Implementation IDDOL Learning in Economy Natural Resources and Environmental to Enhance Student Knowledge about the Use of New and Renewable Energy (NRE) in Economic Activities

Wahjoedi[1]*, Magistyo Purboyo Priambodo[2], Dian Rachmawati[3], Menik Kurnia Siwi[4]

[1,2,3] *Economic Faculty, Universitas Negeri Malang, Indonesia.*
[4] *Economic Faculty, Universitas Negeri Padang, Indonesia.*
Corresponding author. Email: wahjoedi.fe@um.ac.id

ABSTRACT

The current issues on global environmental are about efforts to reduce global warming, namely with low-carbon economic actions. The real implementation is to change the original economic action by using fossil-based energy to use the renewable energy. The important event of the global agreement on climate (*Paris Climate Agreement*) requires all countries to realize their economic actions must be directed at efforts to reduce carbon emissions. In terms of accelerating the understanding of the use *of new and renewable energy* (NRE) in all economic activities of the community, education is one of the efforts. Through education, the content of economic literacy with NRE is an effective step towards low-carbon economic action. With use learning method *Inquiry Discovery Discussion Online (IDDOL),* hoped that it can increase student literacy about economic action with NRE. The results of *Learning Natural Resources-Environmental Economics (NREE)* with the IDDOL method can increase knowledge about economic actions with NRE, but are less significant for increasing attitudes and action tendencies of low-carbon economic behavior. This is possible because students are still unfamiliar with the issue of new and renewable energy. Therefore, intensive steps are still needed for learning that discuss about important issues regarding low-carbon economic actions and the importance of using NRE which is included in the curriculum and relevant lecture materials.

Keywords: IDDOL, natural resources and environmental economic (NREE), new renewable energy (NRE), economy activities.

1. INTRODUCTION

Recent global environmental issues focus on global warming, greenhouse gas emissions, and global climate change. It is realized that globally environmental problems occur due to excessive human economic behaviour and do not care to maintain the quality and balance of the environment. Natural resources and the environment have been treated as abundant resources and as if they are inexhaustible and experiencing extinction. Environmental pollution is considered unimportant, and taken for granted, finally environmental problems have become a global concern, thus raising global awareness as well, namely with awareness to improve climate change through reducing greenhouse gas emissions [1].

The United Nations international movement that focuses on efforts to improve the global climate has been carried out through the Framework Convention on Climate Change which was carried out in Paris France in 2015, known as the Paris Agreement convention. The convention has resulted in the United Nations Framework Convention on Climate Change (UNFCCC) agreement. The convention focuses on efforts to mitigate greenhouse gas emissions, adaptation measures, and funding issues [2].

Indonesia signed the Paris Agreement on climate change on 23 April 2016 [3]. Through representatives of the Minister of Environment and Forestry, the Indonesian government signed the Paris Agreement on Climate Change at the UN headquarters, New York. The Paris Agreement is a very monumental global agreement to

deal with climate change. Countries that are signatories to the Paris Agreement have commitments stated through their Nationally Determined Contribution (NDC) for the period 2020 – 2030, plus pre-2020 actions that focus on efforts to reduce greenhouse gas emissions [4,5].

The NDC is a document developed to realize the Paris Agreement which sets a limit on the increase in the earth's temperature below 2 degrees Celsius or below 1.5 degrees Celsius compared to the pre-industrial period. The Paris agreement aims to stop global warming by no more than 2 degrees Celsius. For that each country needs to include a commitment on how much carbon dioxide emissions can be reduced. Indonesia's commitment to reduce greenhouse gas emissions in the Paris agreement is 29% without conditions or on their own, while if there is international assistance (conditional) it is 41% in 2030 [6].

