JPII 9 (2) (2020) 287-293

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

IMPLEMENTATION OF DISCOVERY LEARNING MODEL BASED ON CALOR CHARACTERISTIC BRICKS MIXED BY (*DURIO ZIBETHINUS*) AND COCONUT (*COCOS NUCIFERA*) SKIN TO IMPROVE STUDENTS' COGNITIVE LEARNING OUTCOMES

A. Mayub[*1], E. Suryani[2], M. Farid[3]

[1]Graduate School of Science Education, University of Bengkulu, Indonesia
[2]SMP N 15 Kota Bengkulu, Indonesia
[3]Physics Study Program, FMIPA Univesitas Bengkulu,Indonesia

DOI: 10.15294/jpii.v9i2.23803

Accepted: March 19th 2020. Approved: June 25th 2020. Published: June 30th 2020

ABSTRACT

This study aims to determine the cognitive learning outcomes of students through learning the Discovery Learning model that uses practicum material bricks mixed by durian and coconut skin. The briquettes were implemented as practicum materials on temperature and heat learning in the Discovery Learning model to improve learning outcomes of KIR students in SMP N 15 Kota Bengkulu. Bomb Calorimeter in Chemical Laboratory Basic Science UNIB was used to determine the calorific value of briquette variations in the mixture of durian and coconut shell skin. The characteristics of briquette were carried out in the Science Laboratory. The instrument used in learning implementation was a multiple-choice test form that has been validated. Result of learning implementation showed that students' cognitive learning outcomes increased after Discovery Learning model was implemented. The N-gain value was 0.78 in the high group, 0.57 in the medium group, and 0.53 in the low group.

Keywords: calorific value; characteristics of briquettes; discovery learning

INTRODUCTION

Durian is a tropical plant from Southeast Asia that has a taste many people like (Wahidin Nuriana et al., 2013; Hasbullah et al., 2018). Indonesian people, especially in Bengkulu, only consume durian meat but its skin becomes a waste that gives a problem in the environment. Durian skin waste can be used as an alternative energy source by making briquettes. Durian skin briquette calorific value is 3,786.95 cal/gram (Hatta, 2007). Durian skin calorific value is still below the SNI standard of 5,000 cal/gram, but can be increased if it mixed with high biomass calorific values. Biomass with a high calorific value is usually used as a mixing base in the manufacture of briquettes (Nurhilal & Suryaningsih, 2018). Biomass used as a briquette mixer in this study used coconut shell.

Briquettes mixture of durian skin and coconut shell were technologies for developing alternative fuels. Briquettes can be used by the community as an alternative fuel and wood for cooking, and as a science learning medium, be a source of fuel in practicum. So that learning science in schools can utilize natural materials around that are not utilized, then learning science Discovery Learning model that utilizes a briquette mixture of durian skin waste and coconut shell as a means of holding practical science

The research aimed to describe the cognitive learning outcomes of students after using briquettes on temperature and heat learning using the Discovery Learning model in SMP N 15 Kota Bengkulu.

***Correspondence Address**
E-mail: afrizalmayub@unib.ac.id

METHODS

This research is scientific research and educational research. The scientific research was direct experimental research that aimed to describe briquettes calorific value that mixed with durian skin and coconut shell. After scientific research, then continued with educational research. Briquettes were used as practicum materials in temperature and heat learning to improve student learning outcomes.

The study located in Science Laboratory SMPN 15 Bengkulu and determination of variations briquette calorific value that mixture of durian skin and coconut shell was carried out in Chemistry Basic Science Laboratory, University of Bengkulu did from December to March 2019.

The raw materials used in making briquettes consist of durian skin charcoal, coconut shell charcoal and tapioca flour solution. Research equipment were drums, briquettes, filters, digital scales, rock collisions and earthen stoves.

Research Steps

Durian skin and coconut shell waste were dried under the sun. After drying, the durian skin and coconut shell will be charcoal. Durian skin and coconut shell will be burned down separately using a clean drum, then the drum was closed for one night until the material becomes charcoal.

