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Integration of Education and Internet of Things as an Environmental Conservation Effort

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Abstract. The population growth rate and the increasing human need for food and shelter cause the environment to be sacrificed to meet human life needs. Between humans and the environment, there is a meaningful reciprocal relationship to meet their needs. In recent years, environmental issues have become an essential concern in the world. These environmental problems are global warming, garbage, and energy needs that encourage natural resource exploitation. Integrating the concept of the Internet of Things in environmental education, relating to the prevention of environmental damage. Internet of Things (IoT) is a development in the technological revolution in the industrial field. Energy saving can also be done by applying the concept of the Internet of Things. In this case, it can be done by introducing the public to smart homes and Internet of Things tools to monitor and save energy consumption. The use of the Internet of Things can increase the efficiency of energy use because users can automatically turn off a number of electrical devices when they are used enough so that no energy is wasted.

Keywords: Environmental Conversation, Internet of Things (IoT), Environmental Problems

INTRODUCTION

The living environment is a unity of a space consisting of objects, forces, conditions, and living things, including humans in it, which form a system with interplay relationships to form the continuity of life and welfare of humans and other living things [1]. The interdependence relationship between all the elements in this system is significant to know, especially by humans as the primary manager in this system. The continuity of this relationship can be maintained for the sustainability of life systems on earth.

The population growth rate and the increasing human need for food and shelter cause the environment to be sacrificed to meet human life needs. Between humans and the environment, there is a meaningful reciprocal relationship to meet their needs. According to Sastrawijaya, there is a reciprocal relationship between humans and their environment [2]. The environment affects human life and vice versa. Their environment influences humans. Humans exist in their environment and cannot be

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separated from it. Thus the environment becomes an integral part of human life to fulfill their daily needs. If the environment is damaged, the needs of human life will be disrupted. A damaged living environment is an environment that can no longer carry out its function in supporting life. Human efforts in improving the quality of life cannot be stopped because every human being is always trying to improve the quality of life further. Thus, the environment that is part of the factors supporting human life quality becomes an object to fulfill human needs. With an increase in population coupled with a rapid change in civilization and an increase in human needs that are so diverse, natural resources will decrease due to efforts to meet human needs. Thus, the environment is increasingly being utilized and will reduce its carrying capacity. Humans will exploit natural resources on a large scale to meet their needs. If this exploitation is not carried out wisely, there will be environmental gaps that impact environmental damage.

Fulfilling the needs of human life is carried out through business and service activities. Inevitably, the final product in this process in meeting human needs in the form of clothing, food, and shelter will produce the final product in waste. Waste in the final process of supplying human needs will become a burden for the environment to degrade it. The more massive amount of waste that is not degraded will cause problems for the environment, namely environmental pollution [2]. Besides, to the result in the form of waste from the process of providing goods and services for humans in the form of waste that cannot be degraded by the environment, a lack of human understanding of the importance of the environment so that humans carry out massive exploitation of natural resources which causes a decrease in environmental quality in the form of environmental pollution and reduction. natural resources.

Environment issues in Indonesia include deforestation; water pollution from industrial wastes, sewage; air pollution in urban areas; smoke and haze from forest fires. International environmental groups have pressed Jakarta to accept environmental responsibility in its territories, monitor pollution in its national territorial waters and to take legal action to prevent the destruction of its rain forests [6]. Environmental pollution occurs when the material cycle in the environment changes so that the balance in terms of structure and function is disturbed. The imbalance of the structure and function of the material cycle occurs due to natural processes or also due to human actions. In this modern century, there are many human activities or actions to fulfill biological and technological needs, which cause environmental pollution [7]. In an effort to change the environment, matters of human life to improve their welfare can cause a problem called pollution [8].

If there is a business and / or activity that will produce waste, it must first be managed before discharging it to the environmental media, so that it does not cause environmental pollution and / or damage. In that case, the waste generated by a

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business and / or activity can be used as raw material for products. However, the utilization process will produce waste, as residue that cannot be reused, which will be disposed of in environmental media [9]. As a factual example of the construction of waste from factories / industries by emitting an unpleasant odor, or in the form of a population of liquid materials. This is the impact of the construction of factories or industries, on the one hand it has a positive multiplier effect for the surrounding environment, including opening up jobs and absorbing labor. But on the other hand, it is also necessary to tackle the emergence of pollution and environmental damage around the industrial area, both preventively and repressively [10].

