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Application of IoT for The Learning Process in All Private Universities

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Abstract. Currently Indonesia is in the industrial era 4.0 which allows all non-computer objects to be connected to the internet. The development of industry 4.0 has penetrated the world of education. IoTs that support the learning process in class include smart presents, room temperature settings, automatic light settings, interactive whiteboards, study desks and IoT chairs. East Nusa Tenggara is one of the provinces in Indonesia which has several private universities, of course it is necessary to know the extent of the application of IoT's which supports the learning process in the classroom. This type of research is quantitative descriptive using statistical descriptive analysis methods to determine the application of IoT in the process of learning activities in the classroom. The population in this study were all private universities scattered throughout the East Nusa Tenggara region. The criteria for the sample were private universities that were accredited B which were scattered in the East Nusa Tenggara region, as well as the office holders. The results of the study show that there are 3 categories of using IoT applications on private campuses in East Nusa Tenggara, namely high, medium and low categories. The results of this study will be a benchmark for the Ministry of Education to assess the most popular and frequently used IoT applications by users in all private campuses in East Nusa Tenggara and become a form of special attention to increase skills and awareness in the use of IoT applications as an awareness of change. 4.0 in education.

Key words: IoT, learning process

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INTRODUCTION

The Industrial Revolution 4.0 challenge in using the Internet and popular automation robots worldwide is impacting the social, political, economic, and educational demands of the evolving global landscape (Bugallo and Kelly, 2017). Opinions are divided on the use of terms of revolution or evolution (Stăncioiu, 2017). IoT is in the early stages and a few applications are currently developed based on it (Abbasy et al, 2017). ''Anytime, anywhere, anymedia" has been for a longtime the vision pushing forward the advances in communication technologies (Atzori et al., 2010).

IoT traversed the world to a new paradigm of having daily-used objects connected to the internet (Montalbo & Enriquez, 2020). Internet of Things (IoT) is the concept of connecting the physical devices, buildings, and other items embedded with electronics, software, sensors, actuators, to the network which enable these objects to collect, exchange, and analyse the data (Lim et al, 2017).

The impacts of the emerging 4IR technology in economic and environmental terms alone will require a drastic reconsideration of the curriculum within higher education to enable students both to comprehend the individual technologies in detail and to be able to thoughtfully analyze and predict the evolution of networked systems of technology, the environment and sociopolitical systems (Gleason, 2018).

(Auliya & Suminar, 2016), mention one of the goals of national education is to develop the potential of students to become independent human beings (Law Number 20 of 2003). So that Educational outputs and outcomes are now the most important part of educational institutions (Mulyadi et al., 2020).

The influence of technology can be seen in many aspects of education from student engagement in learning and content creation to helping teachers provide personalized content and improving student outcomes. IoT can help institutions to improve the quality of teaching and learning by providing a richer learning experience and real-time actionable insight into students' Performance (Movahed & Bagheri, 2017). According to (Pervez, 2018), the Internet of Things (IoT) era without any doubt, is equipped with ubiquitous computing & networks of interconnected and Internet-enabled objects.

The IoT progress already shows a positive influence on education, moving classrooms from traditional to smart and interactive (Maksimović, 2017). Smart classrooms are actually interconnected devices (Gonda et al, 2020). (Gul, S, et al., 2020), explain smart classrooms concept means an intellectual environment equipped with advanced learning aids based on latest technology or smart things. These smart things can be cameras, microphones and many other

sensors, which can be used to measure student satisfaction regarding learning or many other related things.

Some of the commonly used IoT devices in the classroom include Interactive Whiteboards, Tablets and Mobile devices, 3-D Printers, eBooks, Student ID Cards, Temperature Sensors, Security Cameras and Video, Room Temperature Sensors, Electric Lighting and Maintenance, Smart HVAC systems, Attendance Tracking Systems, and Wireless door locks. Use of IoT in a classroom may help to provide a better learning and teaching environment. Because learning media is an important part when teachers organize a learning activities (Hazizah & Ismaniar, 2020). Focus of this research is the IoT application that is used to support teaching and learning activities in the classroom as follow.

Microcontroller Development Boards. In (Bugallo, and Kelly, 2017), explain that the attitude of microcontroller users for teachers of Design and Technology, by using microcontrollers in teaching can improve teacher achievement in teaching and learning so that students can design various smart electronics technology projects based on creative and innovative microcontrollers in practical classrooms.

