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1. Solar Cell as its power
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The Strategy of Simulation of Powered LED Lamp System (Solar Cell Diesel Engine) to Traditional Fishing
Vessels in Makassar

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Abstract

This paper deals with explaining the importance of higher education research that is directed to the design the strategy of simulation of powered LED lamp system solar cell in future fishing vessels. The principal aim of this research is the utilization of renewable energy with the use of solar cell technology as a driver of lux system on fishing vessels. This research was a panel solar cell yields its power is 100 WP. It is applied to implement LED lamp with its power 100 WP. This wind energy is environmentally (clean energy), economically (cheapest), easy to operate and easy to maintain, also renewable energy. The method of analysis is quantitative approach using one way classification (analysis of variance or design of experiments). The finding of this research is accepted the null hypothesis or not differ significantly at 5% from each independent variable. The scenario and the parameters during the strategy simulation powered LED, solar cell as a power generated by The Fcount is higher than Ftable (3635,27 > 5,77), so H0 is rejected, it means at least there is one light intensity mean value that is produced by the different sun panel significantly on the real stage of 5%. So that the obtained LED lamp system at Paotere fishermen vessels in Makassar. It is expected to encourage and motivate the fisherman public in developing and applying this technology, so that it can upgrade the fish production quality and increase the economic value of fishermen society.

Keywords: Power LED; Renewable Energy, solar cell, enlighten, economic value.

I. Introduction
In Indonesia, industry Energy has an important role in the attainment of social, economic, and environmental goals for sustainable development, and is a supporter of national economic activities. The usage of energy in Indonesia is increasing rapidly in line with the economic

growth and resident increase; to fulfill requirement of energy that is increasing, develop various kinds of alternative energies, including renewable energy (solar cell), which until now has not been widely exploited.

Solar cell is one of the energies currently being developed today by the Government of Indone-sia because as tropical state, the solar energy potency is big enough. Based on irradiation, data of the sun mustered out of 18 locations in Indonesia, solar radia-tion in Indonesia can be classified as follows: for occi-dental area and Eastern Indonesia with distribution of irradiation in KBI around 4.5 kwh/m2/day with month-ly variation about 10%; and in KTI around 5.1 kwh/m2/day with a monthly variation of about 9%.

Fishery potency of deconvolution in Indonesia spreads over all part of water territories of the Indonesia Sea such as in territorial sea waters, marine waters of the archipelago and marine waters Exclusive Economic Zone (ZEE). The width of water territory of Indonesia sea is estimated 5.8 million km2 with the longest coastline in world of 81,000 km and islands bunch of 17.508, having fish potency estimated at 6.26 million tons/year which can be managed everlastingly with details of 4.4 million tons can be caught in water territory of Indonesia and 1.86 million obtainable tons from water territory ZEEI.

The problems of traditional fisherman, especially fieldsman, still use hold with ice block media as haul fish preservative media. Besides applying big cost, it also requires big storage space. While on the ship itself, it is very possible to install solar panels on the roof. So it enables scheme and making of hybrid power refrigerator. Energy yielded by solar cell hardly depends on weather and absorption time of energy which only happened in the day time. Therefore, it is necessary to conduct hybrid power research (solar cell diesel engine) as energy for refrigerator on traditional fisherman ship (Ariawan, 2008).

II. LITERATURE REVIEW

2.1 SEER Base

The Sun Energy Electric Revival (SEER) is the revival that uses the sunshine as the electric producer source. The main tool is to catch, change and result the electric is Photovoltaic (PV) or it is generally called Module/Panel Solar Cell. By PV, sun shine is changed into the negative and positive electron flowing process in PV because of the electron difference. The result of these electron flowing is the direct current electric energy that can be used to fill the battery/accumulator according to the needed tension and ampere (Figure 2.1).

The set capacity total in the sun energy conversion nowadays is less than 0,008 GW (8 MW). The national sun energy reached 4,8 kWh/m2/day (Table 1.1 and www.anekasurya.com).. The advantage of SEER can be de-veloped in the isolated region, especially in the unreachable region by the electric net/ state electric revival, hospitality envi-ronment, cheap operation cost and treatment.

The electric energy cost per kWh by using the earth heat energy is USD 0,08 (Rp. 800) and the electric selling price by PT PLN is USD 0,06 or around Rp. 650 per kWh. The electric energy cost per kWh for electric revival using motor fuel is USD 0,12 (Rp. 1.200). The coal usage is cheap, but it produce the high pollution and emission.