The quality of the environment is currently decreasing due to excessive exploitative action against nature without paying attention to the carrying capacity of the environment and its ecological functions. For example, excessive deforestation can lead to catastrophic floods and landslides, and the use of dynamite for fishing can damage coral reefs. Some of these things are acts of unwise human behavior towards the environment [11]. The lack of citizen awareness of the environment also occurs due to the perception that the use of nature for humans is a natural thing. For example, cutting down trees for human needs and littering is a natural thing because there are no strict rules for this. If this is still allowed, damage to the natural environment will occur [11].

This condition encourages the need to provide understanding to the younger generation in Indonesia about the importance of caring for the environment. Basically, it is the responsibility of all of us to care for and maintain the environment, the earth and everything in it. Concern for the environment can be instilled through character education caring for the environment, especially in schools. Environmental problems cannot be separated only technically, but what is more important is a solution that can change mentality and awareness of environmental management. To overcome the impact of environmental damage, a change in attitude and behavior in society and moral improvement through education is needed [12].

With increasing environmental pollution problems and reduced natural resources, an understanding of environmental conservation efforts is needed. Law Number 32 of 2009 on Environmental Protection and Management states that everyone has the right and role in environmental management [3]. This means that whoever he is, either the government or the community must take part in environmental protection and management efforts. Schools as educational institutions and educational institutions for humans are the main target to be involved in efforts to manage the environment through implementation in every subject in education.

Law Number 20 of 2003 about National Education System states that education is a conscious and planned effort to create a learning atmosphere and learning process that enables students developing their potential to have religious, spiritual strength,

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self-control, personality, intelligence, noble morals, as well as the skills needed by him, for the prosperity of society, nation and State [4].

Understanding the importance of protecting and preserving the environment to maintain sustainability and balance in life on this earth needs to be understood by humans. This understanding must be instilled from generation to generation. Humans must understand the basic understanding of the importance of the environment, living things in this system who can think and have a conscience to capture information, culture, and technology [5]. Awareness of the importance of the environment needs to be instilled in humans and needs to be done early on so that the values of love for the environment are embedded. It is hoped that the embedded values of love for the environment will continue to increase knowledge and understanding of the importance of the environment to raise awareness to protect and preserve the environment. This underlines the importance of environmental education in schools ranging from elementary to tertiary education.

Environmental education is a process where there is learning that makes people aware of environmental problems around them. Environmental education aims to increase individuals' positive attitude in preserving the environment so that it is useful for increasing caring attitudes towards the environment in society. The living environment includes the natural living environment, the non-living natural environment, the artificial environment, and the social environment that affect the life and welfare of humans and other living creatures.

The importance of environmental education is that the Minister of Environment and the Minister of National Education issued a joint decree Kep No 07 / MenLH / 06/2005 No 05 / VI / KB / 2005 for the guidance and development of environmental education. This joint decision emphasizes that environmental education is carried out in an integrated manner with existing subjects. This has led the government to include environmental education in the school curriculum, at the elementary, junior high, and high school education levels inserted in certain subjects following environmental education.

Internet of Things (IoT) is one of the new trends in the world of technology that will likely become a trend in the future. Simply put, the IoT connects physical devices such as lights, televisions, refrigerators and even doors to the Internet continuously and can be controlled remotely via a user's device. According to Burange and Misalkar, the Internet of Things (IoT) is a structure where objects, people are given an exclusive identity and the ability to relocate data through the network without requiring two-way touch between humans, for example, source to destination or human-to-computer interaction [13]. According to Wang et al [14], of all the activities that exist in IoT is to collect the correct raw data in an efficient manner; but what is more important is to analyze and process raw data into more valuable information. The access capabilities of the IoT can be unlimited thanks to IoT devices that are

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always connected to the Internet, so they can be accessed and used anytime and anywhere.

