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IMPLEMENTATION OF ECO-EFFICIENCY CALCULATIONS BASED ON ECO-FRIENDLY WEBSITES

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ABSTRACT

Social restrictions during the Covid 19 pandemic created a new pattern of human life, where people don't leave the house much and spend more time at home. The increase in activities at home certainly affects the consumption of daily utilities, such as water and energy, which are sources of life for living things whose sources are limited and non-renewable. During covid 19 the use of water increased in the housing sector. The environmental impact arising from households with water consumption contributes to more than 60% of greenhouse gas emissions globally and 80% of total water use. Eco-technology plays a role as an important facilitator of economic growth in separating environmental issues from economic development. This research was conducted to produce an accounting information system design to measure the eco-efficiency of website-based water use. This research will first carry out an analysis of eco-efficiency calculations and then design an information system.

Keywords: Eco-Efficiency, Information System, Accounting Information System, RAD Method.
JEL Classifications: JEL Classifications codes.

1. INTRODUCTION

Organizational Social restrictions during the Covid-19 pandemic have created a new human lifestyle, where people do not leave the house much and spend more time at home. Increasing activities at home certainly affect the daily consumption of utilities, such as water and energy, which are sources of life for living things whose sources are limited and non-renewable. During covid 19 water use is increasing in the housing sector (Tleuken et al., 2021). In the Iranian metropolitan area of Tabriz, for example, water consumption increased by 18% (Amuakwa-Mensah et al., 2021). Environmental impacts arising from households with water consumption contribute to more than 60% of greenhouse gas emissions globally and 80% of total water use (Tleuken et al., 2021). Increasing water consumption during covid 19 creates inefficiencies both on the economic side because it increases the water bills that must be paid and the impact on the environment itself (Ivanova et al., 2016).

It is important to provide insight to water users in residential areas to be more efficient in using water. This is because water users can directly. control the use of water for household needs (Jorgensen et al., 2009). The efficiency of water use can certainly reduce the environmental impacts that arise, as well as an effort to maintain the availability of water whose sources are limited can continue (Vieira et al., 2018)By the sustainable development goals that are being carried out by the world (Ruan et al., 2022). Related to ecological economic efficiency (eco-efficiency) a concept present in environmental management accounting that shows the relationship between productive activities and low resource use (Agustia et al., 2019). Emphasizing measurement issues related to environmental aspects determines the relationship of eco-efficiency with the achievement of the entity's environment. The concept of eco-efficiency combines key environmental performance indicators such as clean water use, pollution prevention, and waste minimization (Pratiwi et al., 2020). Eco-efficiency has been widely studied as a measuring tool to determine the environmental efficiency of company production

activities (Wu et al., 2021). Eco-efficiency provides economic value to existing environmental impacts (Kortelainen & Kuosmanen, 2004). In addition, the concept of eco-efficiency has advantages over other measures of environmental performance. This tool can be used in all lines, namely residential areas to assess the efficiency of the environment in residential areas (Moutinho & Madaleno, 2021). Now it is not only environmental institutions, governments, and companies that can measure environmental efficiency for the activities carried out. With this research, it is hoped that the public can find out the amount of clean water consumption used and about the level of eco-efficiency of clean water use. This is so that the community can increase awareness of the efficiency of using clean water and know how much impact daily activities of water use have on the economic aspects of the family and its impact on the environment. In the process to achieve sustainable development, the community has an important role so that the goals of all aspects of sustainable development set by the government can be achieved.

During the Covid-19 pandemic, social restrictions are certainly a challenge to assess environmental efficiency manually, the importance of role of information technology is needed today with environmentally friendly information technology or eco-technology. The demand for eco-technology is growing rapidly by protecting the environment (Wu et al., 2021). Eco-technology plays an important role as an important facilitator of economic growth in separating environmental issues from the economic development (Sanni, 2018). Eco Technology is also an added value for companies, cities, and countries in the sustainability development (Zhong et al., 2020). The framework of eco-efficiency in the technology development process was in 2018 (Caetano et al., 2018). Previous researchers have also carried out an eco-efficiency analysis to assess organizational performance with a big data approach (Gunasekaran et al., 2017) (Kiani Mavi et al., 2019). If previously the eco-efficiency analysis could only be done by companies or environmental institutions by doing calculations manually and taking a long time. In this study, a computerized accounting information system design was built so that eco-efficiency calculations and analysis could be carried out by the entire community, but in this study, a trial of eco-efficiency analysis and calculation was carried out in housing groups in Palembang. The system is built using Rapid Application Development (RAD). The output of this study is an electronic product in the form of an eco-efficiency calculator (EEC) based on an eco-friendly website. The calculation results from the eco-efficiency calculator (EEC) will describe the efficiency of water use economically, which is assessed from the amount of rupiah, and environmentally, which is judged by the amount of water use. The results of this calculation can also provide an overview of the impact of water use on the family's economic side and the impact on the environment, as well as greenhouse claims. In practice, the eco-efficiency calculator (EEC) can be used by everyone both individually and non-individually such as water users in households, MSMEs, and even companies

