

Education on the Use of IoT Technology for Energy Audit and Management Within the Context of Conservation and Efficiency



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Abstract

Education on the use of IoT technology for energy audit and management within the context of conservation and efficiency The demand for electrical energy rises in direct proportion to a region's economy. The basic electricity rate rises in response to the steadily growing demand for electrical energy. Increased use of electrical energy is a result of wasteful conduct and a disregard for equipment standardization. increases the utilization of electrical energy. The local population still does not appear to be concerned or aware of how crucial it is to keep the electrical supply sustainable. Many studies that are pertinent to energy efficiency and conservation education have been conducted. Thus, the community needs to be informed of this information in order to, among other things, increase understanding, encourage the community to behave economically, conduct audits, and manage electrical energy in accordance with standardized practices. SMK N 1 Brebes, a vocational school for electrical and electronics, is a setting that is pertinent to the use of this technology. The development in students' abilities after engaging in this activity shows that it has delivered education in the form of reading material and energy management practice.

Keywords: *Electrical energy, energy management, and energy efficiency.*

1. Introduction

The first step in tracking energy consumption, locating energy waste sources, and examining the potential for energy savings is to conduct an energy audit [1]. computations for the required measures, as well [2], [3]. Finding the "Portrait of Energy Usage" and looking for initiatives to increase energy efficiency are the goals of an energy audit.

The value of the Energy Consumption Intensity (ICE) of electricity in a specific building can be determined through the energy audit process, and this can give a general idea of how efficiently electrical energy is used in the structure. Also, recommendations for the use and standardization of electrical equipment will be offered by the energy audit [4], [5].

At this time, more and more people are using electricity in a variety of areas of their lives [6]. High electrical energy consumption is a result of several problems, including wasteful behavior, a lack of knowledge about equipment standardization [7], [8], and poor electrical energy supply [9].



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Because of this, it is imperative to alter how people utilize electrical energy, beginning with educating them on how to do it in a manner consistent with accepted standards [10], [11]. The community (participants) can receive instruction and practice in how to audit and manage electrical energy to be efficient in accordance with its purpose and use based on their level of competency [12], [13].

The ideal audience for this activity is vocational high schools (SMK) that specialize in the fields of electronics and computers [14]. This activity is a way for universities to support government initiatives in the energy sector [15]. The participants' interest in creating technological innovations, particularly technology energy management audits based on the Internet of Things, is stimulated by this course as well (IoT) [16].

In order to implement the energy conservation program and raise public awareness of how to act in an energy-efficient manner and use electrical equipment in accordance with the Standard, this activity, which takes the form of auditing procedures and IoT-based energy management, aims to disseminate research results to the community [17], [18].

2. Research Method

The most effective way to educate the public about audits and energy management is through hands-on learning. preliminary findings from conversations between professors and instructors at SMK N 2 Brebes The issues that existed prior to activities are understood to be:

1. Participants are not entirely aware of how to use energy sources economically and efficiently, and they are not aware of how to use electrical energy economically and effectively.
2. The participants were unaware of energy management and audits.
3. The participants are unaware of the many technologies available for energy management and auditing.
4. The participants lacked knowledge on how to build and deploy an IoT-based energy audit prototype.
5. Participants lack knowledge of energy management and auditing procedures With this preliminary data, the activity
This method is carried out as follows:
 1. Site analysis, It was ensured during the survey that the aims for the implementation of the activities are suitable and capable of receiving the information supplied.
 2. Preparing Materials; The materials that are developed include papers that are distributed and discussed during the implementation of activities as well as electronic and programming components that are employed as key elements in the scope of energy audits and energy management.
 3. Setting up activities at the designated site, SMK N 2 Brebes, in advance.
 4. Participate in activities, such as content presentation, discussion, and question-and-answer sessions, as well as practice sessions and energy management.
 5. Assessment and monitoring are carried out to determine whether the activity was successful and to identify areas for future development.

2.1 Formula/Algorithm [optional]

The amount of electrical energy consumption compared area provides information on the value of the Energy Consumption Index Energy Consumption Index (IKE) which is written in the following equation:

$$IKE(kWh) = \frac{\text{Total Konsumsi Energi}(kWh)}{\text{Luas Total area (m}^2\text{)}}$$

IKE value can indicate whether or not a building's electrical energy consumption is occurring. Energy management actions must be conducted if there are signs of waste or noncompliance with the standard. Anyone with a rudimentary understanding of electrical engineering may perform this energy management. The most effective way to educate the public about audits and energy management is through hands-on learning.

2.2 Literature Review

In the study that was conducted concerning the application of IoT technology to energy management and auditing of electrical energy created a working prototype [19]. With the main part of the digital Kwh meter, calculate the amount of electrical energy usage. Software allows for real-time monitoring of the electrical energy measuring results in the form of a graph and electrical energy consumption figures [20]. For management or energy management, the measurement data can also be followed online.