Security Cameras and Video Conferencing. In (Bálint, 2021), The administration before and during lectures is a necessary, albeit an encumbering task. It includes the register of attendance considering students and lectures. This task can be automated by security cameras. During the practical realization of this system, security cameras were implemented featuring the following functions: Facial detection, Facial recognition, Headcount, Black and whitelist, and Deep learning.

Electronic Whiteboards. Electronic whiteboards (EWs), sometimes referred to as interactive whiteboards or SMART Boards (Sobel-lojeski, 2010). An interactive whiteboard is a presentation device that interfaces with a computer and data projector, creating a large computer image displayed on its surface. The user may access and manipulate computer applications directly from the interactive whiteboard and take notes using virtual whiteboard software that is a part of the technology (Basilicato, 2005). In Health department, electronic whiteboards (EWs) are large electronic wall-mounted screens that display patient-specific information and/or information about the status of tasks related to the care of individual patients, making this information available to staff at a glance, and often replacing traditional dry-erase whiteboards (Gjære & Lillebo, 2014).

Radio Frequency Identification Connect with Student ID Card. Internet of Things (IoT) is defined as The Radio Frequency Identification (RFID), infrared sensors, global positioning systems, laser scanners and other information sensing device, according to the agreed protocol, to any article connected to the Internet up to information exchange and communication, in order to achieve intelligent, identify, locate, track, monitor and manage a network (Sun, 2012). A common application of IoT in the healthcare is the use of wearable technology. Smartwatches and fitness bands are the most common use case examples of these wearable devices.

A study (Takpor & Atayero, 2015), shows how RFID technology is used to implement an eHealth solution to monitor students at risk of high blood pressure through the use of wearable devices. The system takes into consideration different students' health information such as their medical history, prescriptions, Electrocardiography (ECG) results, blood pressure and other vital signs by IoT Technology. RFID will take auto attendance for all the students entered in the class which will remove the time loss of the professor. On the other hand, Face Recognition will verify the student which will remove the proxy attendance (Patel & Dr. Priya, 2014).

Automatic Lighting System. Lighting is a very important element in educational facilities especially in classrooms (Hui et al, 2008). In (Montalbo & Enriquez, 2020), author presents develop an IoT based controller device with a cloud-based system to switch, manage, and monitor the lights of university classrooms. The project output shall aid the problem in the operation of lights from unnecessary energy consumption to save energy. The developed applications not only serve as a controller but a management system to set appropriate schedules for class hours, a monitoring system that indicates the length of usage and the total amount of energy consumed from lights. The management can set class schedules to allow the room to operate the lights on a given period if there are occupants in the room. Failure to occupy the room even with a set schedule, the lights will not turn ON, thus reducing excess energy consumption. Furthermore, lights can still be controlled over a separate remote network through the applications even beyond the given schedule.

In (Suresh, 2016), the author presents developed Automatic lighting and control using Arduino for the efficient use of energy in classroom conditions where we have divided the classroom intro grids. The system developed will control lighting in a particular area of the classroom based on the presence of humans using relay control compared to the one placed in the ceiling which would switch on or off based on presence of humans in the room irrespective of position. In addition to relay control, we have also provided mobility and remote command execution to the system using Android mobile App via

Bluetooth to control lighting based on voice command.

In (Liang et al., 2013), intelligence and energy saving for university classroom lighting, energy saving lighting control system in university classroom based on wireless sensor network is designed, including design of sensor node and sink, as well as corresponding development of control program and upper-computer software. The system sets single-chip Ameg16 as control center, realizes communication between nodes via nRF24L01 wireless transceiver mod- ule, and realizes communication between sink and upper computer via w5100 wireless internet module. It perceives illumination intensity via photoconductor, detects the human body position via infrared pyroelectric sensor, and places the sensor node on the lamp, so the light can be controlled according to position of human body and current illumination intensity, which can realize energy saving to a large extent on condition that lighting requirement is satisfied. The sys- tem has low cost, and there is no need to change the original lighting circuit. The light can be turned off by hand, and when multi-media is used for the class, the light can keep off even if it is dim. In addition, this system has the function of automatic.

