Magnétisme concepts analogy for Pesisir (coastal) students education

L Handayani¹,², A Yulianto³, S Haryono³, S E Nugroho¹,², T R Rohidi¹,⁴ and Wiyanto¹,²

¹Program Pascasarjana, Universitas Negeri Semarang
²Physics Dept., Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia
³Sendratasik Dept., Faculty of Languages and Arts, Universitas Negeri Semarang, Indonesia
⁴Fine Arts Dept., Faculty of Languages and Arts, Universitas Negeri Semarang, Indonesia

*Corresponding author: langlangharyono@gmail.com

Abstract. The unique of magnet behaviour has been explored by many parties and attracted them to describe its characteristics using analogy. The use of magnetism concepts analogy are varies including those in the field of education. As a part of a research aiming to investigate culture-based elementary school students’ analogical thinking skill, a study on magnetism concepts analogy has been carried out. By using interview, documentary study and literature review methods, several analogies of magnetism concepts were generated with the basis of various sources of students’ cultural background and learning materials. This paper discusses the analogies, particularly those which can be delivered in elementary school science class, and their implication for education of Pesisir (costal) students. Based on the review and discussion, it was concluded that the analogies of magnetism concepts facilitate people with high educational values which can be put into practice in science learning for Pesisir area students.

1. Introduction
Magnetism is a topic included in the list of learning materials taught in elementary school science class. This topic discusses magnetism concepts, such as kinds of magnet poles, magnetic materials and magnetic force exerted by two magnets brought near each other. As some abstract concepts involved in this topic, it is necessary to use the right way to explain them for students. Using analogy is one of the ways that can serve teacher to deliver such difficult abstract materials [1,2].

Thinking analogically refers to term used for representing a process of finding and mapping structural similarities [3] between analog or base and target object [4]. In science learning, students can use the analog of daily experiences having structural similarities to the target of the learnt science concepts [5]. For this case, students, initially, observe the analogins their life which has similar structural knowledge to the concept target. This will then followed by finding out the similarities between the analog-target, and finally, the target will be learnt based on the determined similarities [6,7].

One of the several benefits of the analogy is to provide motivation to students [8, 9]. Motivation can be done by using the analogy which takes into account the students’ cultural background involved in daily experiences [10]. In addition, an analogy utilizing something that brings value to the students and used to describe the subject matter will have an impact to the students as listeners [11,12]. Based
on the above reasons, the use of culture-based magnetism concept analogy in science learning is considered to be important to motivate students.

As a part of a research on the students’ culture-based analogical thinking skill of elementary school students live in *Pesisir* (coastal) area, a study to explore the analogy of science materials delivered in science class has been performed. In this research, the lesson materials related to magnetics topic has been investigated. This paper discusses findings of several analogies generated with the basis of magnetics concepts and students’ cultural background which in turns can be used to motivate students living in *Pesisir* area.

2. **Methods**
The capital city of *Tegal* regency, namely *Slawi*, was chosen as the research area. Two different elementary schools in this famous region of *Pesisir* area with seventy five students involved in the study. The schools were selected based on specific criteria of having students with parents who born and live in surrounding school. These schools implemented different curriculum for their academic activities: the *KTSP* (*Kurikulum Tingkat Satuan Pendidikan*) and the 2013 curriculum. The literature review aiming to gather the data related to the culture of research area in general and material concepts delivered in the class was implemented in this qualitative research as well as the documentary study. In addition, the interview with students, parents and teachers was carried out to derive the students’ cultural background in more detail. The data of the magnetic concepts and the students’ cultural background were, then, analyzed using the descriptive method to generate the culture-based magnetic concepts analogy which can in turn be utilized in science lesson.

3. **Results and Discussions**

3.1 **Results**

3.1.1 **Magnetism concepts of learning material**
The result of data analysis regarding with topic contents as well as the concepts representation of magnetism learning materials is shown in Table 1.

| No | Learning Material Contents | Concepts |
|----|-----------------------------|----------|
| 1  | Kinds of magnetic poles     | Every magnet has pair poles: north (N) and south (S) |
| 2  | Magnetic Forces             | When two magnets are brought near one another there will be repulsive or attractive force occurs. The repulsive force takes place when like poles are brought closer, while the attractive one is exerted by the unlike poles |
| 3  | Kinds of materials          | • There are two big groups of materials, namely magnetic and non-ferromagnetic materials  
• (Ferro)magnetic materials are those which are easy to be magnetized: can be made into strong magnet |
| 4  | Magnetization               | • Magnetization can be performed by giving an external magnetic field on magnetic materials, e.g. stroking the material with a strong magnet’s pole and placing the material near an electric current  
• The moment of dipoles in magnetic materials remain in parallel position even though the external magnetic field is removed  
• When the external magnetic field is removed, the moment of dipoles of non-magnetic materials can have non-cooperative behaviour or a partial slightly alignment |
| 5  | Demagnetization             | • Process to remove or reduce magnetism of a magnet can be done by heating, striking or dropping the magnet |
3.1.2 Research area description and its culture

