International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Growing Values and Attitudes of Conservation of Electric Energy through Physics Learning in Vocational Schools

Agus Kurniawan[1], Nuryani Rustaman[2], Ida Kaniawati[3], Lilik Hasanah[4]

[1, 2]Program Studi Pendidikan Ilmu Pengetahuan Alam, Sekolah Pascasarjana, Universitas Pendidikan Indonesia
Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

[3, 4]Departemen Pendidikan Fisika, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

Abstract: ***Values and attitudes are part of affective goals which include the desire to respond, beliefs to respond, acceptance of values, choices for a value, commitment, and conceptualization for a value. The purpose of this study was to determine the characteristics of Physics learning models that can facilitate the cognitive-affective and TEL integrated skills of vocational students. This research uses the method of observation and literature study. The results showed that the application of physics learning models based on STEM and Multiple Intelligences can facilitate the cognitive-affective and TEL integrated vocational students' TEL skills in the theme of electrical energy conservation.***

Keywords: Values and attitudes, conservation of electrical energy, learning physics, vocational school

1. Introduction

Energy limitation is one of the crucial issues that is currently emerging in almost all countries in the world. Even this crucial issue is one of the targets that is expected to be overcome and realised in 2030 in addition to other crucial issues related to poverty and climate change. These targets are listed in the 2030 Sustainable Development Goals (SDGs) agreed by world leaders [1]. Also, this crucial issue is a very serious concern for Indonesia, given data from the ASEAN Center for Energy (ACE) in 2013 stated that Indonesia is the country with the highest level of waste of electricity at this time [2]. Even though electricity supply in Indonesia is currently in a critical and alert condition because there are not many available reserves. As reported by the Technology Assessment and Application Board (BPPT) in 2014 by PT PLN (Persero), in the last five years the growth of power plant construction, at 6.5% per year, was unable to catch up to 8.5 electricity demand growth % per year [2].

In several other countries, efforts to save (efficiency) electricity which is one of the most inexpensive, fast and environmentally friendly ways to overcome the limitations of electrical energy compared to having to build a supply of electrical energy resources has entered the policy level such as reducing the use of electrical energy for purposes industry. This means that only 20% of industrial activity uses electricity, while the rest uses natural energy (solar thermal energy, gas energy, wind energy, tides, etc.). As for Indonesia, although it has not yet reached the regulation on the percentage of electricity used for industrial purposes, various efforts have been taken by the government to reduce a large number of electricity usage, through a 10% movement campaign. The movement aims to educate the public regarding the use of electricity during the day, turn off the lights when not in use, and even use energy saving lamps. However, the culture of people who still like to turn on the lights during the day or use electricity for things that are not important still occur. Based on the report on the implementation of exploratory research and the implementation of the campaign, the campaign activity of the 10% cut movement is considered to be less efficient and effective in increasing public awareness about saving electricity because the campaign on saving electricity is felt only as an insert, not as the main message to be conveyed [3]. Based on this, efforts to solve the problem need better. One of them is through structured, systematic and massive education in the school-age community that can provide a positive impact on the wider community.

Physics is one part of science held to develop thinking skills in solving problems related to surrounding events that occur in society, both qualitatively and quantitatively, and can develop skills and attitudes of confidence. This is in line with the objectives of physics at the secondary school level [4]. Besides, in the early 2013 curriculum and the revised 2013 curriculum in 2017, the subject of Physics is included in the group of specialisation subjects (C1) Basic Field of Expertise. That is, physics subjects in SMK should be able to be a bridge between knowledge and skills gained from other productive subjects with changes in the social environment and the development of science and technology.

From the description above it appears that the administration of physics at the secondary school level is intended as a vehicle or means to equip students to be able to master the knowledge, concepts, and principles of physics. In the process of learning, physics not only emphasizes cognitive mastery (content) but also should contain all four things, namely: content or products, processes or methods, attitudes, and technology so that students' understanding of physics is intact and can be useful to overcome problems that are confronted him [5]. This is in line with the statement that,

teaching physics is oriented only to mathematics, without connecting the concepts of physics with social contexts and containing social content is a mistake [6].

Judging from these objectives, physics is very good for students if it can be carried out as expected. But in reality, what happens on the ground is still not following the expected goals.

Based on the description above, the purpose of this study is to find out how the characteristics of the physics learning model in Vocational Schools can foster the values and attitudes of conserving electrical energy.

2. Method

The research method used in this research is observation and literature study.

