



EFFECTIVENESS OF DEVELOPMENT LEARNING MEDIA USING ELECTROCARDIOGRAMS (ECG) IN ELECTRICITY AND MAGNETIC LECTURES

Fasih Bintang Ilhami^{1,2}, Mohammad Budiyanto¹

¹Department of Natural Science, Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya, Surabaya 60231, Indonesia

²Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taipei 10607, Taiwan

Abstract

Learning creative media can expedite and increase the efficiency of learning to lead to goals of learning that can be achieved owing to delivering easy message technology for learning purposes. This study aims to find out the effective development of learning media using electrocardiograms (ECG) in electricity and magnetic lectures. The population of this study was used students in electricity and magnetic lectures with a total of students 20 and samples were by purposive sampling technique. Data collection techniques used were questionnaires with pre-test and post-test and conducted by statistical analysis Paired t-test. The average score of students before being taught using learning media using ECG is 6.65 and significantly increases to 8.40 after being given a learning media using ECG. The effectiveness analysis of learning media using ECG by Paired t-test showed there is a significant difference between before and after being taught using learning media compared to before learning creative lectures with results $\alpha=0.000 < 0.05$. Therefore, the development of learning creative media using ECG in electricity and magnetic lectures increasing of student knowledge which is fundamental considering utilize of ECG for possibly early detection of heart problems

Keywords: Learning media, electrocardiograms (ECG), electricity and magnetic lectures

© 2022 Universitas Negeri Surabaya

²Correspondence Address:

Department of Natural Science, Faculty of Mathematics and
Natural Science, Universitas Negeri Surabaya
Jl. Ketintang Gedung C12 Surabaya 60231
E-mail: fasihilhmi@unesa.ac.id

p-ISSN: 2527-7537
e-ISSN: 2549-2209

INTRODUCTION

In the extracellular spaces of animals, and humans, constant (direct current; DC) electrical impulses have been known for more 2nd a century. Most excitable cells experience cellular re-/depolarization as a result of sodium ion migration, which can occur through a number of processes including opening of voltage-gated sodium channels (Alessi, Raspanti, & Magistretti, 2016), stimulation of Na⁺-dependent amino acid co-transport mechanisms can function like sodium ionophores, and reduction of the Na⁺/K⁺-ATPase activity and provides electrical impulses in cellular environment (Lucena, Garçon, Fontes, McNamara, & Leone; Oluah et al., 2020). The opening inner in mitochondrial membrane permeability transition pores might be due to mitochondrial re-/depolarization, leading to disrupting the membrane potential by allowing ion redistribution across a membrane (Klumpp et al.). Many biologists are unaware of the roles these electrical impulses play in development, physiology, regeneration, and disease (Hussain et al., 2019; McCaig, Rajnicek, Song, & Zhao, 2005).

Furthermore, the majority of electrical signals in the heart are caused by leakage between different cell types or layers of cells, such as an ion-transporting epithelium by spatial changes in the way that ion pumps operate. The electrical stimulation of the heart is coordinated by the cardiac conduction system. The sinoatrial (SA) node is the starting point for electrical impulse generation, which sequentially propagates to activate atrioventricular (AV) node, his and purkinje systems, and ventricles (Hulsmans et al., 2017). Clinically, AV block prevents or delays atrial impulse conduction to the ventricles that if untreated would lead to hemodynamic deterioration, syncope, and death (Vogler, Breithardt, & Eckardt, 2012).

An electrocardiogram (ECG) is a diagnostic technique used to assess the electrical signals that regulate different cardiac functions. An ECG taken while the heart is at rest just records the heart's activity at that specific moment and does not take into consideration any potential anomalies (Oresko et al., 2010). The ECG systems relied on wet electrodes that were adhered to the patient of skin using electrolyte gel. However, application of ECG is not commonly known by public, especially in Indonesia.

Learning creative media can expedite and increase the efficiency of learning so that the goals of learning can be achieved owing to delivering easy message technology that can be used for learning purposes (Sefton-Green & Soep, 2007). In addition, creative media has various advantages including helping lectures convey their teaching

material, a communication tool that bridges abstract ideas and the real activity. Nowadays, there are several kinds of learning creative media for study, one of the media that has many advantages over other media is direct demo learning media due to provides any information in the form of writing, audio, and images can be shown simultaneously (Budiyanto, Yasin, & Suharningsih, 2018). Herein, we reported effectiveness of development learning media using electrocardiograms (ECG) in electricity and magnetic lectures. The results were obtained that the level of knowledge of students has increased after being given attractive and interesting methods owing to learning media using ECG, leading to easier for brain to understand the usefulness of ECG in the early detection of abnormalities in the human heart. Therefore, the introduction of ECG to public straightforwardly especially in lectures is fundamental considering that ECG can possibly early-detection of heart problems in Indonesia.

