# CAN GREEN ICT BE APPLIED TO THE CAMPUS WITH THE GREEN CAMPUS AWARD? AN EXPLORATORY STUDY ON THE FACULTY OF AGRICULTURE IN INDONESIA

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## ABSTRACT

The development of information technology in the campus environment is one form of business process implementation support. However, ICT's role does not necessarily have a positive impact and it also has a great opportunity to have a negative impact. ICT is actually not environmentally friendly due to the large amount of energy used to operate the equipment, increased energy costs and also the resulting waste. The aim of this research is to comprehensively describe the efforts of applying Green ICT in the Green Campus environment of the Faculty of Agriculture, UPN "Veteran" East Java, Indonesia. The research samples consisted of the managers of the Faculty of Dean and Vice Dean, the head of laboratories, lecturers, and employees that were known to be as many as 50 respondents and then analyzed using the Principal Component Analysis. The results concluded that the campus with the predicate "Green Campus" can perform and consistently on environmental conservation efforts, especially in the context of the use of ICT, through the change in the area of working areas combined with Stakeholder change in the campus environment.

**Keywords:** Green ICT, Green Campus, and Factor Analysis.

## INTRODUCTION

Education also has an important role in the progress of a country (Baglieria, Francesco and Christopher, 2018), because with education can bring people into professional human resources that are useful for ourselves and sustainability social community (Olalla and Amparo, 2019; Lozano et al., 2013). In the disruption era, demands campus as a structured organization with the main activities of producing graduates, academic works of lecturers, research and community service and supporting activities, including academic services, financial services, personnel, information system services, facilities and infrastructure services, and student services, are supposed to be done management oriented to the business process.

Davenport (1993) defines business processes as measurable and structured activity to produce specific outputs for specific customer circles. There is a strong emphasis on "how" the work is run in an organization, unlike the focus of products that focus on the "what" aspect. A process is therefore a specific sequence of work activity across time and space, with a prefix and suffix, and clearly defines inputs and outputs. A college is said to be good by organizing the educational business to synergize its functions and business processes between departments, can forget the traditional way and have an open mind to the opportunities offered (Baglieria , Francesco and Christopher, 2018; Haertle, Parkes, Murray, & Hayes, 2017; Karatzoglou, 2013; Rasmussen et al., 2006; Wals, 2014).

The development of information technology in the campus environment is one form of business process implementation support. Along with the ease of use of the computer, there is also the impact.

The increase in the number of computers used, the replacement of old computers with new, makes the environmental impact very ematable. Murugesan, (2008) present the use of IT to meet human needs not escape from electricity consumption, so that the increase in electricity use affects the increase in the production of carbon dioxide gas so that there is a rise in earth temperature called global warming. Carbon dioxide emissions and their impact on the environment and global warming can be reduced when electricity consumption can be reduced. A study conducted Kochhar et.al. (2011) generates some interesting facts i.e. the average desktop computer requires 85 watts to be idle even though the monitor screen is not lit. If the computer is idle within just 40 hours in addition to 168 full hours a week, more than 40 dollars for energy costs can be saved annually, one computer is left lit 24 hours a day requiring a fee between 115 to 160 dollar energy costs per year and in addition to forming 1500 $CO_2$ pounds in the atmosphere. Otherwise, a tree will absorb 3-15 $CO_2$ pounds per year. This means that it takes up to 500 trees to absorb $CO_2$ emissions annually from a single computer that lights up throughout the day.

Further exploring the amount of energy used to operate computer equipment, the increasing energy costs and waste generated due to human indifference to the environment. Therefore, efforts should be made to reconstruct awareness and thoughts known as Green ICT. Green ICT is a general concept related to efforts to reduce energy consumption and natural resources, in addition to emissions and waste generated from activities in the field of information and communication technology. The application of the Green ICT concept is widespread in various business processes. In principle, business people or anyone who uses ICT service support is expected to be able to do efficiency to support the preservation of the surrounding environment (Molla, 2008; Mingay, 2007; and Murugesan, 2008; 2011).