2.1.1. SEER main component

Several SEER main components are as follows :

1.Solar Panel

2.Solar Charge Controller

3.Battery

4.Inverter.

2.1.2. Solar Cell Panel

Figure 2.1. Solar Cell energy (Sumber: http://www.energi- ku.com/2016/04/modal-rp2-juta-rumah-anda-bisa-dapat.html).

Figure 2.2. The kind of Solar Cell Panel.

2.1.3. The Difference Between Polycrystalline and Mono-crystalline

Table 2.1 Explains about the difference between polycrystalline and monocrystalline.

Table 2.1. The Difference between Polycrystalline and Monocrystalline

No.	Criteria	Polycrystalline	Monocrystalline
1	Making Process	Simple Pure single silicone crystal	made with the process of czochralsky, com-plicated and expen-sive process
2	Price	Cheap	Expensive

3 Heat Effect	Low Temperature coefficient, power reducing on every high tem-perature increasing	High Temperature coeffi-cient, power reducing on every high temperature in-creasing
4 Efficiency	Low	High
5 Dimensi-on/measurement	Big	Small

1 4

2
3
Figure Explanation: Figure 2.3. Scheme of SEER

1. Panel solar cell; 2. Battery; 3. Burden; 4. Solar Charge Con-troller (SCC).

2.1.4. Solar Charge Controller

Solar Charge Controller (SCC) is the tool that func-tions changing DC solar panel tool into DC battery tension, and regulate the energy filling from solar panel to battery and regulate the energy usage from battery to the burden.

2.1.5. Battery

Battery is the tool to save the energy. The kind of battery nowadays is used for the need of SEER is AGM battery, Deep Cycle VRLA, GEL Battery, and Lithium. While the kind of battery based on the electric tension, that often used on SEER is: battery with the tension 12 V and 24 V.

2.1.6. Inverter

Inverter is the tool that functions to change from DC tension into AC tension (figure 2.4 and 2.5).

figure 2.4. Battery, inverter and burden.

2.2 Formulas that are used
Several formulas that used in the designation accounting of SEER are

2.1.1 The power sum (P) that produced can be counted with the formula are as follows: P = V * I
where:

P = is power [watt] or [W]
V= is tension [volt] or [V]
I = is current [ampere] or [A].

2.3. The Definition of Project Based Learning

Project Based Learning (PBL) is the learning modern that have been developed in the progress countries as the United States. If it is translated into Indonesian, Project Based Learning means as the learning based project.
The learning based project (PBL) is the learning method that used the problem as the early step in collecting and integrating the new knowledge based its experience and real activity. PBL is designed to be used in the complex problem that needed learning in do investigation and understand it.

2.4. Simulation

Simulation is an imitation process from something that is real and its state of affairs. The action of conducting this simulation describes the key characteristic qualities from the physical system behavior or certain abstract system (http://artikata.com/arti-351211-simulasi.html).

RESEARCH METHOD
3.1. Research Design

This research design is conducted with the step such as flow diagram :

Figure 3.1. Flow Diagram of Research activity.

3.2. Approach Method

This research used the quantitative and qualitative ap-proaches by referring the teaching method based on project (PBL).

3.3. The kind of research

The kind of research that is conducted is the exper-imental design.

3.4. Place

This research is conducted in the department of Me-chanical Engineering in the State University of Makassar.

3.5. Population and Sample

3.5.1 Population

The sun panel laboratory design with the power of 100 WP.

3.5.2 Sample

The research subjects of the sun panel laboratory of 100 WP are the students of Semester IV of Thermodynamics lecturer sub-ject participants of Technique and Heat Transfer

3.5.3 Research Instrument

The research instruments that used are as follows:

1. Score of Thermodynamics with Conventional Method.

2. Score of Thermodynamics lecturer subject with PBL method.

3.5.4 Research Data

Data is taken from observation result by digital multi-tester measurement tool.

3.5.5 Data Collecting Technique

Data collecting technique are by,

1. Taken data is the primary data (from measurement result).

2. Experimental Test.

3.6. Analysis

Analysis is conducted by using experimental design of factorial experimental design (Miller, I,

1985: 389) with math-ematics model are as follows:

RESULT AND DISCUSSION

4. Testing measurement tool

Flow Diagram (Figure 4.1) of research that been conducted and light intensity measurement

Figure 4.1. Flow Diagram of Measurement light intensity

4.1. Research result data

There are several this chapter describe that::

1. Measurement and tools

2. Measurement procedure

3. Research result

4.1.1. Measurement and tools

Figure 4.2 The light intensity tools lamp that have been seen and time measured with the used light sensor.