After becoming charcoal, the ingredients were mashed by using rock collisions and sifted with sieves to get the same size. Furthermore, the mixture of durian skin and coconut shell become charcoal with a composition of 20%: 80%; 50%: 50% and 80%: 20%. The next process was mixing with the adhesive material of tapioca flour solution then ready to mould. Briquettes were dried under the sun for four days. From the mixing variations, the calorific value and the characteristics of the briquette were tested, including the lost water content, briquette density, burning speed. Briquettes calorific value was determined by Bomb Calorimeter at the Chemistry Basic Science Laboratory University of Bengkulu. The Bomb Calorimeter can be seen as in Figure 1.

Figure 1. Bomb Calorimeter

Water Content Lost

The water content lost is the percentage of the difference in mass of the briquette before it is heated (m_1) with the mass of the briquette after burning (m_2) to the mass of the briquette before it is heated (m_1) According to Yuliah et al. (2017), the lost water content can be calculated using the equation:

$$content\ of\ water\ lost_{=}\frac{m_1-m_2}{m_1}x100\% \quad (3.1)$$

Density (ρ)

The density is the mass of briquettes after being heated (m) to the briquette volume (V). The density is calculated using the equation:

$$\rho = \frac{m}{V} \quad (3.2)$$

(Yuliah et al., 2017)

Used of Briquettes (Fcd)

Is the amount of biobriquette used during cooking water to boil until 100%, calculated by subtracting the initial biobriquets that are burned (F_{ci}) with the weight of the remaining biobriquette (F_{cf}) (Fajari, 2012)

$$F_{cd} = F_{ci} - F_{cf} \quad (3.3)$$

Cooking Time (Td)

The amount of time to heat the water starts when laying the pan until the boiling water is perfect in 100°C (Fajari, 2012).

Biobriquette Burning Speed (Rcb)

Many biobriquets used (Rcb) when boiling water (td) with units of g / minute (Fajari, 2012).

$$R\ cb = \frac{Fcd}{td} \quad (3.4)$$

Total of Briquette Calorific Used (Q_{total})

Total of briquettes calorific was determined by multiplying the total briquettes used with the calorific value contained in the briquettes.

Implementation in Educational Research

The mixed briquettes of durian skin and coconut shell were used as material for temperature and calorific material practicum. Educational research design using one group design in a homogeneous class. The research design is presented in Table 1.

Table 1. Research Design

Pretest	Implementation	Posttest
O_1	X	O_2

Notes:
X: Learning with Discovery Learning models
O1: Pretest
O2: Posttest

The research subjects used KIR 7th Class students in SMP Negeri 15 Kota Bengkulu as much as 25 students, which were divided into three groups, namely the high group, the medium group and the low group.

Data collection

To find out the cognitive learning outcomes of students obtained by using the questions given to the sample. This study uses 16 actual items with a minimum-maximum total score range of 0 to 100.

Data analysis

Cognitive learning outcomes of students are said to increase when the results of the posttest (X_2) students are higher than the results of the pretest (X_1) or ($X_2 > X_1$) and the number of students who are worth ≥70 ≥80%. The level of students' cognitive learning outcomes was presented below

$$N_{gain} = \frac{(X_2 - X_1)}{(X_3 - X_1)}$$

The G_{ain} Index Criteria is presented in Table 2.

Table 2. G_{ain} Index Criteria

Quality	N_{gain}	Category
Greatly increased	≥ 0,70	High
Increased	0,30 - 0,70	medium
Quite increased	0,30	Low

Whereas to determine the level of students' cognitive learning outcomes the *N-gain* formula is used which is the comparison between the difference between posttest and pretest.

RESULT AND DISCUSSION

Durian skin and coconut shell briquettes in this study consisted of three types: K1, K2 and K3, with different composition comparisons. K1 briquettes consist of 20% durian skin charcoal and 80% coconut shell. K1 briquettes have a dry mass after an average drying of 31.67 grams, a briquette height of 2.1 cm and a briquette diameter of 5 cm. K2 briquettes consist of 50% durian skin charcoal and 50% coconut shell. K2 briquettes have a dry mass after an average drying of 29.67 grams, a briquette height of 2.43 cm and a briquette diameter of 5 cm. K3 briquettes consist of 80% durian skin charcoal and 20% coconut shell. K3 briquettes have a dry mass after an average drying of 26.67 grams, a briquette height of 3.13 cm and a briquette diameter of 5 cm. The calorific value and characteristics of mixed briquettes of durian and coconut shell skin can be seen in Table 3.