Real steps to reach an understanding of the implementation of the Paris Agreement and concrete steps to reduce greenhouse gas emissions need to be carried out together with the nation's components, including the younger generation. For the sake of improving the climate, and using New and Renewable Energy (NRE) to reach all Indonesian citizens as economic actors, whether as producers, consumers, or distributors, strategic steps are needed. One of the strategic steps is through education, by involving the target generation of young people. The Ministry of Energy and Mineral Resources has created a patriot energy program. The government has involved the younger generation to be directly involved in the development of NRE, starting from survey activities to an ongoing NRE project.

Universities in addition to acting as developers of knowledge, must also disseminate the results of knowledge innovation to the community. One of them is through the process of education or learning, namely through lectures on Natural Resources and Environmental Economics (NREE). The process of education or learning for the NREE course which has a field of study on environmental problems, especially the problem of using new and renewable energy sources (NRE) can be carried out directly face to face (offline) if conditions are normal, while online (online) when conditions are normal. conditions do not allow or emergency to meet face to face.

During the COVID-19 pandemic, face-to-face learning cannot be carried out, so it is necessary to look for other learning strategies, namely online strategies. Then in the online learning process itself, certain learning methods are also needed, even the incorporation of several learning methods that are relevant to the Covid-19 situation. One of the online learning methods that is implemented or tested is through the IDDOL learning method. The learning is a combination of several methods, namely the methods of Inquiry Discovery Discussion online [7].

The IDDOL learning strategy has been researched and tested in real terms in the Natural Resources and Environmental Economics course, in the Department of Development Studies Economics, Faculty of Economics, State University of Malang. The results can be presented in this article, that IDDOL learning has effectively increased students' insight into the environment, especially regarding the issue of using New and Renewable Energy (NRE). but to improve aspects of student attitudes and behavioural tendencies regarding the application of the use of new and renewable energy (NRE) it has not shown optimal results. This is possible, because the NRE problem is a new problem in Indonesia that still requires more intensive socialization. More intensive introductions need to be carried out at all levels of education from elementary to tertiary education.

1.1 The Need for Application of New Renewable Energy

Human economic activities have actually provided benefits for meeting the needs of human life, but also have a negative impact on the decline in the quality of the human environment. Economic actions have brought negative impacts, such as causing pollution, damage and extinction of natural resources, as well as decreasing the quality of the human environment from generation to generation. The determinant of the sustainability of nature and the environment is from human behaviour itself. Therefore, it is very important to take action to build attitudes, awareness, and good behavioural tendencies (insight) for economic activities to fulfil needs while maintaining the quality of the environment. The education path is a strategic step to increase human insight and literacy on issues and the importance of maintaining the quality of the environment.

To reduce the reliance on fossil fuel, renewable energy should be emphasized as a sustainable alternative so that the nascent demand for energy can be met [1,8].

The extant literature identifies several factors as determinants of renewable energy consumption. For example, GDP growth [9], R&D investment [1], FDI [10], trade openness [11,12], and financial development [13,14,15] significantly affect renewable energy consumption.

Most of the existing studies [1, 9, 10] mainly concentrate on aggregate renewable energy consumption.

1.2 Inquiry- Discovery Discussion On Line Learning (IDDOL)

The IDDOL learning model is a combination of online and offline learning or what is known as the blended learning method [16]. IDDOL learning

accommodates inquiry, discovery and discussion learning methods that are carried out online and offline. The learning syntax used in this study begins with the inquiry and discovery process carried out by students related to problems regarding NRE. Then students are asked to conclude and report the results of their investigations and discuss them online with classmates then the results of the discussion will be presented via power point by all groups. This learning experience is intended to improve students' abilities and insight regarding NRE
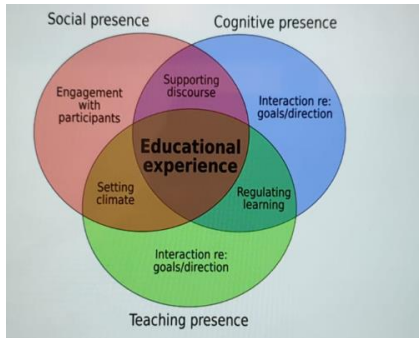
Source: (Garrison, Anderson & Archer, 2010) [17]

Inquiry can be defined as "the intentional process of diagnosing problems, critiquing experiments, and distinguishing alternatives, planning investigations, researching conjectures, searching for information, constructing models, debating with peers, and forming coherent arguments" [13].