3. Result and Discussion

Based on the results of a preliminary study in one private vocational school in the city of Bandung, it can be analysed that the learning process in the classroom is only oriented towards the cognitive abilities of students. Even if there is an orientation towards affective abilities or attitudes, it is still separate and very limited to certain scientific attitudes such as bold and honest, but even then it has nothing to do with the context of the teaching material being delivered. In fact, in the taxonomy of educational objectives (book two affective domain), Krathwohl explains three types of relationships between the cognitive domain and the affective domain in learning. One of them is cognitive objectives as means to affective goals, namely the learning process of cognitive domains that have affective domain goals. Based on that context the material presented is not contextual or not sought to be associated with important issues that exist in the daily environment. As stated by DeBoer, the purpose of understanding physics or science is not solely for the sake of learning, but to further activate and motivate citizens to contribute and be involved in society [7]. In addition, the learning process that does not place students as constructors of knowledge and is not contextual with issues in the surrounding community results in low student Technology and Engineering Litercy (TEL), which is an understanding or ability related to the use of technology and engineering in order to solve problems in daily life [8].

Finally, based on the results of the preliminary study, it can also be analysed that in the learning process the teacher is more dominant in accommodating students who have multiple intelligence that includes language and logical mathematics whereas based on the results of the pretest using a standardized test adapted from "The Rogers Indicator of Multiple Intelligences (RIMI) Test" shows that the compound intelligence profile of students in the class is quite diverse with the percentage of linguistic intelligence 25%, musical intelligence 8.33%, mathematical logical intelligence 36.11%, spatial intelligence 19.44%, kinesthetic intelligence 13.89%, intrapersonal intelligence 19.44%, interpersonal intelligence 16.67%, and naturalist intelligence 13.89% [9].

In connection with these problems, it is necessary to make efforts to improve or innovate the learning process so that students are more involved in learning and feel the various challenges they have to find solutions to the various problems they face in the surrounding environment. With the involvement of students in the learning process like that, it will be easier for them to find and understand the concepts learned, improve their TEL ability, and no less important to make them more sensitive and able to behave the best in a variety of problems in the surrounding environment they.

One alternative effort to answer these problems is through a learning process based on science, technology, engineering, and mathematic (STEM) that accommodates the multiple intelligence (MI) it has (Model PBSTEM-MI). STEM becomes an important issue in the current educational trend [10-11]. STEM has been applied in various countries such as America, the United Kingdom, and Japan. Bybee stated the purpose of STEM education, so that students have the literacy of science, technology, engineering, and mathematics visible from reading, writing, observing, and doing science so that if they later get involved in society, they will be able to develop the competencies they already have to be applied in dealing with problems in everyday life related to STEM science [12]. Presentation of content material in STEM is integrated into one with the field of mathematics used as tools to facilitate the fields of science, engineering and technology. STEM education can develop if it is associated with the environment so that learning that presents the real world (real life) experienced by students in their daily lives is realised [13].

Also, in the learning process, it is necessary to be able to understand students' abilities personally, acknowledge their existence with all their abilities, appreciate their talents and the results of their work. Several researchers [14-21] affirm that student success in class depends on the proper use of the various intelligence they have. Compound intelligence does not only cover language (linguistics) and mathematical logic but also includes kinesthetic, musical, visual-spatial, interpersonal, intrapersonal and naturalist aspects which are adapted to the characteristics of the concepts being studied. These types of intellectual intelligence are known as multiple intelligences which are introduced and developed by Howard Gardner [22].

Based on the STEM education framework and theory about MI, a PBSTEM-MI model was designed which consisted of a learning syllabus development plan, a lesson plan design plan, a student worksheet design (LKS), an engineering design process sheet (LPDE) design, a design tests to determine the intelligence profile of multiple intelligences, as well as the design of integrated cognitive-affective abilities and technology and engineering literacy (TEL). Following Figure 1 shows the PBSTEM-MI framework model.