2. LITERATURE REVIEW

The concept of eco-efficiency, which can be defined as the simultaneous ability to achieve economic results with minimal environmental degradation, has recently become the subject of lively discussion among politicians and scientists (Stępień et al., 2021). Eco-efficiency analysis at various levels can overcome the disconnect between macro-level needs and micro-level contributions. This cross-level analysis helps policy-makers to systematically improve the industry sustainability (Ruan et al., 2022). Awareness of environmental pollution originating from all aspects of the earth's human activities has awakened many parties to care more about and protect the environment. This can be seen from the many studies both from a social and economic perspective, as well as the use of information technology that has been carried out by many researchers around the world. A study was conducted in 2017 to assess the effectiveness of using an eco-feedback system, built with two technologies, namely a website and a mobile application, in three different university dormitories in China. The result is that the mobile application-based system achieves much better performance, the reason for the higher accessibility of the application-based system. Practically speaking, mobile applications provide more effective delivery of feedback information and are considered an effective alternative technology in the eco-feedback systems (Lin et al., 2017). In 2018 the development of an eco-friendly website system was carried out for the student learning process on environmental pollution material. The choice of technology in the development of eco-friendly websites is adjusted to the ability of researchers as product developers, time availability, equipment and costs required. Supporting applications are selected based on the multimedia concept that will be presented on an eco-friendly website which includes text, graphics, audio, video, and animation elements. The data analysis and discussion results prove that the feasibility of an eco-friendly website based on the assessment of material experts, media experts, and peer reviewers is very good. While based on student assessment is good. In addition, students' cognitive abilities have increased after participating in Biology learning activities with the implementation of eco-friendly websites ((Fitriani et al., 2018). In England, the Eco website was also developed to provide information to small and medium enterprises (SMEs) who wish to increase their green credentials, save energy costs, and market environmentally friendly products and services (Gholami et al., 2018). The creation of a sophisticated information system in the form of continuously functioning monitoring that provides the eco-industry park with complete, reliable, and up-to-date information on modern innovation processes has been carried out by previous studies. It is important to use automation and actively involve innovative technologies to increase the efficiency of the functioning of eco-industrial parks in Russia (Yaroslavtsev et al., 2019). In Indonesia, an information system for measuring green productivity and environmental management accounting is designed to help a Batik SME area that has a high level of waste disposal. Water waste is generated as much as 568 m^3 per day to produce 1400 pieces of batik. Production and waste management are needed that is effective and efficient economically and in

terms of its impact on the environment. The results of this research are a draft standard measurement procedure for evaluating green batik productivity in small and medium enterprises that can guarantee business sustainability, both in financial and environmental aspects. Where SMEs can be more efficient in using raw materials and minimize negative impacts on the environment, or eco-efficiency (Suhartini, 2018). Based on research results from various research objects, it can be concluded that the use of information technology is needed for every line of life in this 4.0 era, where technology can synergize with all kinds of knowledge including accounting to facilitate human work. Thus, the research developed a computerized accounting information system for measuring eco-efficiency in water use based on an eco-friendly website. Where later this system can help the whole community to be able to calculate and find out for themselves (self-assessment) the level of efficiency in the use of clean water and also the financial and environmental impacts.