METHODS

This research was conducted in electricity and magnetic lectures semester of the 2021/2022 academic year. The research procedure begins with the validation of ECG learning media on three validators and is supported by experimental test data from learning media using ECG. The purpose of this study is to understand difference in knowledge of students about electricity on heart by ECG after being taught learning creative compared to before learning creative lectures. The population of this study is all students of a total of 20 students with the sampling technique *Purposive Sampling* by giving some questions for pre-test and post-test. The result of this research was conducted by statistical analysis using *Paired t-test* (SPSS).

RESULT AND DISCUSSION

First, we prepared instruments for this study. The instrument (pre and post-test questionnaire with open and closed questions) is given to students who have been selected as a sample. After collecting data from students, results are tested by the normality test. The results obtained by Kolmogorov-Smirnov showed $\alpha=0.063$ (pre-test) and $\alpha=0.057$ (post-test) > 0.05 respectively, indicating that data in this study are normally distributed. In addition, the data was homogeneity conducted by Leaven's test with the value $0.31 > \alpha=0.05$. To further evaluate whether there is an increasing of knowledge student between before and after being given a learning creative on electricity on heart by ECG were examined by statistical analysis. As shown in **Table 1**, the average score of students before being taught learning media using ECG is 6.65. These results

illustrating that not all students know about the existence of electrical energy in our own bodies. However, the average value has increased to 8.40

after being given a learning creative media on electricity on the heart by ECG.

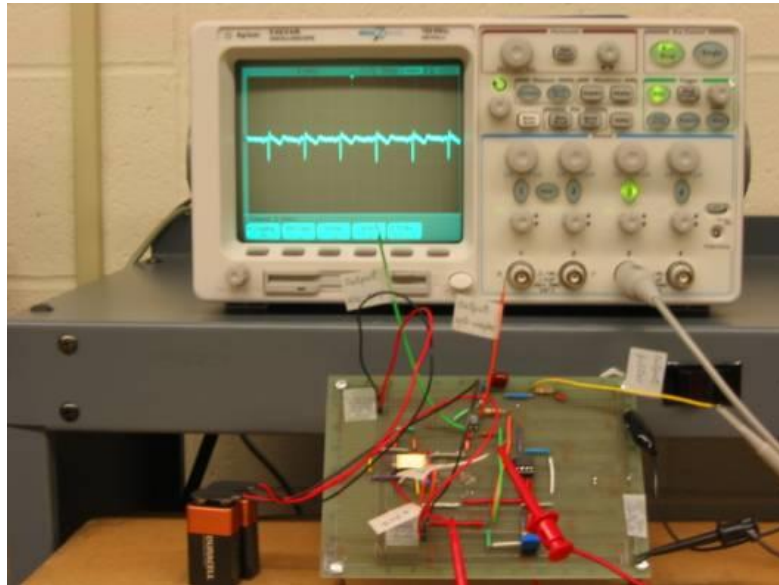


Figure 1. Learning creative media through ECG

Table 1. Mean, median, and standard deviation values of knowledge student between before and after being given a learning creative media using ECG

Groups	Mean	Median	Std. Deviation
Pre-test	6.65	7.00	1.22
Post-test	8.40	8.00	1.42

Furthermore, we analyzed the characteristic respondent of student. As illustrated on **Figure 1**, the majority respondents are female with percentage 90%. This is very influential on student understanding on study of ECG for possible early-detection of heart

problems, which is in line with several studies that explain female gender will tend easier to understand and listen to learning, as well as depend on learning method. These results suggest that male students are more inclined to method convergent learning, while student girls