Additive Manufacturing Devices to create 3D objects. The fourth industrial revolution, namely Industry 4.0, is the recent movement on intelligent automation technology. In the age of Industry 4.0, all these sectors will probably use AM with further improvements on quality of produced parts (Melik et al, 2017). According to (Schelly et al, 2015), in this paper they investigate the potential of open-source (OS) 3-D printers based on OS design designed to bring OS3DP technologies into the classroom. The result of this research is 3-D printing technologies based on open-source design have transformative potential in an educational realm. Teachers described how their understandings of these newly emerging technologies evolved via workshop participation, as they learned about their environmental, economic, and social impacts. They also described the sense of empowerment resulting from the experience of making something, in turning a pile of parts into an operable printer and then an abstract design into an actual object. The teachers discussed this transformative potential as an important consequence of getting OS3DP in the classroom, as students themselves may be able to experience a transformation that allows them to see themselves as active creators, makers of objects and their own educational experiences.

Smart HVAC Systems. One of the important aspects that supports learning in the classroom is the proper setting of room temperature. Smart HVAC (Heating, Ventilation and Air Conditioning), electric lightning, temperature sensors, attendance tracking or wireless door locks save teachers' precious time, making teachers free from classroom procedures, and help them to spend more time to organize and present learning materials (Maksimović, 2017).

The efficient management of Heating Ventilation and Air Conditioning (HVAC) systems in smart buildings is one of the main applications of the Internet of Things (IoT) paradigm (Carli et al., 2020). In (Carli et al,2020), this research develops IoT based architecture, the sensing, control, and actuating subsystems are all connected to the Internet, and a remote interface with the HVAC control system is guaranteed to end-users. In particular, sensors and actuators communicate with a remote database server and a control unit, which provides the control actions to be actuated in the HVAC system; users can set remotely the control mode and related set-points of the system; while comfort and environmental indices are transferred via the Internet and displayed on the end-users' interface. The proposed IoT based control architecture is implemented and tested in a campus building at the Polytechnic of Bari (Italy) in a proof of concept perspective.

Attendance Tracking System. Internet of Things (IoT) is the concept of connecting the physical devices, buildings, and other items embedded with electronics, software, sensors, actuators, to the network which enable these objects to collect, exchange, and analyse the data (Lim et al., 2017). In (Lim et al., 2017), the author presents a concept of applying IoT technology, the connected camera incorporated with the computer vision technologies and machine learning algorithms to automate the classroom monitoring task using three important analysis modules which are face recognition, motion analysis, and behavior understanding modules.

In (Patel & Dr. Priya, 2014), present an analysis of different technologies which are used for attendance making system included are Computerized Attendance System, Bluetooth Based Attendance System, NFC based Attendance System, Fingerprint based Attendance System, Iris Based Attendance System, Face Recognition based Attendance System, Mobile Based Attendance System, and RFID based Attendance System. RFID will take auto attendance for all the students entered in the class which will remove the time loss of the professor. On the other hand Face Recognition will verify the student which will remove the proxy attendance and eBook, and Mobile phones, iPADs, Laptops and Tablets.

This research aim is to analyze the application of IoT in the process of learning activities in the classroom. This research is expected to provide benefits for many parties. The parties who can benefit from this research are: 1). The results of this study can be

used as a reference for stakeholders in the world of education, especially the ministry of education so that it can be a reference for increasing the using IoT in the learning process in the classroom in a campus environment in East Nusa Tenggara. 2). To identify the most popular IoT applications used by all private campuses in East Nusa Tenggara in the process of classroom learning activities.

METHODS

This type of research is survey research. Survey research is research conducted on a large population and the data used is obtained from a portion of the population (sample) to determine relative events, distributions and relationships between variables. This research was conducted in all Accredited Private Universities spread across East Nusa Tenggara.

The data used in this study is primary data. Primary data is data obtained by direct field surveys using all original data collection methods. Primary data in this study were collected through the distribution of questionnaires. Respondents who became the research sample were given several questions related to the research variables by choosing one of the answers that had been provided. The questionnaire in this study was adopted from previous research conducted by (Motyl et al., 2017), (Gul et al., 2017), and (Pervez, 2018).

The questionnaires in this study were divided into two groups. The first part is a questionnaire regarding the demographic characteristics of the Respondents, and the second part is a research questionnaire regarding the use of the IoT which consists of;

1) Do you use applications based on microcontroller development boards (applications that enable students and lecturers to connect) in the learning process in the classroom?

2) Do you use security cameras and video conferencing? (Security cameras and video conferencing) in the learning process in class?