3. METHOD

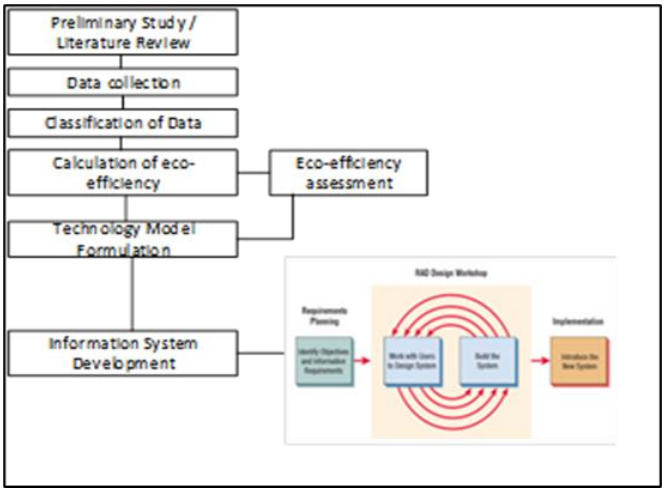
This research is a research and development where researchers will design a model of design, development, and evaluation of the system. In this research, researchers will start with eco-efficiency calculations, and algorithms, down to the website design model for computerized eco-efficiency calculations. This is also a research limitation. The selection of the research sample will use purposive sampling with certain sample selection criteria (Sugiyono, 2016). Mathematically, the following is the calculation of the eco-efficiency:

$$eco\ efficiency\ ratio = \frac{Water\ usage\ expenditure(idr)}{Monthly\ Revenue\ (idr)}$$

Source: (Irwin Rodney, 2015)

Data collection is in the form of relevant information regarding the economic conditions of the community, namely monthly income, and environmental aspects namely costs incurred in using water each month. The result of the calculation of eco-efficiency is in the form of a ratio that describes the amount of water use efficiency carried out by a person every month. The results of the eco-efficiency ratio every month become data for users to see the trend of efficiency that has been carried out in one year as a person's self-assessment whether in one year the trend is upward or sloping. If it goes up, it means that the eco-efficiency ratio increases in value every month, which means that the use of water every month increases, and the efficiency that has been carried out has not been successful. Meanwhile, if the eco-efficiency ratio decreases, it means that the use of water is reduced, the costs incurred are also reduced, and the efficiency carried out in one year has been successful

Figure 1. Research Stages



This research will begin with a preliminary study/literature review of data collection and then the classification of data, after that doing Eco-Efficiency Calculations, Eco-Efficiency assessments, and then formulation of Technology Models. After the results were obtained, system development was carried out with the RAD model, which is explained below:

A. Systems Development Techniques

The technique used by the author in this study is Rapid Application Development (RAD).

4. RESULTS

4.1. Requirements Planning Phase

At this stage, the process of identifying system requirements is carried out by involving analysts and users. Identify information needs and problems encountered to determine goals, system boundaries, constraints, and alternative solutions to problems. When the eco-efficiency ratio calculation has been carried out by the user, the data is automatically stored in the database. Users can see the data that has been entered every month and can also see the trend of eco-efficiency ratio calculations that have been done. In one year of using the application, there will be a notification to the user regarding the success or failure of the efficiency that has been carried out. This can be seen from the trend of the eco-efficiency ratio itself, which will be divided into three, namely ascending, sloping, or constant which has its meaning

4.2. Eco-Efficiency Ratio Analysis

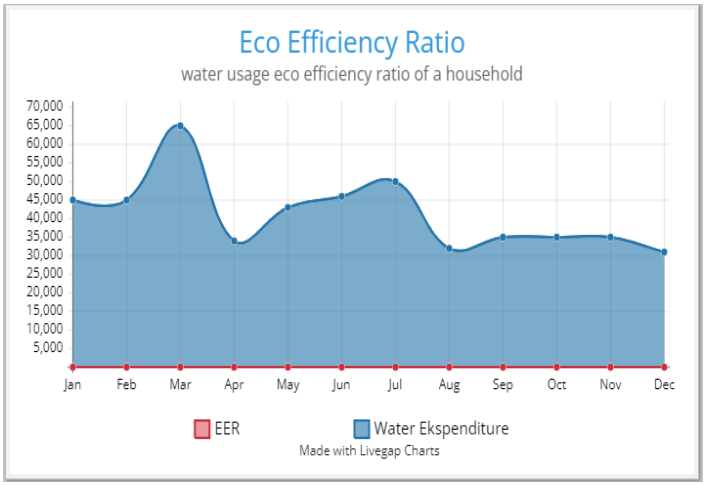
The calculation of the Eco-efficiency ratio for water use in one house in a housing complex is described in table 1. This calculation is entered when the system trial is carried out to see how many ratios are calculated and see the trend of the eco-efficiency ratio in one year.