3. Findings

Students at SMK N 2 Brebes who are majoring in electrical engineering will participate in Internet of Things (IoT) technology application training for energy audit and management for SMK students in the context of energy conservation and energy efficiency. Twenty students from class XI and two teachers from SMK N 2 Brebes participated in the training activities. The execution of training activities starts with a pretest intended for participants to gauge their level of familiarity with the training.

3.1 Problem

This instruction takes the form of practical experience to calculate the energy usage at SMK N 2 Brebes [11]. Particularly in the areas of energy audits and management, the participants' basic skills remained deficient. The findings of each group showed that all participants completed the assigned tasks successfully after receiving material exposure and discussion time. The discussion time, ability, and knowledge of training materials improved from the pretest scores from poor to good [21]. Participants can comprehend the measurement of electrical energy usage, the circuit used, and online data processing online.

This activity can help participants become more proficient at doing energy audits and management management [22]. This activity has been carried out in accordance with the goals and expectations that were set forth for its implementation, namely to enhance community awareness of energy conservation and the proper use of electrical equipment.

3.2 Research Implementation

Before the training material was provided, a pretest was offered. It consisted of 10 different multiple-choice questions. The inquiries centered on energy management, audits, and conservation. On the attached paper, participants may select the response they believe is the most appropriate, with a processing period of 15 minutes and a possible score of 100. The

highest score, a 75, and the lowest score, a 45, were acquired from the results of the pretest. Examination of the pretest results revealed that the trainees' initial proficiency is deficient, particularly in the areas of energy audits and energy management. The results of this evaluation can be used as a guide to determine the participants' level of skill and knowledge. Table 1 shows the distribution of the preliminary evaluation findings for the participants' abilities.

Table 1. Distribution table of initial evaluation results Distribution table of initial evaluation results

Range	Number	Category
100 – 85	0	Very good
84 -70	3	Good
69 – 50	12	Fair
49 – 30	5	Insufficient
0 – 30	0	Very Poor

The presentation of audit and energy management materials by the Service Team comes after the pretest as the following action. In addition, the training participants directly carried out the practice of energy audits and management. The training participants were split into 5 groups, each with 4 persons.

A prototype that had been online connected with monitoring software for an energy audit was handed to each group. software for keeping track of energy audits. Results in practice for each group The outcomes of the energy audit made up each group (electrical energy consumption). These energy audit results can be printed out right away and used as a guide when formulating suggestions for energy management.

After the presentation of the training materials, a final evaluation was undertaken to ascertain the level of achievement before the training activities were concluded. The distribution of the final assessment of this training activity is shown in table 2 below.

Table 2. shows the distribution of the preliminary evaluation findings.

Range	Number	Category
100 – 85	5	Very good
84 -70	9	Good
69 – 50	6	Fair
49 – 30	0	Insufficient
0 – 30	0	Very Poor

The following analysis is derived from the final evaluation's findings as follows:

1. Every participant was aware of the Department of Electrical Engineering's existence inside the University of Brebes' Faculty of Engineering
2. A greater understanding of science and technology among students.
3. Participants can develop and deploy novel energy management and auditing tools.

The following conclusion may be drawn from the use of Internet of Things application training activities for energy audit and management for vocational students in the context of conservation and energy efficiency:

1. According to the findings of the evaluation, it was determined that the participants had learned new information on audit technologies and energy management.
2. The participants are capable of managing, reporting, and conducting energy audits.
3. Participants are inspired to develop new technologies.
4. The participants understood the value of following SOPs to operate electrical equipment and acting in a prudent and efficient manner when utilizing power.

4. Conclusion

Education on the use of IoT technology for energy auditing and management in the context of energy conservation and efficiency is essential. Demand for electrical energy increases as the economy grows, which can result in increased electricity rates due to wasteful energy use and non-standardised equipment. The public needs to be informed about the importance of maintaining a sustainable electricity supply. This education can improve people's understanding and behaviour in managing electrical energy. SMK N 1 Brebes, a vocational school in electricity and electronics, is relevant to conduct this activity. The results of students' skill development show that education is delivered through reading materials and energy management practices.

Energy audits are used to track energy consumption, identify sources of waste, and evaluate potential energy savings as well as provide recommendations for standardisation of electrical equipment. High electrical energy use is often caused by wasteful behaviour and lack of knowledge about equipment standardisation. Therefore, education on efficient energy management is essential.

Training using IoT technology for energy auditing and management can increase public awareness about energy conservation and the use of standardised electrical equipment. This activity also stimulates participants' interest in creating technological innovations, especially in IoT-based energy auditing.

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