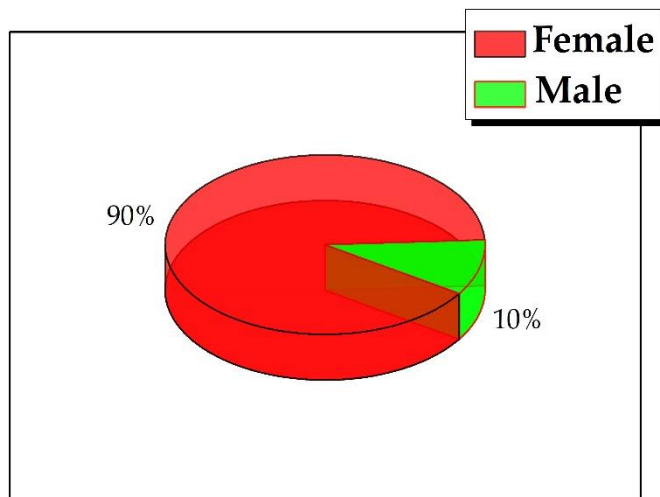


Figure 2. Characteristics of students in learning creative media through ECG

are more inclined to learning method divergent (Al BuAli, Balaha, & Al Muhaidab, 2013). Moreover, only 30% of students succeed as participate in lectures owing to they have a learning method that is suitable to the teaching method applied by the lecturer in class.

The remaining 70% of students experience difficulties as participate in class because they have other learning method, which are not suitable with the teaching style applied in class (Pratiwi, 2014).

Table 2. Paired *t*-test of student knowledge before and after being given a learning creative media by ECG

Groups	Mean	Std. Deviaion	Sig
Pre-test – Post-test	6.65	1.446	0.000

Next, we investigated the effectiveness of development learning media using electrocardiograms (ECG) in electricity and magnetic lectures. There is a difference in knowledge of students about electricity on heart by ECG after being taught learning creative compared to before learning creative lectures with value $\alpha=0.000 < 0.05$ (Table 2). These results suggest that learning media using ECG carried out by involving or providing examples which close to the actual situation will be more easily understood for students due to the ability of the left brain which has a large role in the critical thinking process of students, leading to they can more easily understand, analyze, summarize, and conclude a lecture process. These results in line with research conducted by (Widiyatmoko & Pamelasari, 2012) that types of learning materials require deeply analysis would be more effectively used emphasizes more on stimulating left brain activity. In addition, most of the respondents who were female had an influence on the results of this study, such as the research conducted by (Goldman, 2017) mentioned female brain are designed to better in learning such as memorizing and analyzing things. More thoroughly in conducting test and always thinking carefully which is more accurately compared to male.

CONCLUSION AND SUGGESTION

Conclusion

This research presents of level knowledge of student development learning media using electrocardiograms (ECG) in electricity and magnetic lectures conducted by pre-test and post-test method. As the results were provided significantly increase after being taught using an attractive and interesting learning media using a direct demo of ECG indicates easier for the brain to understand and analyze the benefits of an ECG in early detection of abnormalities in the human heart. In addition, characteristics of response clearly show that females more easily understand for

conclude a lecture on ECG compared to males due to female brain is designed to better in learning such as memorizing and analyzing things and more thoroughly in conducting test and always thinking carefully. Therefore, the introduction of ECG to lectures through learning creativity may contribute to the development increasing of student knowledge which is fundamental considering that ECG can possibly early-detection of heart problems.

Suggestion

Learning attractive and interesting would greatly assist the teaching process especially in learning that involves explaining real activity and all things related to living, including electricity in our body and ECG.

REFERENCES

- Al BuAli, W. H., Balaha, M. H., & Al Muhaidab, N. S. J. A. I. M. (2013). Assessment of learning style in a sample of Saudi medical students. *21(2)*, 83.
- Alessi, C., Raspanti, A., & Magistretti, J. (2016). Two distinct types of depolarizing afterpotentials are differentially expressed in stellate and pyramidal-like neurons of entorhinal-cortex layer II. *Hippocampus*, *26(3)*, 380-404. doi:https://doi.org/10.1002/hipo.22529
- Bernardi, P. (1996). The permeability transition pore. Control points of a cyclosporin A-sensitive mitochondrial channel involved in cell death. *Biochimica et Biophysica Acta (BBA) - Bioenergetics*, *1275(1)*, 5-9. doi:https://doi.org/10.1016/0005-2728(96)00041-2
- Borgens, R. B., Vanable, J. W., Jr., & Jaffe, L. F. (1979). Bioelectricity and Regeneration. *BioScience*, *29(8)*, 468-474. doi:10.2307/1307539
- Budiyanto, M., Yasin, M., & Suhariningsih, S. J. J. P. P. I. (2018). Pengembangan Media Pembelajaran Optik Menggunakan Sensor