Table 1 Water Usage EER of a HouseholdSource: (data processed, 2021)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Perfomance	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**	**IDR**
Revenue	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
Water Ekspenditure	45000	45000	65000	34000	43000	46000	50000	32000	35000	35000	35000	31000
EER	0,009%	0,009%	0,013%	0,0068 %	0,0086 %	0,0092 %	0,01%	0,0064 %	0,007%	0,007%	0,007%	0,0062 %

Table 1 shows the amount of a person's income, namely IDR. 5,000,000 per month and the amount spent on clean water use. From table 1 the costs incurred for water use fluctuate each month, which means that the use of clean water each month varies. The highest consumption in March 2021 was IDR. 65,000 with an eco-efficiency ratio (EER) value of 0.013%. This means that with an income of IDR 5,000,000 per month, the costs incurred for clean water consumption are 0.013% of the monthly income. Meanwhile, the lowest consumption in December 2021 is IDR. 31,000 with an EER value of 0.0062%. Costs incurred for water use for one month are less than 0.05% of the income generated. The expenditure costs for water consumption calculated in this study are clean water consumption for household activities such as bathing, washing, watering plants, etc. Does not include the consumption of clean water to drink directly. In practice, users can enter the amount of expenditure incurred for the overall use of clean water, including for those consumed directly.

Figure 2: Line-Chart Eco-Efficiency Ratio of A Household

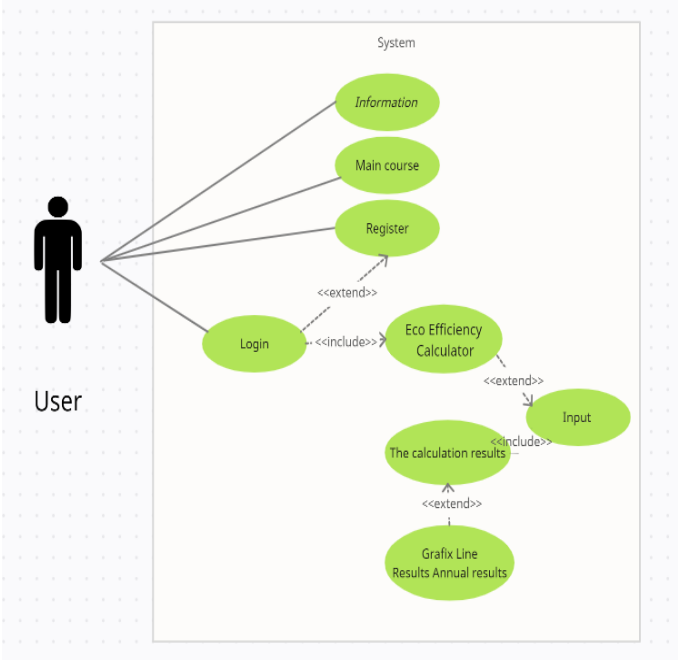


4.3. Workshop Design

After the Planning Phase, the requirements for needs and the calculation of the eco-efficiency ratio have been carried out. Researchers design the process with the UML approach and use case diagrams. Activity diagram Class diagram and then a programming design is carried out for the data that has been obtained and modeled in the information system architecture using Visio and a text editor using Visual Studio Code.

Based on the data that has been analyzed, this diagram addresses the system process flow planning which can be seen in figure 3. Use case diagram