3) Do you use Electronic white boards in the learning process in class?

4) Do you use Mobile phones, iPads, Laptops and Tablets in the learning process in class?

5) Do you use Radio Frequency Identification which is connected to the student card in the learning process in class?

6) Do you use the automatic light system in the learning process in the classroom?

7) Do you use Additive Manufacturing Devices to create 3D objects in the classroom learning process?

8) Is the lecture room equipped with Smart HVAC systems (Heating, Ventilation, and Air Condition)?

9) Does the learning process use the Attendance tracking system?

10) Is the learning process using eBooks?

Measurement in research consists of assigning points to empirical events according to certain rules. Data measurement scale in this study uses a nominal scale.

Instrument testing is needed to determine whether the measuring instrument used in the study is feasible to use. Validity test was carried out using the product moment correlation technique and reliability testing was carried out using the Cronbach Alpha technique.

Validity Test

Validity test (suitability) is used to determine the level of suitability of the questionnaire instrument used in data collection. This validity test is carried out to find out whether the items presented in the questionnaire are really able to reveal with certainty what will be studied. A valid instrument can measure something exactly what it wants to measure. The question item is said to be valid if the value of r count > r table. The value of the r table for 55 data is 0.266. The results of the analysis show that the r-count value of all questions is more than 0.266 so that it can be concluded that all research questions are

Table 1. Validity Test

Items	Corrected Item–Total Correlation	$r_{<Table>}$	Description
Item1	0,411	0,266	Valid
Item2	0,339	0,266	Valid
Item3	0.471	0,266	Valid
Item4	0,302	0,266	Valid
Item5	0,579	0,266	Valid
Item6	0,556	0,266	Valid
Item7	0,279	0,266	Valid
Item8	0,470	0,266	Valid
Item9	0,308	0,266	Valid
Item10	0,297	0,266	Valid

Reliability Test

Instrument reliability test is the fidelity or accuracy of the measuring instrument. Reliability tests are carried out to determine the consistency and accuracy of measurements, if measurements are made on the same object repeatedly with the same instrument.

Table 2. Reliability Test

Cronbach's Alpha	N of Item
,732	10

An instrument is declared reliable or reliable if it has a Cronbach's Alpha value> 0.6. The test results obtained a Cronbach's Alpha value of 0.732. The results showed that the value of Cronbach's Alpha all variables> 0.6 so it can be concluded that all items are reliable.

Descriptive statistic

Descriptive statistics is a statistical analysis that provides a general description of the characteristics of each research variable seen from the average (mean), maximum, and minimum values.

RESULTS AND DISCUSSION

The Internet of Things (IoT) is the network of physical objects—devices, instruments, vehicles, buildings and other items embedded with electronics, circuits ,software, sensors and network connectivity that enables these objects to collect and exchange data (Khan, 2019). One of the ioT concepts is smart classrooms. The concept of smart classrooms has been explained by (Xie et al.,2001), the smart classrooms, just like many other similar Intelligent Environments, is an assembly of many different kinds of hardware and software modules such as projectors, cameras, sensors, face recognition module, speech recognition module and eye gaze recognition module.

Based on the results of research using questionnaires and statistical tests on 55 samples are the Frequency Table.

Table 3. Is the educational institution accredited?

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
A	3	5,5	5,5	5,5
B	52	94,5	94,5	100,0
Total	55	100,0	100,0	

Table 4. How long have you been?

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
1 Year	8	14,5	14,5	14,5
>2 years	14	25,5	25,5	40,0
>3 years	8	14,5	14,5	54,5
>4 years	25	45,5	45,5	100,0
Total	55	100,0	100,0	

Table 5. Do you use a Laptop?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	2	3,6	3,6	3,6
Yes	53	96,4	96,4	100,0
Total	55	100,0	100,0	

Table 6. Do you use a Tablet?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	47	85,5	85,5	85,5
Yes	8	14,5	14,5	100,0
Total	55	100,0	100,0	

Table 7. Do you use a Computer?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	39	70,9	70,9	70,9
Yes	16	29,1	29,1	100,0
Total	55	100,0	100,0	