IoT aims to expand the benefits of perpetually connected internet connectivity. As for abilities such as data sharing, remote control, and so on, including objects in the real world. For example food, electronics, collectibles, any equipment, including living things which are all connected to local and global networks through embedded sensors and are always on [15]. The internet of things is a concept in which the virtual world of information technology blends with real objects in the real world. This is possible by providing certain sensors to an object so that the object can capture events that occur in the real world as data and then send it to the server system. These sensors can be in the form of RFID or other sensors that work like the human senses such as sensors for light, sound, pressure and others. In some internet of things systems, objects that have sensors are also given the ability to carry out reactions ordered by the server through an embedded controller based on what is happening in the surrounding environment [16]. This allows a job to be done without human intervention. For example, a temperature sensor that is placed on a boiler will catch a certain temperature and send data to the server. The server will instruct the boiler to stop working through the controller when the temperature reaches a certain degree of height [16].

Internet of Things (IoT) is a development in the technological revolution in the industrial field [3]. The existence of IoT can make a major contribution to development such as smart cities, smart environments, smart governance, smart branding, smart living, and smart education. Zanella, Bui, Castellani, Vangelista, & Zorzi [17] suggest that the use of IoT can be built on a complex architecture, a variety of devices, which are integrated in a communication system. In the field of education, IoT has an important role to help organizations monitor and control educational activities. Like several activities, namely to control entrances and exits, monitor access in the library, and help monitor student and staff attendance. The application of IoT in higher education can also be developed for several benefits such as energy savings, health checks and administration [18].

Since the Internet of Things is usefull to save usage, this can have a positive impact on environmental conservation. So that the use of the internet of things should be encouraged in Indonesia, especially in providing this material for environmental education. Therefore, this study is the integration of education and internet of things as an environmental conservation effort.

LITERATURE REVIEW

1.1. Environment Education

The implementation of environmental education can be done through education in general or through formal education, namely schools [19]. Environmental

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education in the formal education pathway can be pursued through two approaches: monolithic and integrative. Monolithic approaches are based on the idea that each subject is an independent component in the curriculum and has a specific goal in complete unity. This approach system can be pursued in two ways: building a new scientific discipline called Environmental Education (EE), which will later be used as a separate subject from other sciences, and building a PLH package, an independent subject. An integrated approach is an approach based on the integration of Environmental Education subjects with other subjects. This approach can be taken in two ways: building a unit or series of subjects prepared to be integrated into specific subjects and building a core program starting from a particular subject.

Environmental education (EE) is education about the environment in the context of internalization directly or indirectly in forming an independent personality and patterns of action and mindset of participants to reflect in their daily lives. EE is an effort to conserve and protect the environment and ecosystems of living things that can contribute to the continuity of life that is balanced and harmonious [20]. EE learning materials need to pay attention to three crucial elements: the heart, mind, and hands. To raise human awareness of the environment around it, the most important thing is to touch the heart. If the awareness process has occurred and changes in attitudes and thinking patterns towards the environment have occurred, then it can be done to increase knowledge and understanding of the environment (thoughts), as well as increase skills in managing the environment (hands). A deeper understanding of the environment according to No. 32 of 2009 is the unity of space with all objects, forces, conditions, and living things, including humans and their behavior, which affect nature itself, the continuity of life, and the welfare of humans and other living things [20].

Environmental problems are caused by the inability to develop a social value system, a lifestyle that cannot make our lives in harmony with the environment. Building a lifestyle and attitude towards the environment to live in harmony with the environment is not an easy job and can be done quickly. Therefore, the education path is the right means of building a society that applies sustainability and environmental ethics principles. Educational paths that can be taken from Kindergarten to Higher Education level. Therefore, the long-term goal of PLH is to develop citizens who know the biophysical environment and its related problems, raise awareness to be effectively involved in actions towards the development of a better, livable future, and generate motivation to do it [20].