Teaching strategies that actively engage students in the learning process through scientific investigations are more likely to increase conceptual understanding than are strategies that rely on more passive techniques, which are often necessary in the current standardized-assessment laden educational environment [18].

The discovery-inquiry learning model (discovery-inquiry learning) is a combination of discovery learning and inquiry models [19]. Both of these models have the same goal, namely to direct and guide students to find their own answers to the problems given. The use of the terms discovery and inquiry by experts is divided into two opinions, namely: 1) The terms discovery and inquiry can be interpreted with the same intent and are used interchangeably or both at once; and 2) The term discovery, although in general it refers to the same meaning as inquiry, in essence it contains differences with inquiry. Moh. Amin explains that discovery learning must include learning experiences to ensure that students can develop discovery processes [20]. Inquiry is created and includes discovery and more. In other words, inquiry is an extension of discovery processes that are used in a more mature way. In addition to discovery processes, inquiry contains higher level mental processes, for example formulating own problems, designing experiments, conducting experiments, collecting and

analysis data, drawing conclusions, having objective attitudes, being honest, curious, open, etc

Based on preliminary data shows that student Initial Capacity Value Data Description of students' initial ability data for the experimental class and control class is presented Students' Ability Learning Number of Samples Average Inquiry-discovery: 67,40 Conventional: 67,43 it can be seen, that the average value of the initial ability of the experimental class students is 67.40, while the control class has an average value of 67.43. Based on these results, the difference in the average value of the initial ability of students between the ANOVA analysis of the interaction between inquiry-discovery learning towards high-order thinking skills in terms of the students' initial ability shows that Sig> α (0.737 <0.05). Therefore, it can be concluded that H0 is accepted and H1 is rejected, this indicates that it is not there is an interaction between inquiry-discovery learning and higher-order thinking skills in terms of initial abilities.

Many studies show that the non-optimal absorption of information in learning is due to misconceptions between teachers and students [21,22]. The model that is suitable to be used to train students' science process skills is the Inquiry Discovery Learning (IDL) model. The IDL model is a model that provides opportunities for students to be able to learn to utilize various learning resources so that students will be more independent and creative and do not make the teacher the only source of learning [23]. This IDL model is effective for encouraging student involvement and motivation in understanding clear topics [7].

2. METHOD

This study was designed with a survey design [24]. with a framework of quantitative research methods. This survey is intended to explore information on the level of student recognition about the use of new and renewable energy which is used as a basis for determining the need for treatment through the Natural Resources and Environmental Economics course. The study also used a simple one-group quasi-experimental design with a pre-test-post-test [25, 26] as one variable for IDDOL learning treatment, to then see the results about students' understanding, attitudes, and behavioural tendencies towards innovation in the use of new renewable energy

Design Minimal Control: One-Group Pre-test-Post-test Design

Pre-test   X   Post-test

Respondents

Respondents included 75 undergraduate students participating in the Natural Resources and Environmental Economics course in the odd semester of the 2019/2020 academic year. The students participating in the lectures are the 2018 batch, covering 3 parallel classes, with the

characteristics: male and female, from rural and urban areas, with a background in Science, Social and Language. All of them are majoring in Economics Development Studies, Faculty of Economics, State University of Malang.

Data Collection

Learning process begins with the provision of a lesson plan that contains learning objectives and materials. Students are given a theme related to NRE and given a source book to be used as a reference in the inquiry discovery process [1,2,4,5,6,8]. Students compile papers/ Power Point to be brought to the online class discussion forum. From this process, students' insights about NRE are formed, including aspects of knowledge, attitudes and behavioural tendencies towards the use of NRE.