Table 8. Descriptive Statistic

Questions	N	Min	Max	MEAN	Dev. std.
Do you use applications based on microcontroller development boards (applications that enable students and lecturers to connect) in the learning process in class?	55	0	1	,60	,494
Do you use security cameras and video conferencing? (Security cameras and video conferencing) in the learning process in class?	55	0	1	,65	,480
Do you use whiteboards or Electronic white boards in the learning process in class?	55	0	1	,35	,430
Do you use Mobile phones, iPads, Laptops and Tablets in the learning process in class?	55	0	1	,84	,373
Do you use Radio Frequency Identification which is connected to student cards in the learning process in class?	55	0	1	,15	,356
Do you use the automatic light system in the learning process in class?	55	0	1	,13	,336
Do you use Additive Manufacturing Devices to create 3D objects in the classroom learning process?	55	0	1	,09	,290
Is the lecture room equipped with Smart HVAC systems (Heating, Ventilation, and Air Condition)?	55	0	1	,42	,498
Does the learning process use (Attendance tracking system?	55	0	1	,40	,494
Is the learning process using eBooks?	55	0	1	,71	,458

Based on the results from table 3 shows that many universities have accreditation A are 3 universities and have B accreditation are 52 universities.

The division of intervals is divided into 3 categories, namely low, medium, and high. The class interval division formula is as follows: highest answer score – lowest answer score/category division = 10 – 0/3 = 0,33.

Note: class intervals can be divided into 2 categories, for example low and high, 3 categories, namely low, medium and high, or 5 categories, namely very low, low, medium, high and very high.

Based on the calculation of the class interval division, the following is the division of the interval for each category as shown in table 9.

Table 9. Class Interval

Mean	Description
0,00 – 3,33	Low
3,34 – 6,66	Medium
6,67 – 10,00	High

Question 1 (Do you use applications based on Microcontroller development boards (applications that enable students and lecturers to connect) in the learning process in class?) Based on the results of the analysis, it is known that the minimum value is 0.60. The mean value of 0.60 based on the division of class intervals is included in the medium category.

Question 2 (Do you use security cameras and video conferencing? (Security cameras and video conferencing) in the learning process in class?) Based on the results of the analysis, it is known that the minimum value is 0.65. The mean value of 0.65 based on the division of class intervals is included in the medium category.

Question 3 (Do you use whiteboards or Electronic white boards in the learning process in class?) Based on the results of the analysis, it is known that the minimum values are 0.35. The mean value of 0.35 based on the division of class intervals is included in the medium category.

Question 4 (Do you use Mobile phones, iPads, Laptops and Tablets in the learning process in class?) Based on the results of the analysis, it is known that the minimum value is 0.84. The mean value of 0.84 based on the division of class intervals is included in the high category.

Question 5 (Do you use Radio Frequency Identification which is connected to student cards in the learning process in class?) Based on the results of the analysis, it is known that the minimum value is 0.15. The mean value of 0.15 based on the division of class intervals is included in the low category.

Question 6 (Do you use the automatic light system in the learning process in class?) Based on the results of the analysis, it is known that the minimum value is 0.13. The mean value of 0.13 based on the division of class intervals is included in the low category.

Question 7 (Do you use Additive Manufacturing Devices to create 3D objects in the classroom learning process?) Based on the results of the analysis, it is known that the minimum values are 0.09. The mean value of 0.09 based on the division of class intervals is included in the low category.

Question 8 (Is the lecture room equipped with Smart HVAC systems (Heating, Ventilation, and Air Condition)?) Based on the results of the analysis, it is known that the minimum value is 0.42. The mean value of 0.42 based on the division of class intervals is included in the medium category.

Question 9 (Does the learning process use (Attendance tracking system?) Based on the results of the analysis, it is known that the minimum value is 0.40. The mean value of 0.40 based on the division of class intervals is included in the medium category.

Question 10 (Is the learning process using eBooks?) Based on the results of the analysis, it is known that the minimum value is 0.71. The mean value of 0.71 based on the division of class intervals is included in the high category.

CONCLUSION

Based on the study, this paper gives recommendation are: (1) for all officers in private campus environments in East Nusa Tenggara can increase the capability and expertise of educators in using IoT applications through seminars, training, or courses related to improving technology ability to use. (2) the focus that the government expects in this case is the ministry of education and the ministry of technology and information in responding to the need for knowledge and facilities that are able to support the ability of educators in all private campuses in East Nusa Tenggara. IoT will allow for better operational efficiency in all learning environments. IoT can support classroom instruction by improving learning setting, enhance learning resources, improve methods and techniques of learning, raise management

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