The objectives of environmental education can be broken down into six groups, namely (a) Awareness, which is to encourage each individual to gain awareness and sensitivity to the environment and its problems; (b) Knowledge, which helps each individual to gain various experiences and basic understanding of the environment and its problems; (c) Attitude, namely helping each individual to obtain a set of values

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and the ability to get the right choice as well as developing a feeling that is sensitive to the environment and providing motivation to participate actively in environmental improvement and protection; (d) Skills, namely helping each individual to acquire skills in identifying and solving environmental problems; (e) Participation, which is to motivate each individual to participate actively in solving environmental problems; (f) Evaluation, which encourages each individual to have the ability to evaluate environmental knowledge in terms of ecological, social, economic, political, and educational factors [20].

Based on the above objectives, it is implied that environmental problems are primarily related to humans, not just the environment. Therefore, in developing the EE program, it must be aimed at aspects of human behavior, especially human interaction with the environment and the ability to solve environmental problems. With about the environment, but also must have a basic understanding of humans [20].

Furthermore, the goals of EE must be in line with the goals of education in general. It is very unrealistic to think of human education in segments. Another important thing is to help humans realize their potential [20]. The past failure was because formal educational institutions put too much emphasis on individual achievement to compete to be the best for awards. As a result, individuals become egocentric and find it difficult to place themselves into a small part of a more extensive system, both social and natural systems, even though perceptions of both systems (social and natural) and ecological perceptions are essential for solving environmental problems [20]. The existing education system does not contribute to the proper use of skills and talents necessary for self-esteem and solving problems faced by society; it is only focused on the intelligence aspect. Thus an essential thing in overcoming environmental problems is a fundamental change in human attitudes towards the environment [20].

If EE's goal is to emphasize changing attitudes, the learning steps can expose students to existing environmental problems. After that, it was continued with the clarification of values; namely, students were allowed to assess conditions, make solution choices. Attitudes will be formed in this way and strengthened by increasing the teacher's number of examples [20].

One of the learning models that can be applied in the classroom is the environmental learning model, an environment-based learning model developed so that students gain more experience related to the surrounding environment. The environmental learning model is a learning model that prioritizes student experience about the surrounding environment. Students can easily understand the content of the material presented, that is, the environmental learning model is intended so that students can have concern for the surrounding environment [20].

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The environmental learning model is used to easily interact with learning materials that have been compiled and adapted to the learning model. In the book Environmental Learning and Experience and an Interdisciplinary Guide for Teachers, it is stated that in the framework of environmental learning, there are principles that help teachers design materials and learning strategies based on the environment or natural surroundings. The first principle is direct experience, which stimulates students' reactions, sensitivity, and negotiation to problems that arise in their environment. The second principle is how students, through their experiences, can describe and deduce principles about the concept of the environment and its preservation.

The learning materials presented to students are prepared by involving the surrounding environment by inserting environmental themes into the learning material or holding learning activities in the natural environment. That is, learning can be done in the classroom and outside the classroom with the aim that students are more comfortable and active in the learning process.

Some things that must be considered in the environmental learning model, namely the content and learning procedures, must be according to the learning environment. The knowledge provided must provide a way out in responding to environmental problems. The fruit of the education and learning process will ultimately boil down to the environment. The benefits of successful learning will be felt when what is gained from learning can be applied and implemented in life's realities. This is one of the positives behind learning with an environmental approach.

The environmental learning model is an environment-based learning model that aims to make students concerned about the environment. This learning model can be done with a learning system outside the classroom so that students have more experience and the learning process can be fun.

The learning model with an environmental approach is not a new learning approach but is well known and popular, it is just that it is often forgotten. As for what is meant by an environmental approach is a learning strategy that uses the environment as a learning target, learning resource, and learning tool. Learning with an environmental approach is very effective in schools. Students' concepts of science and the environment around students can be easily mastered through observations of concrete situations.

Basile said that learning with an environmental approach encourages students to learn to "do science" instead of just learning to "know science". Using nature as an outdoor laboratory helps conditions conducive to learning. The positive impact of environmental learning implementation is stimulating students to be curious about everything in their environment [21]. If we reflect on the four pillars of education: learning to know, learning to be, learning to do, and learning to live, it can be

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implemented through learning with an environmental approach packaged in such a way by the teacher.