Through the treatment of Natural Resources and Environmental Economics lectures for one full semester, they are given pre-test and post-test, which are then compared with the value of their insights, attitudes, and behavioural tendencies towards the problem of innovation in the use of new and renewable energy as an effort to reduce carbon emissions, towards improving the global climate and greenhouse gas effect.

Data Analysis

After the quantitative data has been collected, from the results carried out by filling out the questionnaire instrument to students, then a comparative analysis is carried out between the pre-test and post-test scores with the ANOVA tool with the help of the latest version of the SPSS program.

3. RESULTS AND DISCUSSION

The IDDOL learning strategy has been researched and tested in real terms in the Natural Resources and Environmental Economics course (NREE), in the Department of Development Studies Economics, Faculty of Economics, State University of Malang. The results can be presented in this article, that IDDOL learning has effectively increased students' insight into the environment, especially regarding the issue of using New and Renewable Energy (NRE). but to improve aspects of student attitudes and behavioural tendencies regarding the application of the use of new and renewable energy (NRE) it has not shown optimal results. This is possible, because the NRE problem is a new problem in Indonesia that still requires more intensive socialization. More intensive introductions need to be carried out at all levels of education from elementary to tertiary education [27].

This study uses the form of pre-test and post-test assessments to see differences and improvements in insight into NRE problems in students before and after being given the IDDOL model of NREE learning. In this study there are 3 aspects, namely aspects of knowledge,

attitudes and behaviour. Based on the results of research data from 75 subjects, it is known that the value of sig. 0.000 which means that there is a difference between the pre-test and post-test in each aspect.

Table 1. Results of Insight's pre-test, post-test scores on NRE

		Mean	Std. Deviation	Std.Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
air 1	Pre_Total Post_Total	-34,707	16,516	1,907	-38,507	-30,907	-18,199	74	,000

This shows that the IDDOL NREE learning given to the subject has an impact on existing aspects, namely aspects of knowledge, attitudes and behaviour. In the aspect of knowledge obtained a significance score of 0.000, which of these scores can be stated that there is a difference or change in the knowledge possessed by the subject as seen from the results of the pre-test and post-test. The increase experienced by the subject in the aspect of knowledge is also in the high category, reaching 93%. The interpretation of the effectiveness of learning also shows that this learning is in the effective category.

Table 2. Pre Test – Post-Test Scores About Aspects of Knowledge About NRE

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pre- knowledge-Post_knowledge	-13,347	5,384	,622	-14,58	-12,108	-21,469	74	,000

Meanwhile, in the attitude aspect, a significance score of 0.000, which means that the difference or change occurred in the pre-test and post-test subjects in this aspect was found. However, in the categorization of improvement, this learning is in the medium category, which is 54.6%. Likewise in the interpretation of its effectiveness, it is in the ineffective to less effective category.

Table. 3 Scores Pre-Test, Post-Test Aspects of Attitude towards the Use of NRE

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pre_Attitude Post_Attitude	-10,400	6,766	,781	-11,957	-8,843	-13,311	74	,000

Furthermore, in the behavioural aspect, a significance score of 0.000 was obtained, which means that there were differences or changes in the pre-test and post-test subjects. However, as in the attitude aspect, in the behavioural aspect, the increase in categorization is also in the moderate category, namely 58.6%. Likewise, in the

interpretation of its effectiveness, behavioural aspects fall into the category of ineffective to less effective.

Table 4. Pre-test – Post-test Aspects of Behavioural Tendency Against the Use of NRE

				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pre_behavior - Post_behavior	-10,960	7,285	,841	-12,636	-9,284	-13,030	74	,000

The results of the categorization and interpretation of effectiveness on aspects of attitude and behaviour may be influenced by the factor that the learning material on New and Renewable Energy (NRE) provided is still relatively foreign or new to the subjects. Therefore, the subject has not been able to practice real and overall attitudes and behaviour in accordance with the learning that has been given during the research. Ameli and Barndt find that credit constraint, informational failures, and consumer behaviour, are the key impediments to the ubiquitous renewable energy consumption [15].