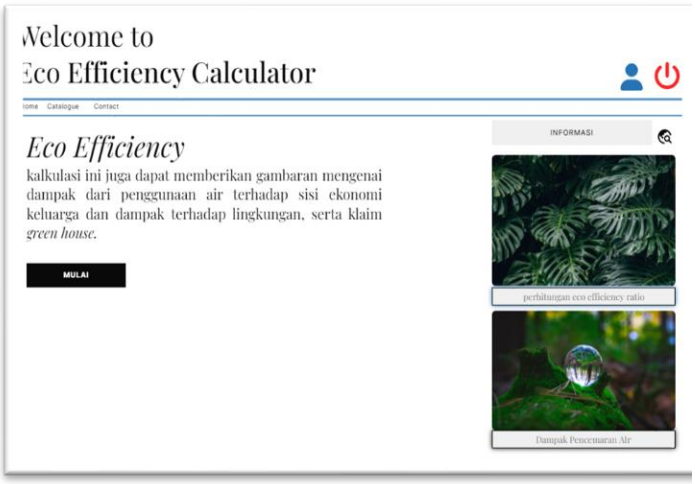
Figure 3: Use Case Diagram



4.4. Development and Testing

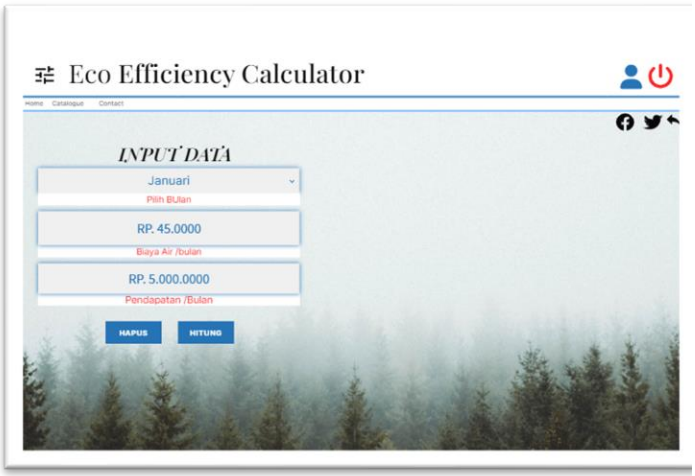
At this stage, system development is based on the results of requirements planning and design workshops using the PHP and MySQL programming languages as databases, then the testing phase is carried out using the black box testing method. The main page on the Eco-Efficiency Calculator website is the initial display when the application is opened, in the main view the user can select information, register, log in then can start the Eco-Efficiency Calculator, and history of eco-efficiency The main page of the website can be seen in Figure 4.

Figure 4: Eco-Efficiency Calculator Main Menu



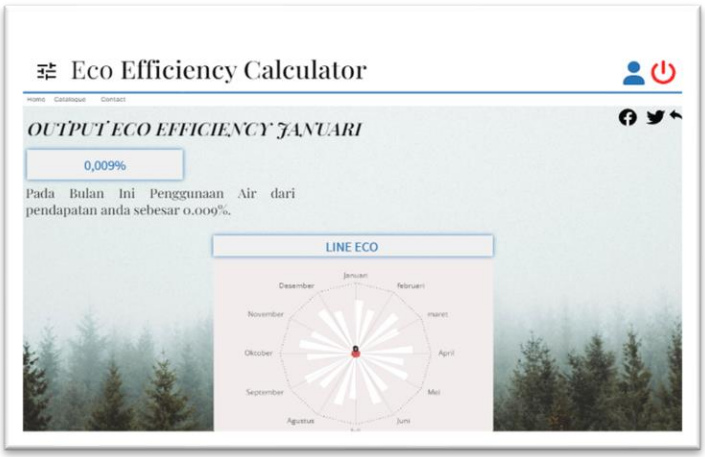
The displays the Eco-Efficiency Calculator, on this page the user inputs data every month according to the data transferred and then performs the process of calculating the data results. More details can be seen in Figure 5.

Figure 5: Data Input



The input data results are then carried out according to the Eco-Efficiency algorithm, and the output results along with information can be seen in Figure 6.

Figure 6 Data Output



5. CONCLUSION

An eco-efficiency calculator developed based on an eco-friendly website can assist users in collecting data on income and costs incurred for using clean water. The eco-efficiency ratio shown can be a source of information in decision-making. Determine the efficiency level of water use in months and years. The amount of expenditure for the use of clean water every month is fluctuating, which means that the use of clean water every month is different. This difference is determined by the number of people in one house and the water use intensity. The expenses calculated in this study are the use of clean water for household activities such as bathing, washing, watering plants, etc. Does not include the consumption of clean water to drink directly. In practice, users can enter the amount of expenditure incurred for the overall use of clean water, including for those consumed directly.

Website development by applying the Rapid Application Development (RAD) system development method framework with the UML modeling approach is then carried out system testing using the Black Box Testing approach. The system has been designed and built to produce an eco-efficiency calculator product. The limitations of this study are the absence of quantity (m3) data on water use and the classification of the eco-efficiency level of the system. Based on test results, algorithms and test users, it can be concluded that the Eco-Efficiency Calculator is a website-based system that meets the requirements to be implemented, then after the website-based Eco-Efficiency Calculator is built, it will become a tool or tool for analyzing Eco-Efficiency water use per point the coordinates of the South Sumatra region, especially the city of Palembang.

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