1.2. The Concept of Internet of Things

The Internet of Things is a technological revolution that represents the future of computers and communications, whose development depends on the dynamics of technological innovation in various fields, from wireless sensors to nanotechnology. [2]. This technology is designed to connect various types of objects and devices every day into a network and a large database. Each object and device is identified by technology such as RFID (Radio-frequency identification), then changes in its physical status are detected using sensor technology [22]. Not only that, every object has some kind of intelligence system embedded in it to empower the network power with the required information processing. Then the whole system is minimized in such a way using nanotechnology, thus enabling various types of objects in this world to be intelligently connected [22].

The use of embedded intelligence technology will transform each object into "smart objects" which can make their own decisions to respond to their environment in a network. This technology will produce a variety of smart devices and equipment, from clothing, vehicles, homes, offices, to roads and other public facilities. The Internet of Things will realize the vision for a fully responsive and interactive network environment [23].

With the potential benefits and advantages that the Internet of Things will provide, the widest possible opportunity is opened for developing countries to improve the quality of life of their people. Various applications are being developed such as Nanofilter, Nanomembrans, and Nanosensor technology in Bangladesh to produce quality drinking water, Nanotechnology to diagnose certain diseases, use of wireless sensor technology to monitor natural disasters, improve the quality of victim evacuation, and so on [24]. Therefore, next-generation communication technology is predicted to come from developing countries, especially China and India, as an anticipation and reaction to problems and problems that arise locally. Seeing this development, it seems that the Internet of Things will truly give birth to a radically new ecosystem. The internet, which has triggered the information revolution, will expand massively, not only in the academic world, but turning into a public and commercial network that connects all parties and objects [25]. Real-time communication, no longer limited between humans, but also between objects, anytime and anywhere. And education as one of the most important sectors in life, of course, will become a very challenging application field for the Internet of Things.

IoT (Internet of Thing) can be defined as the ability of various devices that can connect and exchange data through the internet network. IoT is a technology that allows control, communication, collaboration with various hardware, data via the internet network. So it can be said that the Internet of Things (IoT) is when we

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connect something (things) that are not operated by humans to the internet [26]. But IoT is not only related to remote device control, but also how to share data, virtualize real things into the form of the internet, and so on. The internet becomes a link between machines automatically. In addition, there are also users who act as regulators and supervisors of the operation of these tools directly. The benefit of using IoT technology is that the work done by humans becomes faster, younger and more efficient [27].

Another similar meaning, Internet of Things (IoT) is a concept / scenario where an object has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. "A Things" in the Internet of Things can be defined as a subject, for example a person with a heart implant monitor, a farm animal with a transponder biochip, a car that has a built-in sensor to alert drivers when tire pressure is low [28]. So far, IoT is most closely related to machine-tomachine (M2M) communications in manufacturing and electricity, oil and gas Products built with M2M communication capabilities are often referred to as smart systems or "smart" (eg smart label, smart meter, smart grid sensor) [29]. This concept was less popular until 1999, but IoT has been in development over the decades. The first Internet tool, for example, was the Coke machine at Carnegie Melon University in the early 1980s. Whether or not there is a cold drink waiting for them, without having to go to the machine [31].

The term IoT (Internet of Things) became known in 1999 when it was first mentioned in a presentation by Kevin Ashton, cofounder and executive director of the Auto-ID Center at MIT. With the development of internet infrastructure, we are moving towards the next chapter, where it is not only smartphones or computers that can connect to the internet [32]. However, various kinds of real objects will be connected to the internet. Examples could be: production machines, automobiles, electronic equipment, wearables, and including any real object which is all connected to local and global networks using embedded sensors and / or actuators.

RESEARCH METHOD

This type of research is library research, a series of studies relating to collecting library data, or research where the object of research is explored through a variety of library information (books, encyclopedias, scientific journals, newspapers, magazines, and documents). Literature research or literature review critically examines or reviews the knowledge, ideas, or findings in academic-oriented literature [30]. The research data comes from a series of relevant journals discussing environmental education and Internet of Things (IoT).