Table 3. Characteristics and Calorific Value of Briquettes in Various Compositions

Briquettes Composition	K1	K2	K3
Briquette calorific value (cal/gram)	7.306,81	6.847,31	6.284,99
Lost Water Content (%)	20,80	25,80	33,30
Briquette Density (Kg/m3)	0,77	0,62	0,43
Briquettes Used (gram)	152,00	155,33	173,67
Time to boil water (minutes)	13,37	12,5	12,02
Briquette burning speed (g/minute)	11,38	12,45	14,46
The total heat of briquettes used (Kcal)	1.110,63	1.063,60	1.091,50

Notes:
Briquette composition
K1 = 20% durian skin charcoal, 80% coconut shell charcoal
K2 = 50% durian skin charcoal, 50% coconut shell charcoal

Based on Table 3, the lowest calorific value obtained as 6,284.99 kal / gram, found in mixed briquettes of 80% durian skin charcoal, 20% coconut shell charcoal and the highest calorific value was found in mixed briquettes of 20% durian skin charcoal, 80% coconut shell charcoal. The calorific value of this briquette showed that the more content of the coconut shell, the calorific value will be higher. The reason was that the coconut shell has more calorific value than durian skin. The calorific value of durian skin in this study increased after being mixed with coconut shell. It was because of coconut shell had a carbon binder for durian skin charcoal. The calorific value of briquettes charcoal would be high if

the value of carbon content bound to briquettes were high (Triono, 2006). The calorific value that produced by three charcoal briquettes with a mixture of durian skin and coconut shell in this study has fulfilled the National Briquette Standard, in a minimum of 5,000 cal/gram (Nurhilal & Suryaningsih, 2017).

Table 2 shows that the water content lost during the smallest briquette drying process was found in the composition as 20% durian skin charcoal, 80% coconut shell charcoal as 20.8% and the highest composition as 80% durian leather charcoal, 20% coconut shell charcoal as 33.3%. The data showed that water content would be higher if the amount of durian skin charcoal increase, and the coconut shell charcoal decrease. The water content will increase because durian skin charcoal particles were hygroscopic towards water and air. Water content closely related to the density of briquettes charcoal. If the density increase, the hygroscopic characteristic of briquettes charcoal will decrease so that the absorption of water will getting smaller. If the density is higher so that the cavities between charcoal particles will be tighter because the particles' density is tighter so that there is no blemish or space (Bahri, 2007).

Smallest briquette density was found in the composition of 80% durian skin charcoal, 20% coconut shell charcoal as much as 0.43 gr / cm3 and the highest density was in the composition of 20% durian skin charcoal, 80% coconut shell charcoal as much as 0.77 gr/cm^3 (Table 2). The difference in the types of raw materials was very influential on the density value of charcoal briquettes produced (Hendra & Darmawan, 2000). High density of raw materials produces a high density of charcoal briquettes, while the low density of raw materials produces a low density of charcoal briquettes. Density affects the calorific value; if the density value was higher so that the calorific value will also be higher (Patandung et al., 2017). Table 2 shows that, the smallest briquette value used for boiling water as much as 152 grams was in the composition of 20% durian skin charcoal and 80% coconut shell. The highest one is in the composition of 80% durian skin charcoal and 20% coconut shell charcoal as much as 173.67 grams. If the calorific value was higher so that the heat produced will also be higher, and time for combusting will be longer (Fajari, 2012). Accordance with this study, that if briquette calorific was higher so that the burning speed value will be slower and the used of briquettes will be less.