Faculty of Agriculture National Development University "Veteran" East Java is one of the campuses that carry out its business process with environmental oriented (Strategic Plan of UPN "Veteran" East Java year 2015-2019). Achievement as a eco campus predicate in 2011 and 2016 proved that the faculty not only focus on the curriculum of agricultural ecosystems but also strive to provide facilities for learning and teaching environment is environmentally friendly. The campus also has a wide natural laboratory. In addition, it is used as an open research place and also as an educational tourism place that is divided into various zones. Zone 1 is for Office and educational activities, agroforestry, verticulture, and hydroponics. Zone 2 contains a collection of ornamental plants, green houses, nurseries and hardening. Zone 3 is a discussion park, a collection of medicinal plants, as well as organic waste processing. Zone 4 is the cultivation of oyster mushrooms, vegetable garden, and practicum area and research area. Zone 5 is used as a pond, a collection of rare crops, and climatological stations. Lastly there is a Zone 6 for agropreneurship that contains campus education trainings. Stickers or labels save water and electricity use has been widely installed in various places, and all academic civitas both lecturers, staff and students have the same understanding to implement them.

Observing the phenomena put forward by looking at the application of Green ICT on a green campus is an interesting idea to be implemented into a study. Creating an environmentally friendly work environment, optimizing existing work to be more effective and efficient and as a basic learning campaign for students in applying environmentally friendly technology in Work and in everyday life. Suryawanshia and Sameer (2015); Posner and Ralph (2013), expressed the lack of motivation and rationale to adopt green policy among the executor really is an obstacle in the sustainable application of Green ICT at higher education institutions in the future. Pattinson (2017) provides recommendations in his research that researching educational institutions requires the involvement and awareness of all elements therein to make changes, so as to verify the positive differences in ICT. Therefore, this research presents a novelty of concept in which Green ICT's perspective on the campus by obtaining the predicate of the Green campus, which has not been found in many scientific journals. The proposed research question is can the concept of Green ICT be applied to the green campus? Because the proposed paradigm is a green campus means all elements therein think and behave green and have institutional policies that lead to environmentally friendly.

**METHODS**

*Location*

The research was conducted by purposively establishing in Faculty Agriculture of UPN "Veteran" East Java. The main consideration is that this campus has gained several times the Green Campus Award from the Surabaya city government, and it is the only city in Indonesia to receive the Global Green City award organized by Organized by the United Nation Environment Program.

*Sample*

The research was designed by taking samples of the parties who are directly involved with the daily ICT implementation. The research samples consist of the management of the faculty, the Dean and Vice Dean, head of laboratories, lecturers, and employees so it is known that as many as 50 respondents.

*Data Analysis*

Principal Component Analysis (PCA) is a statistical technique that linearly converts the form of a set of native variables into smaller, uncorrelated variables that can represent information from a set of native variables (Andersson et.al., 2010). Tabachnick (2001) explains the PCA (Principal Component Analysis) is a statistical technique applied to a set of variables when researchers are interested in discovering which variables in the group relate to others. Variables correlate to one another but independently of the other subset which is a variable-variabei combination within the factor. The factor is that reflects the underlying process that has a correlation between variables.

The purpose of PCA is to explain part of the variation in the set of variables observed on the basis of several dimensions. From variables that are widely converted to fewer variables. PCA objectives are:

a. Summarize the correlation pattern between the variables observed.
b. Reducing a large number of variables into a small number of factors,
c. Provide an operational definition (a regression equation) the underlying dimensions of the use of observable variables.
d. Test the underlying theory (Tabachnick, 2001).