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FINDINGS AND DISCUSSION

1.3. Environmental Problems in Indonesia

Modern urban growth in Indonesia began in the 1870s [33]. The share of urban populations jumped from 3.8 percent in 1930 to 17.1 percent in 1960 and 52.6 percent in 2009. Today, Indonesia's total population is 260 million people. Between 1960 and 2009, the population grew at a rate of 1.9 percent per year, but the urban population grew at a rate of 4.6 percent per year. More than 90 percent of the urban population is located in Sumatra, Sulawesi, and Java-Bali, the latter region having by far the largest urban population. Urbanization is linked to economic growth, but, as shown by Blane Lewis, the pace of urbanization is negatively correlated with economic output [34]. A plausible explanation for this result is that the speed of Indonesia's urbanization has overwhelmed the government's ability to meet infrastructure needs. Therefore, it is not the pace of urbanization per se that negatively affects growth, but rather the government's inability to invest sufficiently in the required infrastructure, a failure that also abets congestion, pollution, and health problems. Time-series data show that local governments that invest heavily in infrastructure are able to cope somewhat with the apparent detrimental effects of rapid urbanization on economic growth.

As Indonesia's urbanization accelerated, pollution of all kinds increased. One of the main issues is solid-waste management—the others being air and water quality [35]. The amount of garbage in big cities and metropolitan areas is increasing exponentially, contributing to a degradation of environmental quality [35]. Domestic waste and toxic and hazardous pollution cases also increased. Solid waste per capita increases as incomes rise and, in cities, the amount of solid waste expands more than twice as fast as the rate of population growth. At present, between 15 and 40 percent of waste is not getting collected at all. As a result, much ends up in uncontrolled dump sites, leading to leachates that contaminate groundwater and contributing to the proliferation of disease-carrying pests. Some uncollected wastes are burned, adding to urban air pollution, and an estimated 30 percent ends up in rivers and canals, where it can contaminate water in low-lying residential areas [35].

1.4. Environmental Education Practices in Indonesia

Indonesia is one of the countries in Southeast Asia, with more than 17,000 islands stretching from Sabang to Merauke. Geographically, Indonesia is located between the Indian Ocean and the Pacific Ocean, between the Asian and Australian continents. Indonesia is also the area where the three plates of the world meet, namely the Indo-Australia, Eurasia, and the Pacific plate. This archipelago is located on the rings of fire, which makes it prone to potential natural disasters. Natural disasters that occur in Indonesia are very diverse, ranging from geological, oceanological to meteorological disasters. Disaster is an event or series of events that threatens and disrupts people's

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lives and livelihoods caused, both by natural and non-natural factors as well as human factors, resulting in human casualties, environmental damage, property loss, and psychological impact. Some of the disasters in Indonesia are purely the result of natural phenomena such as tsunamis, earthquakes, and volcanic eruptions. Part of it is disasters due to human intervention, such as floods, landslides, and drought.

Problems related to the environment are the problems of all citizens, including the government, society, teachers, and especially students, to create awareness starting from an early age of the environment's important because students are the nation's successor generation. Therefore, education may be the right place to build the nation's next generation to apply sustainability principles and environmental ethics [20]. Education can be taken from childhood to college. Therefore, environmental education is a form of development for citizens to know the environment and foster a sense of care for the environment in the future.

In Indonesia, the development of the implementation of environmental education began in 1975. IKIP Jakarta (now Jakarta State University - UNJ) for the first time pioneered the development of environmental education by compiling the Outlines of the EE Teaching Program, which was piloted in 15 elementary schools in Jakarta in the period 1977 / 1978. In 1979 the Center for Environmental Studies was formed in various public and private universities. Simultaneously, the development of Environmental Impact Analysis education was started by all Center for Environmental Studies under the coordination of the State Minister for Development and Environmental Monitoring. Besides, various public and private universities have begun to develop and form special study programs for environmental science and environmental education. The environmental science study program pioneers are IPB Bogor and UI Jakarta, while the environmental and population study program is IKIP Jakarta.