Furthermore, in table 2 is found that briquettes with the composition of 80% durian skin charcoal and 20% coconut shell charcoal had the fastest time as much as 12.02 minutes and maximum boiling time as much as 13.37 minutes in briquettes composition of 20% durian leather charcoal and 80% shell charcoal coconut. Burning speed of briquettes was briquettes' amount that burns in the unity of time. If the value was high, so that the briquettes would be burned faster and more flammable. The composition of 80% durian skin charcoal briquettes and 20% coconut shell charcoal has fastest burning speed as much as 14.46 gram/minute and the lower one as much as 11.38 grams/minute in the composition of 20% durian skin charcoal and 80% coconut shell charcoal. From the briquette calorific value, it can be seen that if the calorific value was higher so that the burning speed will be slower. Burning speed was influenced by material structure, bound carbon content and material hardness (Patandung et al., 2017). The burning rate of briquettes affects the burning time of fuel briquettes. If burning speed value is higher so that the briquettes will burn out faster, and if burning speed value is lower, so that the briquettes will burn out slower.

The total calorific value that lowest used was in the composition of 50% durian skin charcoal and 50% coconut shell as much as 1,063.6 Kcal. The highest one as much as 1,110.63 Kcal in the composition of 20% durian skin charcoal and 80% coconut shell charcoal. The highest calorific value makes burning more efficient so that the number of briquettes used and the amount of heat produced were more efficient (Patandung et al., 2017).

Implementation in Education

The implementation of this research was held in SMP N 15 Kota Bengkulu in the 2018/2019 academic year. This study aims to determine the improvement of student learning outcomes using the Discovery Learning model on the subject of temperature and heat. The Discovery Learning model consists of 6 stages: (1) Stimulation (2) Problem Statements (3) Data Collection (4) Data Processing, (5) Verification, and (6) Generalization. Before learning was started, students were given pretest. To find out an increase in cognitive learning outcomes, then students were taught using Discovery Learning model. After the learning process, students were given a posttest.

Pretest aimed to find out the students' new understanding of the Temperature and heat's subject material before learning. Posttest aimed to find out the final understanding of students about the subject after learning by Discovery Learning model. Pretest and posttest questions were the same questions as much as 16 items. The results of the pretest and posttest can be seen in Figure 2 below.

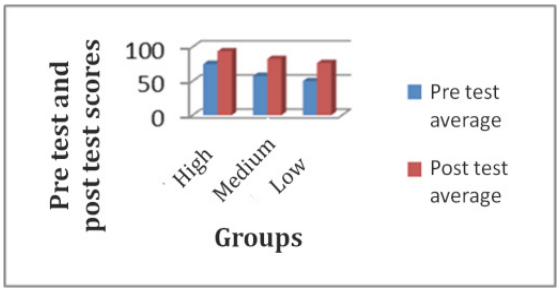

Figure 2. Pretest and Posttest Value Charts

From Figure 2, it can be seen that the average value of the pretest and posttest of each group has increased. The high group have an increase average value as much as 18.75, 25 for the medium group, and the low group have an increase average value as much as 26.56.

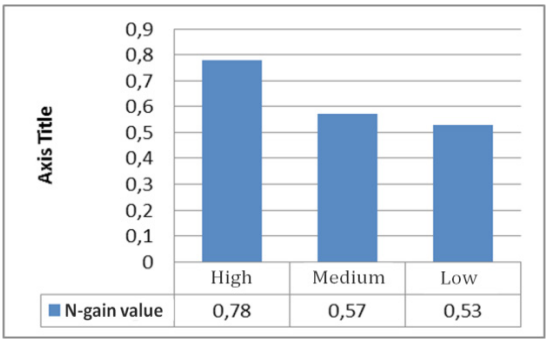

Figure 3. N-Gain Value Grafic

Figure 3 can be seen that the application of the Discovery Learning model based on calorific characteristics research of mixed briquettes of durian skin and coconut shell can improve students' cognitive learning outcomes. It was indicated by the high group that having higher N-gain values than the other groups, which had 0.78 in the high category. The medium group has as much as 0.57 N-gain value in the medium category. The low group has the lowest N-gain value as much as 0.53 in the medium category. It means that there was an increase of learning outcomes in the high group that have more increase than the medium and low group; this results were under the results of research by Sudiro et al. (2018).