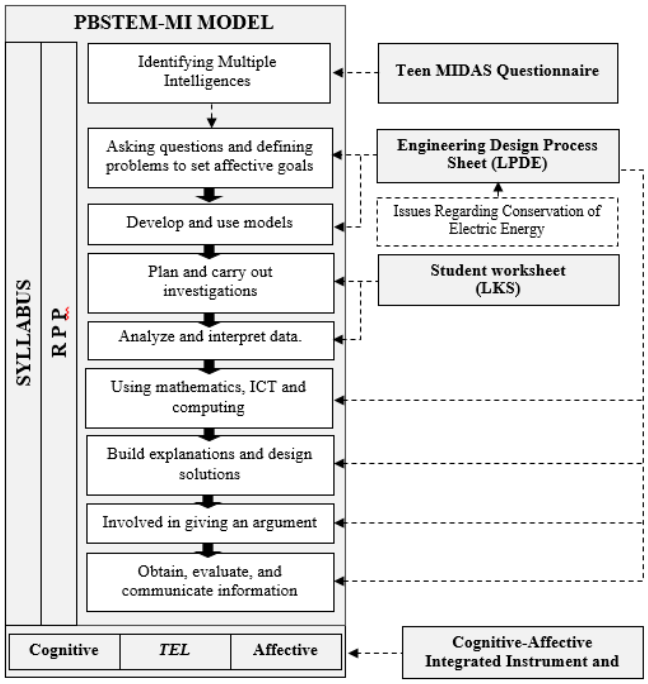

Figure 1: PBSTEM-MI Model Framework

Based on Figure 1 it can be observed that in addition to the cognitive domain (knowledge) and technology and engineering literacy (skills), the PBSTEM-MI model framework that is built has the ultimate goal in learning that is values and attitudes in the affective domain. So that at the stage of asking questions and defining problems, students are not only asked to understand the subject matter, but to be more meaningful students are required to set affective goals (values and attitudes that are solutions to existing problems). The cognitive domain used is based on Bloom's revised cognitive taxonomy Anderson and Krathwohl, while the technology and engineering literacy used is based on ideas developed by the National Assessment Governing Board. The affective objectives used in the PBSTEM-MI model framework use the theory proposed by Krathwohl in revising Bloom's taxonomy. However, the affective goals in the PBSTEM-MI model framework only take a range of affective goals that represent values and attitudes. Based on these affective objectives, the content of the teaching material is added and developed concerning the content value in KI-1 (Spiritual Attitude) and the attitude content in KI-2 (Social Attitude).

Table 1: Addition and Development of Content in Basic Competencies Regarding Direct Current Power

Grade	Curriculum 2013	Curriculum 2013 (2017 Revision)	Values / Attitudes / Learning Materials
KI-1: Spiritual Attitude			
X/XI	Live and practice the teachings of the religion they hold		Spender is a friend of Satan (Surah Al-Isra: 27)
KI-2: Social Attitudes			
X/XI	Living and practicing honest behavior, discipline, responsibility, caring (cooperation, cooperation, tolerance, peace), polite, responsive and proactive shows attitude as part of the solution to various problems in interacting effectively with the social and natural environment and in placing itself as a reflection of the nation in the world community		the problem of waste and limitations of electrical energy in Indonesia and the world
KI-3: Knowledge			
X	-	3.8 Understand the laws of electricity in direct current	- Ohm's Law - Electric conductor wire conductor - Series and parallel circuits - Kirchhoff's First Law - Electric power and energy
XI	3.5 Evaluate the working principle of direct electrical (DC) equipment in daily life	-	
KI-4: Skills			
X	-	4.8 Presenting the results of a trial of direct current electricity laws	- Ohm's Law - Electric conductor wire conductor - Series and parallel circuits - Kirchhoff's First Law - Electric power and energy
XI	4.5 Plan and carry out direct current (DC) electrical circuit experiments	-	

Table 2 shows the addition and development of content that is interrelated with the basic competencies regarding direct current electricity.

This is certainly in line with the vocational education revitalisation document (SMK) from the Ministry of Education and Culture (2016) which states that one of the characteristics of good vocational education is education oriented to education for sustainable development (Education for Sustainable Development abbreviated as ESD). In sustainable development education is interpreted as an effort to provide vocational students two types of skills, namely (1) knowledge, abilities, and values to respond to social, environmental and economic challenges of the 21st Century, and (2) skills to help care for and restore environmental quality and improve human welfare and social justice.

Based on the analysis of the vocational education revitalization document and in line with the physics learning objectives at the vocational level which are included in the structure of basic subject areas of expertise in Minister of Education and Culture Regulation number 130 of 2017, physics subjects should be able to take the role of a bridge connecting the vertices the knot of knowledge, skills, and attitudes towards problems in the real world through the PBSTEM-MI model.

4. Conclusion

Based on the analysis of the research data, it can be concluded that the application of the PBSTEM-MI model can foster the values and attitudes of electrical energy conservation of vocational students in Physics learning related to direct current electricity teaching material.

5. Acknowledgments

Thus the author can convey about the material that has been discussed in this article. Thank you to all those who have helped in the implementation of this research. One of them is to the LPDP who has deigned to finance an education program at Universitas Pendidikan Indonesia. Do not forget. The writer also realises that this research or article still has many shortcomings. Therefore, the authors expect a variety of suggestions and constructive criticism to correct the deficiencies found in this research or article. Finally, the authors hope that this article can be useful for all parties in developing a physics learning model that can foster the value and attitude of conserving electrical energy.

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Author Profile

Agus Kurniawan is an LPDP awardee who is pursuing a doctoral scholarship program at the natural sciences education at the University of Indonesia graduate school. The writer is also one of the lecturers at SMK Daarut Tauhiid Boarding School.