The analysis Model factor is expressed with the following formula:
$$F_i = W_{i1}X_1 + W_{i2}X_2 + W_{i3}X_3 + \ldots\ldots\ldots + W_{ik}X_k$$

Where:
$F_i$ = Estimated to-i Factor
$W_i$ = Weight or coefficient of score factor
$X_k$ = Amount of X variables on the K factor

Variables as a measured factor in the study are:
$X_1$ : Anytime Using ICT
$X_2$ : Label Energy Saver of ICT
$X_3$ : Investation of ICT
$X_4$ : Waste Managemant of ICT
$X_5$ : Applying Hardware Biodegradable
$X_6$ : Applying Software Integrated
$X_7$ : Restrictions on Multimedia Sites
$X_8$ : Socialization of Green ICT
$X_9$ : Applying of Solar Panel
$X_{10}$ : Applying of Upgrade PC
$X_{11}$ : Applying of Sharing Printer
$X_{12}$ : Applying of E-Mail to Replace Paper
$X_{13}$ : Applying of E-Learning
$X_{14}$ : Concern of Environmentally Friendly of ICT
$X_{15}$ : Quality of Campus Services

**RESULTS**

Priority of this research is the implementation of ICT is already a part that must be guarded continuity in supporting the business process of the college, and its impact is serious about the environment, the handling of this impact should be with good planned. Most campuses are aware of the impact, but they are still tentatively. So it needs research to see the extent to which Green ICT is already done. Green ICT is a study and practice in designing, creating, and using computers, servers, monitors, printers, harddrives, communications, and networks with zero or minimal impact on the environment (Molla, 2008; Mingay, 2007; Murugesan, 2008).When Green ICT's conception began to be applied, the colleges became increasingly interested in understanding and tracking their full social and environmental impacts to improve the economic sustainability of business processes. Colleges can be like a small town with a population consisting of academic staff, students, and all employees with various activities in it. The availability of supporting facilities and the management of the existing space arrangement must be able to provide a sense of comfort for the inhabitants while supporting student learning activities.

Testing of research using Principal Component analysis is known to some results. Bartlett's Test of sphericity is a statistic test for the overall significance of all correlation in a correlation matrix, which is characterized by significance (p value of < 0.05). From table 1 results. Visible Significance level 0.00 (P value < 0.05) The statistic test for the sphericity is based on a Chi square transformation of the matrix correlation determinant. Another statistic used is KMO (Kaiser-Meyer-Olkin) measuring adequacy sampling (sampling adequacy). The output table of KMO and Bartlett's Test is useful in knowing the feasibility of a variable, whether it can be further process using this factor analysis technique or not. How to see the value of KMO MSA (Kaiser-Meyer-Olkin Measure of Sampling Adequacy). Based on the output above is known KMO MSA value of 0.583 > 0.50 and the value of Bartlett's Test of Sphericity (Sig.) 0.000 < 0.05, the analysis factor in this research can be continued because it already meets the requirements. The Anti image to be valid when the value is greater than 0.5. The population correlation is an identity matrix, where each variable correlates to itself perfectly with R = 1, and is not at all correlated with the other (r = 0), so the element on the main diagonal of the matrix is all I value, while outside the main diagonal is value 0.

The whole variable is extracted if displayed, it can be known that the number of squared loading for each line represents the total number of variances of each item that can be described by the extracted component and called the Communalities item. Table 2. indicates the value of the variables researched whether able to explain the factor or not. Variables are considered able to explain factors if the Extraction value is greater than 0.50. Based on the output, the known Extraction value for all variables is greater than 0.50. It can therefore be concluded that all variables can be used to describe factors.

**Table 1. Output KMO and Bartlett's Test**

**KMO and Bartlett's Test**

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .583 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 269.717 |
| | df | 105 |
| | Sig. | .000 |

**Table 2. Output Communalities**

Communalities

| | Initial | Extraction |
|---|---|---|
| AnytimeUsing_ ICT | 1.000 | .757 |
| Label_EnergySaver of ICT | 1.000 | .564 |
| Investation_ICT | 1.000 | .683 |
| WasteManagemant_ICT | 1.000 | .530 |
| Applying_Hardware_Biodegradable | 1.000 | .759 |
| Applying_Software_Integrated | 1.000 | .821 |
| Restrictions_on_MultimediaSites | 1.000 | .835 |
| Socialization_Green ICT | 1.000 | .422 |
| Applying_SolarPanel | 1.000 | .567 |
| Applying_UpGradePC | 1.000 | .709 |
| Applying_SharingPrinter | 1.000 | .610 |
| Applying_E-Mail_ReplacePaper | 1.000 | .699 |
| Applying_E-Learning | 1.000 | .656 |
| Concern_EnvironmentallyFriendly_ICT | 1.000 | .837 |
| Quality_CampusServices | 1.000 | .860 |

Extraction Method: Principal Component Analysis.