Similar research showed that Discovery Learning Model could improve student learning outcomes on cognitive aspects. Students who were taught using discovery learning is better than students who were taught using conventional learning. Teachers who are implementing discovery learning can create high-quality learning (Raharjo & Kisworo, 2019). The significant improvements indicated that discovery-based speaking assessments were practical to improve the students' speaking skill, critical thinking, and creativity (Wahyudi et al., 2019). The critical thinking ability of students applying discovery learning model is better than students' critical thinking ability with conventional learning (Martaida et al., 2017). It can be seen from the percentage of completeness in each cycle. Students who were declared complete in the first cycle based on the results of the test there were seven students (26.92%), the second cycle became 17 students (65.38%) and the third cycle 23 students (88.46%) (Rosarina et al., 2016).

The results of the study by Salmi (2019) indicated that using the discovery learning model of students' learning completeness before and after the actions consists of cycle I (60.00%), and cycle II (90.00%). The results of student learning with Discovery Learning model is higher than direct instruction learning, with the acquisition t-test is t count 3,291 > t table 1,99, with details of the average value of the experimental class 80,176 and the average value of the control class 76,083 (Mubarok & Sulistyo, 2014). Based on the results of the study concluded that the application of discovery learning model increases the activity, scientific attitude and student cognitive learning outcomes (Malinda et al., 2017). There is a positive and significant linear influence between the mathematical representation of skills and the learning outcomes of science, through a problem-based learning model of discovery (Ertikanto et al., 2018). So it is concluded that there is an influence of using discovery learning model with LKS based on discovery learning outcomes, science process skills, and students' learning interest (Novita et al., 2017). Based on the results of the research, it can be concluded that the application of problem-based learning model can boost the activity and student learning outcomes and problem-solving skills (Baksir et al., 2017)

Based on the data, it was also found that students' skills in problem-solving, critical thinking, and finding knowledge can be improved through research-based learning (Srikoon, 2014; Alshehry, 2014). Increasing physics concepts and

generic abilities of students can be done effectively through research-based learning (Usmeldi, 2016a). Students' physics and process skills can be improved through research-based learning (Usmeldi, 2016b). When it is with a scientific approach, it can improve students' scientific literacy effectively (Usmeldi et al., 2017). Student curiosity about the subject matter can be improved through research-based learning (Liu & Li, 2011; Walkington, 2011). Cognitive skills, critical thinking skills, scientific work skills, and students' scientific attitudes can be improved through research methods in research-based learning (Cahyani, 2014; Sulistijo, 2017; Hairida, 2016). According to Trisnasih (2013), activities, skills and knowledge of students in science lessons could be improved through research-based learning.

CONCLUSION

Based on the research, the calorific value of the mixture durian briquettes was 20% and 80% coconut shell as much as 7306.81 cal/gram; durian briquette mixture value of 50% durian skin and 50% coconut shell as much as 6487.31 cal/gram, the mixture of durian skin briquettes 80% and 20% coconut shell as much as 6284.99 cal/gram. The implementation in learning showed that there was an increase in cognitive learning outcomes students in the high, medium and low groups after learning by Discovery Learning model. The N-gain value for the high group was 0.78 in the high category, the medium group was 0.57 in the medium category, and the low group was 0.53 in the medium category.

REFERENCES

Alshehry, Amel Thafer. "Teaching research writing to female undergraduates in Saudi Arabia." *International Journal of Education Learning and Development* 2.4 (2014): 15-25.

Bahri, S. (2007). *Pemanfaatan limbah industri pengolahan kayu untuk pembuatan briket arang dalam mengurangi pencemaran lingkungan di Nanggroe Aceh Darussalam* (Master thesis).

Baksir, E. L., Mayub, A., & Putri, D. H. (2017). Peningkatan aktivitas dan hasil belajar siswa serta kemampuan pemecahan masalah melalui model problem based learning pada konsep cahaya di kelas VIII. E SMPN 6 Kota Bengkulu. *Jurnal Ilmu dan Pembelajaran Fisika*, *1*(1).