The school locations are positioned at Slawi, a town located in southern part of Tegal. As a part of Pesisir community, students in this research area have some specific cultural backgrounds as shown in Table 2.

| No | Culture elements       | Students’ cultural background descriptions                                                                 |
|----|------------------------|------------------------------------------------------------------------------------------------------------|
| 1  | Language               | Bahasa Indonesia and mother tongue for school time                                                         |
| 2  | Knowledge system       | Having some understanding of surrounding nature and some flora and fauna knowledge                        |
| 3  | Life tools & technology system | Having some understanding of some housewares, transportation, and communication tools                  |
| 4  | Livelihood system      | Most parents’ occupations are labour and merchant                                                          |
|    |                        | Most parents have educational background of primary school                                                 |
|    |                        | Idea of taking job after graduating from senior high school                                               |
| 5  | Religion               | Having religion class (madrasah) after school time                                                          |
| 6  | Arts                   | Having local content learning of traditional dance                                                          |
|    |                        | *Dangdut* is the most preferred music                                                                     |

3.1.3 Magnetism concepts culture-based analogy

Based on the concepts delivered for students in elementary science class and students’ cultural background, some magnetism concepts culture-based analogies have been generated in this research. The following table examines the analogies.

| No | Concepts                                                                 | Magnetic concepts culture-based analogy                                                                 |
|----|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| 1  | Every magnet has pair poles: north (N) and south (S)                     | Most living things are created in pairs, e.g. human and animal                                         |
|    | When two magnets are brought near one another there will be repulsive or attractive force occurs. The repulsive force takes place when like poles are brought closer, while the attractive one is exerted by the unlike poles | A man loves a woman.                                                                                 |
|    |                                                                          | Cockfighting event.                                                                                    |
|    |                                                                          | Female dove do mate with male dove                                                                     |
| 3  | There are two big groups of materials, namely magnetic and non-magnetic materials | There are kinds of student’s response in accepting external influence: good students’ response and the bad one. |
|    | Ferromagnetic materials are those which are easy to be magnetized: can be made into strong magnet    | Students with good response will keep their understanding longer than the bad one even without teacher with them anymore. |
|    | Paramagnetic materials are those which can be magnetized with moderate response to the external magnetic field effect | Students who have a moderate response will easily lose their understanding. When the teacher is at his side, he understands, but when the teacher is not with him, then he forgets his understanding. |
|    | Diamagnetic materials are those which cannot be magnetized because they have opposite magnetic response | Students who cannot be taught or be directed to receive lessons because they have an attitude that is always against (stubborn, disobedient). |
| 4  | Magnetization can be performed by giving | Someone can change his/her way of |
an external magnetic field on magnetic materials, e.g. stroking the material with a strong magnet’s pole and placing the material near an electric current thinking/idea/personality due to his/her surrounding environment. The greater the environmental effect, the greater the change.

5 Process to remove or reduce magnetism of a magnet can be done by heating and striking (using strong magnet with alternating direction) Disrupting students’ circumstances can be done to get rid of students' knowledge Erratic command will confuse students and make them lose their temper

3.2 Discussion

The main topic studied in this research was magnetism. In the KTSP (Kurikulum Tingkat Satuan Pendidikan) this topic was set to be delivered for grade five students in second semester[13,14], while in the 2013 curriculum, it is given for sixth grade students [15]. However, the contents of the learning material are same, those are related to magnetic properties consisting of pair magnetic poles of a natural or artificial magnet, magnetic forces between two different magnets and magnetic and non-magnetic materials [13,14].

This research deals with the use of culture as the reference for generating magnetism concepts analogy. The research area is located in Slawi, a small town having a geographical characteristic of a highland area and positioned about 14 km, southern part of Tegal city. Based on the observation data and literature review, it can be stated that students involved in the research belong to group of Pesisir community which tend to be spontaneous and straightforward in dealing with problems, have egalitarian believe [16] and use foul language in their daily communication [17].

Several culture-based analogies of magnetism concepts were generated with the basis of the learning materials delivered in science class and the students’ cultural background. Most living things are created in pairs, e.g. human and animal is analogous to the poles pair. Every magnet has pair poles: north and south [18]. The analog of human different gender, i.e man and woman is used to represent the target concept of pair poles owned by a magnet. In addition, rooster and hen can also be given as the analog of north and south poles. These analogs of different gender for either human or animal are chosen since students are familiar with this terms which the real object can easily be found around homes and school yard. Such kind of analogy drawn by utilizing the resources known by the students support elementary schools science learning[19].