At the primary and secondary education levels (general and vocational secondary), the delivery of population and environmental problems is integrative in the 1984 curriculum system by incorporating population and environmental issues into almost all subjects. Since 1989/1990, the Ministry of National Education has introduced various environmental training for elementary, junior high, and high school teachers, including vocational schools. Various NGOs also carried out environmental education development initiatives. In 1996/1997, the Environmental Education Network was formed between NGOs interested and concerned about environmental education.

1.5. The Contribution of Internet of Things in Environmental Education to Environmental Conservation

The surrounding environment is damaged because it is not properly maintained so that the environment is polluted and damaged, so humans are unable to avoid the negative impacts it causes. In the end, human life is threatened. When the environment has been damaged, we just realize the importance of environmental

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preservation. Increased awareness and a form of environmental concern in today's society continues to develop until now. Humans are increasingly aware of the importance of preservation for their survival, both for the present and for future generations. Humans do keep trying to improve their welfare. However, this does not mean that we must destroy and pollute the environment so that it threatens the preservation of life and reduces the rights of future generations. Therefore what must be done is to carry out sustainable development. This means continuing to build to improve welfare without reducing the rights of future generations. The ways to prevent pollution and strive for environmental sustainability are the responsibility of the Government and each individual. Basically, there are 3 (three) basic principles that can be carried out to preserve, prevent and combat pollution, namely as follows. (1) Administratively (there are regulations / laws from the government); (2). Technologically (the existence of waste processing equipment, waste burners); (3). Educatively / educationally (doing outreach to the community, education in schools). [36]

Administrative countermeasures, namely a number of efforts related to administrative or statutory regulations, or related regional leadership regulations aimed at preventing damage and preserving the environment. As it is known that development in Indonesia is a whole human development, meaning development in the material and spiritual fields in a balanced manner [37]. This is intended so that there is no imbalance between the fulfillment of the physical needs of the community and the psychological needs which are the determining elements of a person's actions in social life. Therefore, one of the physical material fields that is closely related to the psyche is about the environment, which includes land, water, forest and air, all of which are closely related to human life. Talking about long-term national development, of course, environmental problems should not be underestimated. So in order to carry out preservation, prevention and countermeasures, countermeasures are carried out administratively.

Administratively, binding rules and laws are required. Therefore, various regulations regarding the environment must be properly implemented. More clearly, the maintenance and development of the environment is disclosed in the Basic provisions of Environmental Management in Law No. RI No. 4 of 1982 and in effect since March 11, which explains: environmental management is based on the preservation of sustainable, harmonious and balanced capabilities to support sustainable development for the improvement of human welfare [6]. Likewise regarding the Government of the Republic of Indonesia Regulation No. 29 of 1986 concerning Environmental Impact Analysis (AMDAL) which was established on 5 June 1986 and came into effect on 5 June 1987 must be taken seriously. From this provision, it is hoped that the community will realize that a good and healthy environment has great benefits for the community itself [6].

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The government issued various policies to prevent pollution and prevent excessive exploitation of natural resources. Regulations and laws have been passed. For example, before disposing of their waste into the environment, the industry is obliged to have a liquid waste treatment facility, or to install an air filter in chimneys. Factory products (goods) must be environmentally friendly. For example, it does not produce goods that can pollute the environment. Production of CFC group gases for example will be stopped because it can cause the depletion of the ozone layer in the statosphere. Disposal of factory waste must be carried out in certain places. For example, in Surabaya there is an incenator, which is a place for burning waste with a very high temperature so that it does not produce smoke, and the resulting ash can be used for other purposes [36].

Technologically, environmental preservation is carried out using technologies that prevent environmental damage, such as the most up-to-date waste treatment technology and other latest technologies. Some industries have a waste processing unit, for example a liquid waste processing unit, which is used to treat liquid waste before it is discharged into the environment. In the process of processing liquid waste, it is classified into 3 parts, namely: physical processes, chemical processes, and biological processes. These three kinds of processes do not run independently, but sometimes must be carried out in combination with one another [25].