Cahyani, R., Rustaman, N. Y., Arifin, M., & Hendriani, Y. (2014). Kemampuan kognisi, kerja ilmiah dan sikap mahasiswa non IPA melalui pembelajaran inkuiri berbantuan multimedia. *Jurnal Pendidikan IPA Indonesia*, *3*(1).

Ertikanto, C., Rosidin, U., Distrik, I. W., Yuberti, Y., & Rahayu, T. (2018). Comparison of Mathematical Representation Skill and Science Learning Result in Classes with Problem-Based and Discovery Learning Model. *Jurnal Pendidikan IPA Indonesia*, *7*(1), 106-113.

Fajari, I., Aceng, R., Budianto, G., & Lutfi, F. (2012). *Karakteristik pembakaran briket arang campuran sekam padi dan serbuk kayu serta implementasinya sebagai model pembelajaran dengan lks kimia berbasis keterampilan proses di sma negeri 3 lubuklinggau* (Doctoral dissertation, Fakultas Keguruan Dan Ilmu Pendidikan UNIB).

Hairida, H. (2016). The effectiveness using inquiry-based natural science module with authentic assessment to improve the critical thinking and inquiry skills of junior high school students. *Jurnal Pendidikan IPA Indonesia*, *5*(2), 209-215.

Hasbullah, H., Iskandar, T., & Yuniningsih, S. (2018). Identifikasi Nilai Kalor Pada Brieket Biochar Berbahan Baku Kulit Durian. *eUREKA: Jurnal Penelitian Teknik Sipil dan Teknik Kimia*, *2*(1), 1-8.

Hatta, V. (2007). Manfaat kulit durian selezat buahnya. *Jurnal. UNLAM*.

Hendra, D., & Darmawan, S. (2000). Pembuatan briket arang dari serbuk gergajian kayu dengan penambahan tempurung kelapa. *Jurnal Penelitian Hasil Hutan*, *18*(1), 1-9.

Liu, X., & Li, Q. (2011). Combination of the Research-Based Learning Method with the Modern Physics Experiment Course Teaching. *International Education Studies*, *4*(1), 101-104.

Malinda, S., Rohadi, N., & Medriati, R. (2017). Penerapan Model Discovery Learning untuk Meningkatkan Sikap Ilmiah dan Hasil Belajar Kognitif Siswa Pada Konsep Usaha dan Energi di Kelas X MIPA. 3 SMAN 10 Bengkulu. *Jurnal Ilmu dan Pembelajaran Fisika*, *1*(1).

Martaida, T., Bukit, N., & Ginting, E. M. (2017). The effect of discovery learning model on student's critical thinking and cognitive ability in junior high school. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, *7*(6), 1-8.

Mubarok, C., & Sulistyo, E. (2014). Penerapan model pembelajaran discovery learning terhadap hasil belajar siswa kelas x tav pada standar kompetensi melakukan instalasi sound system di smk negeri 2 surabaya. *Jurnal Pendidikan Teknik Elektro*, *3*(2).

Novita, I., Mayub, A., & Swistoro, E. (2017). Pengaruh model discovery learning dengan lks berbasis penemuan terhadap hasil belajar, keterampilan proses sains, serta minat belajar pada konsep getaran dan gelombang di smpn 1 kota bengkulu. *Jurnal Ilmu dan Pembelajaran Fisika*, *1*(1).

Nurhilal, O., & Suryaningsih, S. (2017). Karakterisasi biobriket campuran serbuk kayu dan tempurung kelapa. *Jurnal Material dan Energi Indonesia*, *7*(02), 13-16.

Nurhilal, O., & Suryaningsih, S. (2018). Pengaruh Komposisi Campuran Sabut dan Tempurung Kelapa terhadap Nilai Kalor Biobriket dengan Perekat Molase. *JIIF (Jurnal Ilmu dan Inovasi Fisika)*, *2*(1), 8-14.

Patandung, P. (2017). Karakteristik Penyalaan Briket Limbah Serbuk Arang Tempurung Kelapa dengan Bahan Pemantik Abu Kelapa (Cocodust). *Jurnal Riset Teknologi Industri*, *11*, 50-58.