Figure 4.2. Light sensor (for measuring light intensity)

Figure 4.3 LED lamp at several time “on”

Figure 4.3. LED lamp at several time “on”

Figure 4.4 measurement of light intensity LED lamp that have been seen by the used tools light intensity lamp light sensor with the used lux.

Figure 4.4. Collecting data light intensity with used light sensor

4.1.2. Measurement procedure

Figure 4.5. solar cell energy flow diagram of measurement that have been seen.

Figure 4.5. solar cell energy measurement flow diagram

Figure 4.6. solar cell energy at fisherman vessel.

Figure 4.7. Solar cell energy at fisherman vessel.

Figure 4.8. Solar cell energy measurement at fisherman vessel.

4.1.3. Measurement result data

Data result of light intensity of Makassar Fishermen Vessel at Table 4.1.

Table 4.1. Time duration and light intensity [lux]:

Replication Light Intensity Measurement at Noon
07.00 a.m 12.00 a.m 14.00 p.m 18.00 p.m
1 140 250 238 227
2 138 221 230 223

3 138 205 228 211
4 130 194 223 209
5 129 185 213 196
6 122 182 190 179
7 177 182 179 151
8 162 180 168 143
9 124 178 133 134
10 110 172 121 117

Note: The primary data that had been managed

4.2. Counting Stage

Data management (Table 4.1) is done by using analysis of variance with one way classification By using the equation, the counting and recapitulation is done on table 4.2 and 4.3. With the following working stages :

1. H0 : μ1 = μ2 = μ3

2. H1 : at least two different medians

3. α = 5%

4. Critical region: f > 2,87

5. Counting

a. See Table 4.1 till. 4.3.

b. See the equation of 3.2 till 3.6 and Table 3.2.

6. Conclusion: Because fcount (5%,3,37) is higher than ftable(5%,3,37), so zero hypothesis is rejected, it means that the time difference against the light intensity mean is on the real stage of 5%.

4.3. Data Management

Data management is done by using the equation and Table 4.1 and is gained as follows:
This counting result is reported on Table 4.3.

Table 4.3. Analysis of Variance.

Source of variation Df SS MS Fratio Ftable
Treatments 3 21,527.40 7,175.80 6.68 2.87
Error 36 38,685.00 1,074.58
Total 39 60,212.40

Irwin Miller, 1985:332-341
Irwin Miller, 1985:332-341
Charles R Hicks, 1983:388

From Table 4.3, it can be concluded that because Fcount is higher than Ftable (6,68 > 2,87), so H0 is rejected, it means that at least, there is one light intensity mean that had been

produced by the significantly different sun panel on the real stage of 5%.
The counting is continued to analyze the difference by using Newman-Keuls range test (Charles R Hicks, 1983: 51).

4.6. Newman-Keuls Range Test Procedure

Table 4.4. One way ano-va

Source Dk Quadrat
Sum Middle Quadrat Fcount Ftable
Inter treatment 4 1399,276 349,81912 3635,9027 5,77
Galat 24 2,405311 0,0962125
Total 29 1401,682

Conclusion: Because fcount is higher than ftable (3635,9027 > 5,77), so the zero hypothesis is rejected (Table 4.4), it means at least – there is one significantly different wind velocity mean value against the electric power of KASV on the real stage of 5%.
The counting is continued to analyze the difference by using Newman-Keuls range test (Charles R Hicks, 1983: 51-54).

4.7. Project Based Learning

PBL is comprehensive approach for teaching and learning that is designed so the learners do the research against the real problem. Where the educated participants in the complex problems, real world problems, wherever the educated participants can choose and decide the meaningful problem. The educated participants are given chance to practice various skills that are needed for their adult life and career (how to allocate time, how to be responsible individual, private skill and learn through experience or experimentation).

Figure 4.9. Teaching Aids Making

Figure 4.8. shows that the teaching aids making by using PBL way .

