

# Building Students' Character using Light Concepts Culture-Based Analogy Delivered for Elementary School Science Class

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**Abstract**—Various concepts of light nature are delivered to elementary school students in science class ranging from light propagation, reflection, refraction and the dispersion of light. These all unique properties of light are interesting to be explained using analogy as they are closed to students' daily experience. In conjunction with a research having purpose of investigating culture-based elementary school students' analogical thinking skill, this study has been performed to explore some analogies derived from light concepts which are learned by the students in grade five and related to their cultural background. Two classes of elementary school students in a Pesisir area were involved in the study. The school was chosen based on some defined criterias which were related to students' and parents' origin, school history of establishment and school academic achievements. The methods of interview and literature study were implemented in order to gather the data of the analogies and the local culture of the research area. This paper presents the discussion on the findings and explores the benefits of the analogies in the field of education, particularly those which can accomodate to the process of building students' character. Based on the data analysis and discussion, it was concluded that the relation between concepts of light delivered in elementary school science class with children' cultural background allows the emergence of various interesting analogies. These culture-based analogies facilitate the teacher to obtain two different benefits in the learning process at the same time, those are interesting science teaching and students' character building.

**Keywords**—character, culture-based

## I. INTRODUCTION

Light is one topic provided in elementary school science class. It is available for grade five students. Based on the 2013 curriculum, it can be stated that after studying this material, students are expected to be able to achieve knowledge basic competence of applying the properties of light and its relation to the sense of sight [1,2] through intra-curricular, co-curricular and extra-curricular learning processes. Within this topic, students learn light properties, those are light does appear to propagate in straight lines, light can be dispersed, light can be reflected and light can be refracted [1].

Light instruction in elementary school has been of interest to several researchers in many points of view. One of the researches was focused on guided inquiry learning. It was reported that this kind of learning model gives positive effects on students' achievement and problem solving skill on the light properties material [3]. In addition, it was also stated that light instruction by using guided inquiry learning increased students' scientific skill [4]. In other research, it was found that problem based learning provides a better and more significant influence on elementary school students' science process skills in terms of observing, classifying, measuring/calculating, predicting, concluding and communicating, particularly on light concept [5]. Furthermore, effect of discovery learning implemented in the light lesson, on the increase of students' creative thinking was studied. It was obtained that this learning model is more effective than the conventional one [6].

Analogy has been used in science since thousands of years ago as it plays significant roles in this area for several functions; one of them is as a means of illustrating objects or events and teaching [7]. Several authors have been informed their research findings on the use of analogy for explaining science concepts, particularly the light properties, such as those which relates to the rebound and reflection [8], the elastic-electromagnetic wave analogy for reflection and refraction problems [9], and similarity between mechanical and optical phenomena, in the case of pendulum systems and laser pulse propagation [10]. In teaching field, one of the benefit of analogy is its service in classroom case [11]. In the field of primary school science learning, for example, the implementation of analogy has been discussed by many researchers. One of the findings in this field was the positive effect provided by the use of analogical reasoning in science teaching to students' concept

construction [12]. In other topic of research, it was stated that eliciting ideas about energy can be forced through the use of student-generated analogies [13].

Culture is considered to be an important aspect in constructing an analogy. Aubusson, Harrison and Ritchie [14] stated that "...different cultures prefer different types of metaphor and analogy". Dealing with this interesting idea, the unique nature of culture surrounding students' dwelling place can be expected to give significance influence to the preference of the analogy created either by the students or the teacher. Although from the teacher side, as stated by Wilbers & Duit in 2006, the analogy used is commonly based on the structure of teaching material [14], students' daily life experiences was suggested to be considered in providing effective teaching to achieve students' understanding of light concepts [15]. Meanwhile, the notion of relationship between science and students' character has also been examined. Science, as a knowledge, accommodates students to know how the universe works, while students' character in a form of moral and ethics, needs to be used when students apply the knowledge [16]. This means that in order to allow the teacher to acquire both expected students' outcomes of learning material and good character, there is a need of proper choice of culture-based analogy to be delivered in science class. What are some culture-based analogies which can be used to facilitate the science teacher to deliver learning material and build students' character? This paper discusses findings on the study of the culture-based analogy of light learning material, focusing on three main topics of light concepts delivered for grade five elementary school student. The study has been carried out as the part of a research on culture-based analogical thinking skill of elementary school students in *Pesisir* area.

## II. METHODOLOGY

This qualitative research highlighted kinds of culture-based analogy of light concepts consisting of light propagation and reflection. The methods of interview and literature study were implemented in order to gather the data of the analogies and the local culture of the research area. Two classes of elementary school students in a particular *Pesisir* area: Slawi, were involved in the study. Besides that, parents, school committee, teachers and community surrounding the school were also interviewed. Additionally, the school was chosen based on some defined criterias which were related to students' and parents' origin, school history of establishment and school academic achievements.