Raharjo, T.J., & Kisworo, B. Harianingsih. 2019. The implementation effect of discovery learning model for non-formal education student. *International Journal of Academic Research in Business and Social Sciences*, *9*(9), 297-306.

Rosarina, G., Sudin, A., & Sujana, A. (2016). Penerapan model discovery learning untuk meningkatkan hasil belajar siswa pada materi perubahan wujud benda. *Jurnal Pena Ilmiah*, *1*(1).

Salmi, S. (2019). Penerapan model pembelajaran discovery learning dalam meningkatkan hasil belajar ekonomi peserta didik kelas xii ips. 2 sma negeri 13 palembang. *Jurnal profit Kajian Pendidikan Ekonomi dan Ilmu Ekonomi*, *6*(1), 1-16.

Srikoon, S., Bunterm, T., Samranjai, J., & Wattanathorn, J. (2014). Research synthesis of research-based learning for education in Thailand. *Procedia-Social and Behavioral Sciences*, *116*, 913-917.

Sudiro, S. J., Farid, M., & Swistoro, E. (2018). Hubungan antara Kedalaman Permukaan Air Tanah dengan Salinitas di Pesisir Pantai Kungkai Baru serta Penggunaan Model Discovery Learning. *PENDIPA Journal of Science Education*, *2*(3), 178-182.

Sulistijo, S. H., Sukarmin, S., & Sunarno, W. (2017). Physics Learning Using Inquiry-Student Team Achievement Division (ISTAD) and Guided Inquiry Models Viewed by Students Achievement Motivation. *Jurnal Pendidikan IPA Indonesia*, *6*(1).

Triono, A. (2006). Karakteristik briket arang dari campuran serbuk gergajian kayu afrika (Maesopsis eminii Engl) dan sengon (Paraserianthes falcataria L. Nielsen) dengan penambahan tempurung kelapa (Cocos nucifera L). *Skripsi. Tidak Dipublikasikan. Bogor: Institut Pertanian Bogor*.

Trisnasih, A. B. (2013). Peningkatan Keterampilan Proses dan Hasil Belajar IPA melalui Model Research-based Learning Siswa Kelas V SD. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha*, *4*(1), 23-28.

Usmeldi, U. (2016a). The development of research-based physics learning model with scientific approach to develop students' scientific processing skill. *Jurnal Pendidikan IPA Indonesia*, *5*(1), 134-139.

Usmeldi, U. (2016b). Pengembangan Modul Pembelajaran Fisika Berbasis Riset dengan Pendekatan Scientific untuk Meningkatkan Literasi Sains Peserta Didik. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *2*(1), 1-8.

Usmeldi, U., Amini, R., & Trisna, S. (2017). The Development of Research-Based Learning Model with Science, Environment, Technology, and Society Approaches to Improve Critical Thinking of Students. *Jurnal Pendidikan IPA Indonesia*, *6*(2), 318-325.

Wahidin Nuriana, N. A., & Martana, T. I. N. (2013). Karakteristik Biobriket Kulit Durian Sebagai Bahan Bakar Alternatif Terbarukan. *Journal of Agroindustrial Technology*, *23*(1).

Wahyudi, R., Rukmini, D., & Bharati, D. A. L. (2019). Developing Discovery Learning-Based Assessment Module to Stimulate Critical Thinking and Creativity of Students' Speaking Performance. *English Education Journal*, *9*(2), 172-180.

Walkington, H., Griffin, A. L., Keys-Mathews, L., Metoyer, S. K., Miller, W. E., Baker, R., & France, D. (2011). Embedding research-based learning early in the undergraduate geography curriculum. *Journal of Geography in Higher Education*, *35*(3), 315-330.

Yuliah, Y., Hakim, L., & Hadiyan, Y. (2017). Nagasari (Mesua ferrea): Budidaya dan Potensinya sebagai Tanaman Obat. In *Proceeding Biology Education Conference: Biology, Science, Enviromental, and Learning* (Vol. 15, No. 1, pp. 808-812).