained in Physics in Biology. Table 1 below is the development of Basic Physics for Biology teaching materials that have been planned. There are eight Physics chapters that will be developed to the Biology concepts such as Friction, Elasticity and Strength of Materials, Fluids, The Motion of Fluids, Heat and Kinetic Theory, Heat and Life, Waves and Sound, Optics. Teaching materials to be developed will follow the design using the STEM-based approach as follows:



Picture 1. Design of Physics Introductory Physics Material for Biology based on STEM

The learning device development model which will be used in this study is a Research and Development (R&D) model often interpreted as a process or steps to develop a new product. The steps of research and development (R&D) according to Borg and Hall (1989: 775) are a) Research and Data Collection, b) Planning, c) Initial Product Development, d) Initial Product Trial / Limited Trial, e) Refinement of Initial Products, f) Wider Field Testing, g) Improvement of Product Results of Wider Field Tests, h) Final Product Trials, i) Revision or Refinement of Final Products, j) Dissemination and Implementation. In this study, the steps used are only at the initial product refinement stage.

3. Discussion

The design of general Physics teaching materials for Biology is one alternative in integrated learning so that students will experience the concepts of Physics directly in Biology. This teaching material will also trigger a positive perception of Biology students towards Physics so that they do not feel that Physics courses are only prerequisite courses but are very useful for their knowledge. Also, it is hoped that a positive perception of Physics will also foster positive scientific attitudes in students. If students have positive perceptions of scientific attitudes, then automatically positive perceptions of STEM will also increase. This combination is the basis for implementing integrated learning that will bring Biology students to understand the importance of interdisciplinary learning to strengthen their understanding of Biology.

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