## III. RESULT AND DISCUSSION

### A. Research Subject Description

The school participated in the research is located at Balapulang district, southern part of Slawi, the administrative center of Tegal Regency, a particular *Pesisir* area in Central Java province. The majority of parents of the students in this school work as merchant and labor. Most of the parents with the labor profession leave their family to work at some urban centers, such as Jakarta and Bandung, and back to see their children for a couple of months. The children, then, commonly stay at home with their mother only or even with their grandparents. After

school, some students in this area have common children activities, such as playing with friends: football and other games, helping to do housework, and studying the Qur'an at the mosque. The students use javanese language at home and their surrounding places for daily routine. During the school time, it is common for the students to have communication with friends, teachers and other school officers using local language, beside the Bahasa Indonesia implemented as formal language. Students also show their freedom and straightforward in communicating opinion and answering question, even with person they just met. The above cultural background shows some unique characteristics owned by *Pesisir* area people: brave, straightforward and dare to face challenges [17].

### B. Light properties and their culture-based analogy

#### 1. Light propagates in straight lines

In elementary school, light is delivered with one of the topics is the properties of light. Under this topic, there are at least three major properties learned by the students: light propagates in straight lines, light passes through a transparent object and reflection. The first concept of light property learning material of light propagation involves the ability of light to travel through a medium if it does not encounter any obstacle. Furthermore, when light passes through a uniform medium, it will propagate in a straight line in a fixed direction. A phenomenon commonly used to give example of these concepts is the beam of light entering inside the dark room through a tiny hole at the wall.

In delivering this property of light, one of demonstrations can be implemented is by using a flashlight and three pieces of paper (or cards) with a hole located at the intersection of two lines connecting opposite corners of each paper. The paper is arranged so that light can be seen through all the holes when the flashlight is turned on. The fact that the light propagates in straight lines can be proven by displacing the middle paper slightly allowing an observer for inability to see the light. The paper displaced from the first position becomes an obstacle for the light to travel which enable it to be seen by an observer.

An interesting structural analogy can be derived from the concepts of light propagation. For this case, the target of light is represented by an analog of the learning process possessed by the students. In addition, the other target of the obstacle is given by students' activities disturbing achievement of their learning goals. Furthermore, light propagation in the straight line is denoted by the smoothness process of the study. From these three, a general statement of the analogy of light travels in a straight line concepts is given by learning process experienced by students will run smoothly if the students do not meet any barrier on their taken path. The educational benefit can be taken from this analogy is to motivate the students to study smart. This analogy implies that in order to study on the right track, students have to pass through the ways with no obstacle, meaning that students have to be able to avoid as many study's obstacles disturbing their study as possible in order to achieve better learning outcomes. Such obstacles of taking too much time for playing useless games and other activities which do not support their study should be kept away from their daily schedule.

## 2. Light passes through a transparent object

An ability of light to pass through a transparent material is the second light property delivered in a science lesson. In general, an object is said to be transparent if most of incoming light passes through when it strikes the object. It happens due to different frequency between the object and the light allowing the light wave to pass through. This kind of object follows the general rule for electromagnetic waves, that is

$$r + t = 1$$

where

$r$  is reflection

$t$  is transmission

$$t \gg r.$$

Several examples of a transparent object are a piece of transparent plastic, a clear glass and so forth.

An analogy which can be used to explain this light characteristic is an information received by an honest person. In this analogy, the target and analog structural similarities being explored are those between the light-transparent object and the information-honest person. As honesty means telling the truth, so someone who said, to be honest, is he/she who tells all information received. Using this analogy, it can be stated that that there will be no information that was not conveyed by the honest person.

## 3. Reflection

The third property of light learnt by the students is a light reflection. Light reflection occurs whenever light traveling in a particular medium encounters other different medium with different optical properties [18]. As stated before, when entering the different medium, part of the light will be reflected and the other will be transmitted. The existence of reflection is represented by propagation direction changes of the part of the incident light following the law of reflection. Reflection takes place in a very tight medium causing it impenetrable to light since its gaps size is much smaller than the wavelength of the light. Because of that, there is a different direction of reflected light between objects having a glossy or smooth surface and the rough one. On the smooth-surfaced objects, the reflected light direction will be same – it is commonly called with specular reflection, while on the rough one there will be various – namely diffuse reflection.

An analogy portraying the concepts of reflection phenomenon can be developed by using students' daily experience. For this case, a serious problem faced by students in their study is used as the analog for the target concept of the tight medium, while the reflected light is equated to reverse a direction of the path of study. General statement of this analogy can be given as students who face serious problems in their study process can have the possibility of having a reverse direction of a track being taken. Same with the light propagation analogy, this reflection analogy can be utilized to motivate students who experience hard study adversity. The analogy brings the value that students do not have to give up to face various difficulties in their study since there are still some solution alternatives can be done. In the case of confronting a problem which can still be handled, the students still have a means of solving it. Inversely, in the case of problem that

cannot be solved, the students can take other different reverse ways to achieve the goals of study.