Meanwhile, educatively, namely through education in formal and non-formal institutions. With educational countermeasures, education is needed to the community [38]. With education, it is hoped that the community will have environmental ethics [39]. Various community outreach activities were held to increase public awareness of the importance of environmental sustainability. Likewise education through schools [25]. Every individual should not pollute the environment. For example, not throwing waste (human waste, household waste) into any place, but in the trash. Candy wrappers, cakes, not thrown anywhere. Put the candy wrappers in your bag / pocket first, before finding the trash can to throw out the trash. Another example is the repeated use of paper, plastic bags, cans before throwing them into the trash.

Apart from instilling the value of cleanliness, another form of education for environmental preservation is to instill the importance of saving energy. Behaving wisely in the use of energy is an implementation of efforts to repair damaged nature. The government conducts outreach to increase public awareness of the importance of saving energy. In order to support the energy saving program, the government, in this case the Ministry of Energy and Mineral Resources, through the Directorate General of New and Renewable Energy and Energy Conservation (EBTKE) has organized the Home and School Energy Efficiency Champion (HSEEC) in 2013 and 2014, namely socialization programs in a number of schools. -schools to carry out

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energy saving activities and monitor and report energy consumption to the competition committee.

Environmental conservation is closely related to energy efficiency and energy conservation. Various existing natural resources, both renewable and non-renewable, have been exploited so far to produce energy for human needs. In order to keep it but sustainable, the various existing resources must be utilized and managed properly. Natural resources that are not renewable need to be used as efficiently and as long as possible and natural resources that can be renewable must be maintained so that their ability to renew themselves is always maintained [40]. So that the function of these natural resources can always be maintained throughout the ages. Natural resources that are not renewable must be able to be used optimally so that there is no waste which can then become environmental pollution. Natural resources and mining resources are indispensable for human needs such as technological and industrial purposes. The more wasteful the use of energy, the more areas to be exploited. If exploitation is carried out uncontrolled, it will cause environmental damage [6].

Energy saving can also be done by applying the concept of the Internet of Things. In this case, it can be done by introducing the public to smart homes and Internet of Things tools to monitor and save energy consumption. The use of the Internet of Things can increase the efficiency of energy use because users can automatically turn off a number of electrical devices when they are used enough so that no energy is wasted. Energy efficiency in buildings is very important for environmental sustainability globally [33]. Meanwhile, the cost of traditional fossil fuels is increasing and the negative impact on the planet's climate and ecological balance is very important for us to explore renewable energy sources and improve energy efficiency on the consumer side. Usually, the Internet of Things is applied to buildings with certain structures that allow the system to work properly. However, this does not mean that this technology can only be used by non-conventional buildings, this system can also be used in conventional buildings and buildings by analyzing the building structure first. These results can be used for further design in implementing IoT-based network systems to build appropriate methods and strategies that can increase energy efficiency for both "Green" and "Non Green" (conventional) [41]. There are three key aspects in the division of the system, namely [41]:

Energy Monitoring: Through the communication network, energy consumption and growth is monitored and the use of any slightest difference of energy including entire buildings, floors, departments, laboratories, rooms and even their occupants. Energy Modeling and Evaluation. Through off-line modeling and evaluation, identify patterns of energy consumption and the factors that can influence consumption levels and their impact. As well as the IoT System for Apply Practical Changes and Strategy adjustments The modeling and evaluation of the results are used to identify

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the main building components, to implement adjustments, and to design strategies to reduce energy consumption. Network systems designed based on IoT and prototypes can realize strategies and achieve desired goals.

CONCLUSION

Internet of Things (IoT) is a development in the technological revolution in the industrial field [3]. The existence of IoT can make a major contribution to development such as smart cities, smart environments, smart governance, smart branding, smart living, and smart education. Environmental conservation is closely related to energy efficiency and energy conservation. Various existing natural resources, both renewable and non-renewable, have been exploited so far to produce energy for human needs. In order to keep it but sustainable, the various existing resources must be utilized and managed properly. Energy saving can also be done by applying the concept of the Internet of Things. In this case, it can be done by introducing the public to smart homes and Internet of Things tools to monitor and save energy consumption. The use of the Internet of Things can increase the efficiency of energy use because users can automatically turn off a number of electrical devices when they are used enough so that no energy is wasted.

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