**Table 3. Output Component**

Component Matrix[a]

| | Component |
|---|---|
| | 1 |
| AnytimeUsing_ ICT | .224 |
| Label_EnergySaver of ICT | -.510 |
| Investation_ICT | .023 |
| WasteManagemant_ICT | -.248 |
| Applying_Hardware_Biodegradable | -.676 |
| Applying_Software_Integrated | .502 |
| Restrictions_on_MultimediaSites | .799 |
| Socialization_Green ICT | .077 |
| Applying_SolarPanel | .175 |
| Applying_UpGradePC | -.520 |
| Applying_SharingPrinter | -.480 |
| Applying_E-Mail_ReplacePaper | .349 |
| Applying_E-Learning | .578 |
| Concern_EnvironmentallyFriendly_ICT | .301 |
| Quality_CampusServices | .799 |

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Component Matrix shows the value of the correlation or relationship between each variable with the factors that will be formed. Table 3. shows that component 1 has factors that have a correlation value close to 1, sequentially from highest to lowest, namely multimedia site Restrictions (0.799), Campus service quality (0.799), Using biodegradable hardware (0.676) and applying learning with e-learning (0.578). Multimedia site retention is and uses biodegradable hardware that reflects the perspective of the work area. The quality of campus services and learning with e-learning is a reflection of stakeholder perspectives. Therefore, to see the success or failure of Green ICT applied to the green campus is to use a level approach to the work area and actors who use computer technology.

## DISCUSSION

Green ICT as a practical effort in responding to environmental responsibility can work at different levels of work area, from the level of physical performance efficiency (hardware), algorithm optimization (software), business process reengineering, policies and rules (governance), to the formation of behavior (Murugesan, 2008). On the other hand, the intended stakeholders are each party involved in or becoming an actor or object of Green ICT. This study termed stakeholders consisting of lecturers, employees, students and university managers comprehensively and integratively in realizing the concept of Green ICT, because the concept does not stand alone but is part of an ecosystem that has subsystems related to each other (Suryawanshia and Sameer (2015); Posner and Ralph, 2013).

UPN "Veteran" East Java certainly had hope to pursue being a "world class college" therefore taking into consideration the speed of internet connection at once on the other hand apply the restriction of internet access to things not productive or wasting time either lecturers, staff or students, adoption of network technology is done by proxy server. Proxy server keeps our computer connected to the internet indirectly. When the computer uses a proxy server, the computer will connect to the proxy server first in requesting some data sources such as Web, MP3, games, videos or any other files on the internet. After obtaining the request, the proxy server will search for that data source in the internal sever hard disk cache. If indeed the file is in the hard disk proxy server then the proxy server will take it from the internal storage without the need to connect to the internet. If it does not exist in the cache server, then the proxy server will retrieve it on the internet according to client computer requests.

Restrictions on multimedia sites are the main factors forming Green ICT in the campus of the Faculty of Agriculture UPN "Veteran" East Java, which is perceived accurately and well. This multimedia site restriction policy through a proxy server restricts doing general things on the internet

such as accessing Facebook, Twitter and other public websites that are not related to work or principally control internet usage. In addition, like what has been done in several companies, to impose restrictions indirectly on the employee computer browser, the client client's computer will be connected to the local proxy server, then the proxy server that has this limitation is also tasked to share connections to other computers or known by sharing internet connection via LAN / Wireless. Another consideration for this restriction is to save bandwidth. The retention policy for multimedia sites helps university leaders save bandwidth when all employees access the same page at the same time. Accordingly, the page is already stored on the local hard disk of the proxy server, so the proxy server does not need to retrieve it again to the internet and quickly forward it to other users requesting the same page. When this happens, the user feels the internet has a very high speed and supports the ongoing learning and teaching activities.