The next analogy is the one for like poles repel and unlike poles attract concept. Repulsive or attractive force will occur when two magnets are brought near one another. The repulsive force takes place when like poles are brought closer, while the attractive one is exerted by the unlike poles [18]. There are three analogies were generated: a man loves a woman, cockfighting, and female dove do mate with the male one. Man - woman and female – male doves are structural analogs for unlike poles target, while cockfighting represents occurrence of repulsive force between like poles when they are brought closer. Surrounding environment events commonly experienced by the students are also used in this analogy. The knowledge of fauna in surrounding area, in this case is the cock behavior, support students to get better understanding of target concept, since the analog and target can be mapped to their experiences [10].

In relation to target of kinds of magnetic materials, three groups of students’ response analog facilitate the creation of the analogy. Since there are three kinds of material related to their magnetic characteristic: ferromagnetic, paramagnetic and diamagnetic materials, structural analogies in conjunction with students’ responses of good, moderate and bad (no) response to environmental influence are applicable. The ferromagnetic materials are those which are easy to be magnetized: can be made into strong magnet, because the moment of dipoles remain in parallel position even though the external magnetic field is removed. This concept is analogous to students with good response who are easy to understand and will keep their understanding longer than the bad one even without teacher with them anymore. In case of paramagnetic material which can be magnetized with moderate response to the external magnetic field effect by having a partial slightly alignment of the moment of
dipoles, the analog of students who have a moderate response will easily lose their understanding is used. For this students’ group, it can be explained that when the teacher is at his side, he understands, but when the teacher is not with him, then he forgets his understanding. Furthermore, students who cannot be taught or be directed to receive lessons because they have an attitude that is always against (stubborn, disobedient) is applied to give analogy of diamagnetic material which cannot be magnetized because of its opposite magnetic response and having non-cooperative behavior. The above analogies utilize structural analog of students to represent materials, kinds of response to depict direction of the moment of dipoles, students’ environment, e.g. instruction and education to portray the external magnetic field and learning outcomes to delineate magnetization result.

The next concept given to students is magnetization process. Magnetization can be performed by giving an external magnetic field on magnetic materials, e.g. stroking the material with a strong magnet’s pole and placing the material near an electric current. The analogy was created based on an idea that someone’s surrounding environment can change his/her personality. The greater the environmental effect, the greater the change. In this analogy, there are three structural analogs, those are personality representing magnetic properties, someone’s change describing the change to bea magnet of the material and surrounding environment is analogous to magnetic field.

Finally, the concept of demagnetization in which magnetism of a magnet can be removed or reduced by heating and striking (using strong magnet with alternating direction) the material is analogous to process of disrupting students’ circumstances to get rid of students' knowledge. Besides that, it can also be used as an analogy for losing students’ temper and confusing students by giving erratic command.

3.3 Implication for Pesisir student’s education
All of the above generated analogies are sourced from research area culture, particularly the one that has been experienced by the students. As stated in the results, most of the parents, especially fathers, have primary school educational background and occupation of merchant and labor which require them to spend more time in the workplace than at home. This condition leads the children to become accustomed to face problems of having little paternal involvement in their daily activities, which according to Sarkadi, et.al. [20] will have a negative effect on child development related to affective, cognitive, psychomotor and social aspects.

In order to motivate the students to be able to change their live better in the future, the created analogies can be used by science teacher. For this purpose, for example, the teacher can use the analogy of magnetization process. The idea behind the concept of the process of becoming a strong magnet by stroking the material with a strong magnet’s pole can facilitate the teacher to always encourage the students to study hard even with the absence of their parents to enable them to reach higher education level and get better future work. This is in line with statement that positive relationship between teacher and students will support students’ academical and emotional achievement [21]. In addition, the other idea of placing the material near an electric current in the magnetization process can also be implemented to give the students such learning condition in which the students can have various activities supporting them to achieve better future education result, for example, the use of both mother tongue and Bahasa Indonesia during class time and all school activities. The use of mother tongue will facilitate the teacher in explaining learning materials [22] and the students to understand the concepts better [23]. Besides that, games [24], magic tricks and drama can also support students’ participation in learning [25]. Furthermore, the analogy value of the process to remove or reduce magnetism of a magnet by heating and striking (using strong magnet with alternating direction) can be taken by always giving the students consistent and continuous directions to make them able to have long lasting the knowledge and educational values understanding. Besides the two examples above, the use of analogy of kinds of magnetic materials with their characteristic can also support the teacher to understand more the students’ competence diversity in the science class. As various students’ response might happen in comprehending delivered material, the teacher should have strategy for creating a comfortable classroom atmosphere can be accepted by all students [26]. The
occurrence of cooperative tutorial study groups is one of the effort to reach a such of the classroom environment [27]. In addition, the use of various instruction will also support creation of pleasant class [28].