- Serat Optik Bundle Untuk Menentukan Konsentrasi Kolesterol. *3*(1), 39-44.
- Geck, P., Pietrzyk, C., Burckhardt, B. C., Pfeifferl, B., & Heinz, E. (1980). Electrically silent cotransport of Na⁺, K⁺ and Cl⁻ in ehrlich cells. *Biochimica et Biophysica Acta (BBA) - Biomembranes*, *600*(2), 432-447. doi:[https://doi.org/10.1016/0005-2736\(80\)90446-0](https://doi.org/10.1016/0005-2736(80)90446-0)
- Goldman, B. J. e.-J. o. S. M. (2017). The cognitive differences between men and women.
- Hulsmans, M., Clauss, S., Xiao, L., Aguirre, A. D., King, K. R., Hanley, A., Nahrendorf, M. (2017). Macrophages Facilitate Electrical Conduction in the Heart. *Cell*, *169*(3), 510-522.e520. doi:10.1016/j.cell.2017.03.050
- Hussain, G., Wang, J., Rasul, A., Anwar, H., Imran, A., Qasim, M., . . . Sun, T. (2019). Role of cholesterol and sphingolipids in brain development and neurological diseases. *Lipids in Health and Disease*, *18*(1), 26. doi:10.1186/s12944-019-0965-z
- Jones, G. S., VanDyke, K., & Castranova, V. (1981). Transmembrane potential changes associated with superoxide release from human granulocytes. *Journal of Cellular Physiology*, *106*(1), 75-83. doi:<https://doi.org/10.1002/jcp.1041060109>
- Klumpp, D., Frank, S. C., Klumpp, L., Sezgin, E. C., Eckert, M., Edalat, L., . . . Huber, S. M. TRPM8 is required for survival and radioresistance of glioblastoma cells. (1949-2553 (Electronic)).
- Lucena, M. N., Garçon, D. P., Fontes, C. F., McNamara, J. C., & Leone, F. A. Polyamines regulate phosphorylation-dephosphorylation kinetics in a crustacean gill (Na(+), K(+))-ATPase. (1573-4919 (Electronic)).
- McCaig, C. D., Rajnicek, A. M., Song, B., & Zhao, M. (2005). Controlling Cell Behavior Electrically: Current Views and Future Potential. *Physiological Reviews*, *85*(3), 943-978. doi:10.1152/physrev.00020.2004
- Oluah, N. S., Mgbenka, B. O., Nwani, C. D., Aguzie, I. O., Ngene, I. C., & Oluah, C. (2020). Tissue-specific changes in Ca²⁺-ATPase and Na⁺/K⁺-ATPase activities in freshwater African catfish *Clarias gariepinus* juvenile exposed to oxadiazon. *The Journal of Basic and Applied Zoology*, *81*(1), 51. doi:10.1186/s41936-020-00186-8
- Oresko, J. J., Jin, Z., Cheng, J., Huang, S., Sun, Y., Duschl, H., & Cheng, A. C. (2010). A Wearable Smartphone-Based Platform for Real-Time Cardiovascular Disease Detection Via Electrocardiogram Processing. *IEEE Transactions on Information Technology in Biomedicine*, *14*(3), 734-740. doi:10.1109/TITB.2010.2047865
- Pratiwi, D. J. J. F. (2014). Gaya belajar dominan pada siswa berprestasi dalam kegiatan siswa yang memiliki gaya belajar di SD Negeri 2 Gombong tahun ajaran 2013/2014. *7*(3), 1-20.
- Sefton-Green, J., & Soep, E. (2007). Creative Media Cultures: Making and Learning Beyond the School. In L. Bresler (Ed.), *International Handbook of Research in Arts Education* (pp. 835-856). Dordrecht: Springer Netherlands.
- Vogler, J., Breithardt, G., & Eckardt, L. (2012). Bradyarrhythmias and Conduction Blocks. *Revista Española de Cardiología (English Edition)*, *65*(7), 656-667. doi:<https://doi.org/10.1016/j.rec.2012.01.027>
- Widiyatmoko, A., & Pamelasari, S. J. J. P. I. I. (2012). Pembelajaran berbasis proyek untuk mengembangkan alat peraga IPA dengan memanfaatkan bahan bekas pakai. *1*(1).