## 4. Building students' character through light concept culture-based analogy

Considering the importance of character in learning material application in daily life, several efforts to form and build students' character need to be carried out. As the character is significantly influenced by social and physical environments factors [19], one of the ways that can be used in forming and building it is by managing both factors through education.

The school is considered to be one party which can influence students to be educated [20][21]. In this place, students can be expected to have character building through the use of many ways of teaching, including those in science class which utilizes the culture-based analogy with the topic of light properties. Various light concepts culture-based analogies can be delivered during science lesson to help a teacher to gain both learning goal aspects: knowledge and attitude for the students. The analogy of light propagation and light reflection, for example, can be used to motivate the students for always happy and brave in facing problems of study. Students who have a relatively unfavorable home environment and other life experiences, such as far from parent causing them for having less attention of education supports, can be encouraged to find a suitable solution of the problems faced. In addition, as honesty is one of the core ethical values [22], the analogy of light passes through a transparent object can be utilized to advise the students to be honest in every moment. By being honest, the students can take several benefits, those are To be brave and happy in experiencing any challenge and to be honest in every situation will lead the students to have a better character in daily life, particularly in science class activities.

## IV. CONCLUSION

Analogy, science learning, and culture are three different terms that take into account students' character building. Dealing with research aiming at investigating culture-based elementary school students' analogical thinking skill, an exploration of some analogies derived from learning material delivered for the grade five of elementary students and related to Pesisir cultural background has been done. Several light properties concepts and student' cultural background data accommodate the creation of the analogy. Based on the result of data analysis and review of the literature, it can be concluded that there are various culture-based analogies of light properties learning material which can be implemented in science class to help the teacher to have an interesting science teaching and build students' character.

## REFERENCES

- [1] S. W. Tumurun, D. Gusrayani, and A. K. Jayadinata, "Pengaruh Model Pembelajaran Discovery Learning terhadap Keterampilan Berpikir Kreatif Siswa pada Materi Sifat-Sifat Cahaya", *Jurnal Pena Ilmiah*, 1(1), 101–110, 2016.
- [2] M. Koszowski, "Multiple functions of analogical reasoning in science and everyday life", *Polish Sociological Review*, 197(1), 3–19, 2017.
- [3] R. Smith, "Optical reflection and mechanical rebound: The shift from analogy to axiomatization in the seventeenth century". Part 1. *British Journal for the History of Science*, 41(1), 1–18, 2008.

- [4] J. M. Carcione and E. A. Robinson, "On the Acoustic-Electromagnetic Analogy for the Reflection-Refraction Problem", *Studia Geophysica et Geodaetica*, 46, 321–346, 2002.
- [5] A. Bakhtadze, "A Mechanical Analogy to Optical Phenomenon for General Physics Courses". *Journal of Technical Science and Technologies*, 1(2), 29–33, 2012.
- [6] R. Duit, "On the role of analogies and metaphors in learning science", *Science Education*, 75(6), 649–672, 1991.
- [7] M. Chuang and H. She, "Fostering 5<sup>th</sup> Grade Students' Understanding of Science via Saliency Analogical Reasoning in On-line and Classroom Learning Environments", *Educational Technology & Society*, 16(3), 102–118, 2013.
- [8] R. A. Lancor, "The Many Metaphors of Energy: Using Analogies as a Formative Assessment Tool", *Journal of College Science Teaching*, 42(3), 38–45, 2013.
- [9] P. J. Aubusson, A. G. Harrison and S. M. Ritchie, "Metaphor and Analogy: Serious Thought in Science Education" in *Metaphor and Analogy in Science Education Science & Technology Education Library* vol 30, Springer, 2006, pp 1-10.
- [10] Ç. Sahin, H. Ipek, and A. Ayas, "Students' understanding of light concepts primary school: A cross-age study", *Asia-Pacific Forum on Science Learning and Teaching*, 9(1), 1–19, 2008.
- [11] J. D. Williams, *How Science Works Teaching and Learning in the Science Classroom*. London: Continuum International Publishing Group, 2011.
- [12] M. Thohir, "Karakteristik Masyarakat Jawa Pesisir" Makalah Seminar "Karakter dan Perilaku Budaya Masyarakat Jawa Pesisir Lor" on 18 July 2017 in Faculty of Language and Arts Universitas Negeri Semarang
- [13] R. A. Serway and J. W. Jewett *Physics for Scientists and Engineers* 6th edition Thomson Brooks/Cole 2004
- [14] P. D. Hutcheon, *Building Character and Culture*. London: Praeger, 1999.
- [15] K. H. Dewantara, *Pendidikan*. Yogyakarta: Majelis Luhur Persatuan Taman Siswa, 1977.
- [16] J. L. Eipstein, "School and Family Connections", *Marriage & Family Review*, 15, 1-2, 99-126, 2010.
- [17] T. T. Koellhoffer, *Character Education: Being Fair and Honest*. New York: Chelsea House, 2009.