4. Conclusion
Results of data analysis and discussion show that the unique nature of magnetic materials possesses close similarity with children daily life characteristics in Pesisir area. Based on the results, it can be concluded that several magnetism concepts delivered in elementary school science class and students’ cultural background accommodate the creation of some interesting analogies. These generated magnetism concept culture-based analogies contain high educational values which can be implemented in primary education, especially in the lesson of science for Pesisir area students.

Acknowledgments
Authors wish to acknowledge grant support from the Ministry of Research, Technology and Higher Education. Authors would also like to thank all students, teachers and staffs involved in the research for all help and assistance in providing valuable information and lovely environment. Our special thanks goes to Drs. Hadi Susanto, M.Si. and Dr. Mahardika Prasetya Aji for their shared worthwhile knowledge.

References
[1] Chuang M and She H 2013 Educ. Technol. Soc.16102
[2] Fraser A 2005 Teach. Sci. 51 16
[3] Itkonen E 2005 Analogy as Structure and Process (Amsterdam/Philadelphia: John Benjamins Publishing Company)
[4] Aubusson P J, Harrison A G, & Ritchie S M 2006 Metaphor and Analogy Serious Thought in Science Education Metaphor and Analogy in Science Education (Science & Technology Education Library vol 30) eds P J Aubusson, A G Harrison and S M (The Netherlands: Springer) 3
[5] Lawson A W 1995 Science Teaching and the Development of Thinking (Belmont, California: Wadsworth Publishing Company)
[6] Blanchette I and Dunbar K 2000 Mem. Cogn. 28 108
[7] Guerin F, Ferreira P A and Indurkhya B 2014 Modeling Changing Perspectives — Reconceptualizing Sensorimotor Experiences Papers from the 2014 AAAI Fall Symposium 14
[8] Duit R 1991 Sci. Educ. 75 649
[9] ConradC, Bliemel M and Ali-Hassan H 2019 J. Inf. Syst. Educ. 30 57
[10] Harrison A G 2006 Metaphor and Analogy in Science Education (Science & Technology Education Library vol 30) eds P J Aubusson, A G Harrison and S M (The Netherlands: Springer) 52
[11] Koszowski M 2017 Pol. Sociol. Rev. I 3
[12] Case, B A 2000 Multicult. Educ. 7 41
[13] Azmiyawati C, Omegawati W H and Kusumawati R 2008 IPA Salingtemas 5 untuk SD/MI Kelas 5 Ariyanti K & Rufaida A D (eds) (Jakarta: Pusat Perbukuan, Departemen Pendidikan Nasional) 88
[14] Winarti W, Winarto J and Sunarno W 2009 Ilmu Pengetahuan Alam 5: untuk Sekolah Dasar/MI Kelas 5 (Jakarta: Pusat Perbukuan, Departemen Pendidikan Nasional) 66
[15] Kementrian Pendidikan dan Kebudayaan 2017 Model Silabus Sekolah Dasar/Madrasah Ibtidaiyah (SD/MI Tematik Terpadu) (Jakarta: Kementerian Pendidikan dan Kebudayaan) 228
[16] Thohir M 2017 Makalah Seminar “Karacter dan Perilaku Budaya Masyarakat Jawa Pesisir Lor” on 18 July 2017 in Faculty of Languages and Arts Universitas Negeri Semarang
[17] Triyanto 2018 Belajar Dari Kearifan Lokal SENI PESISIRAN (Semarang: Cipta Prima Nusantara) 7
[18] Serway R A and Jewett J W 2004 Physics for Scientists and Engineers 6th edition Thomson Brooks/Cole 895
[19] Yanowitz K L 2001 Sch. Sci. Math. 101 133
[20] SarkadiA, KristianssonR, Oberklaid F and BrembergS 2008 Acta Paediatrica 97 153
[21] Mendenhall M, Bartlett L and Ghaffar-KucherA 2017 Urban Rev 49 1
[22] Ahmed F, AminR U, NawazM and JavedA 2018 TRAMES 22 299
[23] MoralesM P E 2015 Cult Stud Sci Educ 10 951
[24] ChenC, Wang K and LinY 2015 Educ. Technol. Soc. 18 237
[25] HilasC S and Politis A 2014 SpringerPlus 3362
[26] Cherif A H, Roze M and GialamasS 2016 Int. Sch. J. XXXV 57
[27] Alt D 2017 Learn Environ Res 20 99
[28] Raza K 2018 J. Ethn. Cult. Stud. 5 16