Quality is a term whose meaning is very subjective and contextual, so the understanding of the quality of educational services will be very different between one person and another and between one agency and another agency (Baglieria, Francesco and Christopher, 2018). Even though quality must be determined to refer to an institution as quality. Operationally, quality is determined by two factors, namely first, the fulfillment of predetermined specifications or second, the fulfillment of specifications expected according to the demands and needs of service users. The first quality is called quality in fact and the second is called quality in perception.

Service means the effort to serve or provide assistance related to all the necessary affairs, and in relation to quality services, these services can be said to be quality if they meet one of the elements that is in accordance with established standards or in accordance with the needs of service users . Relationship with the concept of quality oriented stakeholders or customers, the service is said to be quality if the product or service is in accordance with customer expectations. Thus, service quality can mean customer perceptions related to the services provided, whether it is in accordance with customer expectations or needs or not. Green ICT can be interpreted as the involvement of all campus community members in combining learning and administration systems with technology in the campus environment in an effective, efficient and environmentally friendly manner so as to be able to provide quality services for users, protect the environment, and save costs. This study provides findings of service quality perceived correctly by stakeholders if they want to realize green ICT on an environmentally oriented campus.

Faculty of Agriculture of UPN "Veteran" East Java utilizes information technology in three levels, namely in providing support for services, administration, as teaching aids and means of communication as well as utilization for decision making. The use of information technology in tertiary institutions, the effectiveness in terms of service to the academic community will also increase because it does not rely solely on manual mode. As with the migration of data from papers to information systems, of course it requires no small cost. Information system development, provision of hardware and software, bandwidth and space requirements for server storage, and maintenance costs. Therefore, faculties and universities synergize and integrate with each other in developing technology or IT Master Plan requirements that are used as a reference, supported by Standard Operating Procedures ranging from purchasing to information technology management processes without ignoring the environmentally friendly principles. Chakraborty, Bhattacharyyal, & Nargiza, (2009); Pattinson (2017), agreed that in his research the term Green ICT "biodegradable" design is not referring to a product, but rather about the efficient use of computers and resources, especially on technological equipment that cannot be recycled. Kochhar & Garg (2011) added that the reliability of hardware devices is also a very important aspect of Green ICT. This is because it can reduce costs that lead to system failures and e-waste. Stakeholder perception in this study provides a description of the use of biodegradable hardware as an indicator in implementing Green ICT in the campus environment.

Considering electronic media is the result or form of information technology, a common thread can be drawn that e-learning is part or one of the examples of the use or application of information and communication technology. Characteristics of e-learning learning are flexible and distributed. The flexibility of e-learning allows students to study whenever and wherever. The distributed nature of e-learning ensures that learning material is well delivered and students have access to receive the material. E-learning classes are a form of campus commitment to Green ICT implementation. Familiarize students with using the e-learning system at universities to support the lecture and

learning process so as to minimize the use of paper and excessive electricity consumption, for example in the use of printers. Arney, Irma and Angela (2012) state that learning with the concept of paper less can reduce costs, including the use of online documents and the collection of tasks that can use lots of paper, so as to create awareness of the importance of a green campus. Agarwal, Goswami, Nath (2013) concluded that the position of e-learning in green computing is something that must be done in the best way to spread awareness to make individuals, students and management of sustainable implementation of green computing. This research also motivates that future studies can be emphasized on investment spent on ICT dissertation on the impact of the existence of the socialization of the application of Green ICT in universities so that they can complement each other.

## CONCLUSION

1. Reduction of the many variables used in the research is perical in the 4 main variables namely restriction of multimedia sites, quality of campus services, using biodegradable hardware and implementing learning with e-learning.
2. The campus with the predicate "Green campus" can conduct and consistently to environmental conservation efforts, especially in the context of the use of ICT, through the change in the area of work areas combined with the change of academic element thinking live in a campus environment.

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