The knowledge aspect tests how much understanding the respondents (students) have on environmentally sound economic development. The questions asked were 27 items with the type of answer choices: know/understand and don't know/don't understand. Data collection was carried out twice, namely before participating in (pre-test) the NREE Economics course and after taking it (post-test). Students' understanding of the Natural Resources Economics course which refers to EBT is getting better by using the IDDOL learning method. Using blended learning increase student understanding [28, 29].

Student need to know about the importance of NRE. Many research related to NRE was do in many country. In Europe 2019, renewable energy represented 19.7% of energy consumed in the EU-27, only 0.3% short of the 2020 target of 20%.3 Research about renewable energy consumption in brazil, China, India and south Africa From 1990 until 2012 do by Kutan et al [30]. Beside that Burokav and freidin (2017) make a research in Rusia from 1990-2014 about related financial development, economic growth, and renewable consumption [31].

In the United States, approximately 12% of energy production relied on renewables, and the annual energy consumption from renewable sources exceeded coal consumption for the first time since before 1885, and the consumption of renewable energy in 2019 was nearly three times greater than in 2000, according to the Energy Information Administration.

Renewable Energy give economic affect not for environment only. [32, 33]. Other research shows that economy growth and financial development have positif

affect by renewable energy in many [32, 33, 34, 35]. Meanwhile the other research shows that have negative relation between financial development with energy consumption in some country. [9, 10, 11, 12, 36].

4. CONCLUSION

The IDDOL learning model combines the Inquiry, Discovery and Discussion learning models, which are taught online. Based on the results of the research above, it shows that students' knowledge of NRE through the implementation of IDDOL learning results in a better understanding. The results of the assessment of the pre-test and post-test of the categorization and interpretation of effectiveness on aspects of attitude and behaviour may be influenced by the factor that the learning material on New and Renewable Energy (NRE) provided is still relatively new to the subjects. The knowledge in NREE aspect tests how much understanding the respondents (students) have on environmentally sound economic development. The categorization and interpretation of effectiveness on aspects of attitude and behaviour may be influenced by the factor that the learning material on New and Renewable Energy (NRE) provided is still relatively foreign or new to the subjects. The need for renewable energy, especially in the economic field, requires students to understand and care about the surrounding environment.

The results showed an increase in student understanding but the attitude of students was still not optimal because NRE was new knowledge for students. Seeing the importance of using NRE, the suggestions given are based on research results is the use of various varied learning methods related to the latest knowledge related to renewable energy is needed in learning both online and offline.

ACKNOWLEDGMENTS

REFERENCES

[1] T. Tietenberg, & Lewis, L. (2012). *Environmental and Natural Resource Economics*. In Pearson Education (9th ed.). New Jersey.

[2] J.M. Harris. & B. Roach, *Environmental and Natural Resource economics: A Contemporary Approach.* Routledge. 2018.

[3] Buku Rencana Strategis (Renstra) tahun 2020-2024, Direktorat Jenderal Energi Baru Terbarukan dan Konversi Energi (Ditjen EBTKE), kementerian Energi dan Sumber Daya Mineral, April 2020

[4] D. A. Anderson, *Environmental Economics and Natural Resource Management*. Taylor & Francis e-Library. 2010.

[5] R. Halvorsen & D.F. Layton, *Explorations in Environmental and Natural Resource Economics*. Edward Elgar Publishing Limited. 2006.

[6] S.C. Hackett, *Environmental and Natural Resources Economics*. M.E. Sharpe, Inc. 2006.

[7] P. Eggel, & Kauchak, D. (2012). *Strategi dan Model Pembelajaran*. Jakarta Barat: PT Indeks.

[8] P. Roger, Yue Ma, James McGilvray, dan Michael Common. 1999. *Natural Resource and Environmental Economics*. Second Edition. United Kingdom: Henry Ling, Ltd.

[9] O. Mielnik, O., Goldemberg, J., 2002. "Foreign direct investment and decoupling between energy and gross domestic product in developing countries". *Energy Pol*. 30 (2), 87–89.

[10] A. Tamazian, Chousa, J.P., Vadlamannati, C., 2009. "Does higher economic and financial development lead to environmental degradation? Evidence from BRIC countries". *Energy Pol*. 37, 246–253.

[11] A. Jalil, Feridun, M., 2011. "The impact of growth, energy and financial development on the environment in China: a cointegration analysis". *Energy Econ*. 33, 284–291.

[12] M.K, Mahalick, Mallick, H., 2014. "Energy consumption, economic growth and financial development: exploring the empirical linkages in India". J. *Develop. Area*. 48, 139–159.

[13] M.C, Linn, Davis, E. A., & Bell. P. (2004). *Inquiry and technology. In M.C. Linn, E.A. Davis, & P. Bell (Eds.), Internet Environments for Science Education* (pp. 3-28). Mahwah, NJ: Lawrence Erlbaum Associates.

[14] S.R. Paramati, M.S. Alam, S. Hammoudeh, K. Hafeez, "Long-run relationship between R&D investment and environmental sustainability: evidence from the European Union member countries", *Int. J. Finance Econ*. (2020) 1e18

[15] N. Ameli, N. Brandt, "What Impedes Household Investment in Energy Efficiency and Renewable Energy?".OECD Economics Department Working Papers, No. 1222, OECD Publishing, Paris, 2015, https://doi.org/10.1787/5js1j15g2f8n-en.

[16] C.J.,Bonk, & Graham, C. R. (2006). *The Handbook of blended learning environments*: Gl

[17] T. Anderson, Garrison, D.R., & Archer, W.(2004). *Critical thinking, cognitive presence, computer conferencing in distance learning*. [Online tersedia di: http.communityofinquiry.com/file/CogPres_Final.pdf

[18] D.D, Minner, Levy, A.J. & Century, J. (2010). "Inquiry-based science instruction--what is it and does it matter? Results from a research synthesis years 1984 to 2002", *Journal of Research in Science Teaching*, 47, 474-496.

[19] M. Amin.1979. *Apakah Metode Discovery-Inquiry Itu?*. Depertemen Pendidikan dan Kebudayaan Direktorat Jendral Pendidikan Tinggi Proyek Normalisasi Kehidupan Kampus.

[20] N. Sudirman, 1992. *Ilmu Pendidikan*. Bandung: Remaja Rosda Karya.

[21] M. Prince, & Felder, R. M. (2007). *The many faces of inductive teaching and learning*.

[22] M.K Slunt, & Giancarlo, C. L. (2004). "Student-centered learning: A comparison of two different methods of instruction". *Journal of Chemical Education*, 81, 985-988.

[23] Zulhelmi. (2009). "Penilaian Psikomotorik dan Respon Siswa dalam Pembelajaran Sains Fisika melalui Penerapan Penemuan Terbimbing di SMP Negeri 20 Pekanbaru". *Jurnal Geliga Sains*. 3 (2). 8-13.

[24] Creswell, John W. 2014. *Research design pendekatan kualitatif, kuantitatif, dan mixed*. YOGYAKARTA : PUSTAKA PELAJAR

[25] A. Donald. (2010). I*ntroduction to Research in Education: 8th (eigth) Edition*. Wadsworth Publishing

[26] I. Stephen. (1971). "Educational and Psychological \\

[27] 'J. Wang, S. Zhang, Q. Zhang, *The relationship of renewable energy consumption to financial development and economic growth in China*, Renew. Energy 170 (2021) 897e904