5. Counting Stage on Newman-Keuls Range Test

The stages on Newman-Keuls range test are as follows.:

1. Arrange and put in order the mean and treatment as follows:

k = 5 mean 6,958 7,35 13,989 21,177 23,467

treatment V1(4,5) V2 (4,7) V3 (5,0) V4 (5,1) V5 (5,2)

2. From Table 5.5 ratio value is 0,0962125 with dk (freedom degree) is 25.

3. Count Standard Error of a Mean sy.j0,0962125
sy.j = = 0,0192
5

4. From Table E1 Charles R Hicks, 1983: 390 (The Signifi-cant Ranges, for n2 = 25 is gain:
p: 2 3 4 5

Ranges: 2,915 3,525 3,895 4,165

5. Count LSR (Least Significant Ranges) as follows.:

p: 2 3 4 5
Ranges:

LSR: 0,056

(0,0192*2,915) 0,0678 0,0749 0,0801

6. Compare:

a. The highest with the lowest Power5 vs Power1, (23,467 – 6,958)

= 16,509 > 0,0801
b. The highest with the lowest II Power 5 vs Power2, (23,467 – 7,35)
= 16,117 > 0,0749

c. The highest with the lowest III Power5 vs Power3, (23,467 – 13,989)
= 9,479 > 0,0678

d. The highest with the lowest II Power5 vs Power4, (23,467 – 21,177)
= 2,291 > 0,056

e. The highest II with the lowest Power4 vs Power1, (21,177 – 6,958)
= 14,218 > 0,0749

f. The highest II with the lowest II Power4 vs Power2, (21,177
= 13,827 > 0,0678

g. The highest II with the lowest III Power4 vs Power3, (21,177 – 13,989)
= 7,188 > 0,056

h. The lowest III with the lowest Power3 vs Power1, (13,989 – 6,958)
= 7,03 > 0,0678

i. The lowest III with the lowest II Power3 vs Power2, (13,989 – 7,35)
= 6,639 > 0,056

j. The lowest II with the lowest Power2 vs Power1, (7,35 – 6,958)
= 0,392 > 0,056

k. From the six steps (a till. j) is got:

a. Power5 is different significantly with Power1. b. Power5 is different significantly with Power 2. c. Power5 is different significantly with Power 3. d. Power5 is different significantly with Power 4. e. Power4 is different significantly with Power 1. f. Power 4 is different significantly with Power 2. g. Power 4 is different significantly with Power 3. h. Power 3 is different significantly with Power 1. i. Power 3 is different significantly with Power2. j. Power2 is different significantly with Power 1.
So it can be concluded that there are difference of mean influence each wind velocity against the power that is produced by KASV of NACA 4412 type on the real stage of 5%.
Or it can be figured as follows.:

Treatment Power5 Power4 Power3 Power2 Power1

mean 23,467 21,177 13,989 7,35 6,958

The other positive impact of solar cell energy usage is LED lamp glow when the state electric company doesn't work (turn off)

Figure 4.9 and 4.10 shows one of the electric flow benefits that are used for the street lightening keep working when the State Electric Company doesn't work (turn off).

5. CONCLUSION AND SUGGESTION

5.1. Conclusion

The conclusion sare as follows.:

1. Because Fcount is higher than Ftable (3635,9027 > 5,77), so H0 is rejected, it means there is one significantly sun panel light intensity on the real stage of 5%.
2. The highest sun panel light intensity value of LED are (23,467 and 7,35 lux).
3. The stage that is done for PBL are socialization, practice of teaching aids making, teaching aids trial, participate in the competition and practice of PBL in the classroom and finally get gift as the first winner on the energy field on the Innovation and Technology competition (INOTEK) of 2017 that is hold by Malang city government and is participated on the national exhibition.
4. The F ratio is higher than F table. It means the zero hypoth-esis is accepted or is not different significantly at 5% from each inde- pendent variable. (3635,9027 > 5,77), so zero hypothesis is rejected (Table 5.5), it means at least – there is one significantly different wind velocity mean value against the electric power mean of KASV on the real stage of 5%.

5.2. Suggestion

Some suggestions that need to be uttered for the next research are as follows :

1. The additional effort of watt peak on the sun pane-that is expected in order to increase the light intensity and operation time
2. The additional effort of the additional tool on the sun panel that is expected can increase the light intensity.
3. The way and practicing of PBL need to be socialized in front of the student.

Acknowledgment

The authors wish to express their gratitude to the Ministry of Re- search, Technology and Higher-Education – Republic of Indonesia and The Director of State University of Makassar for their sup- port.

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Modelling students' activities in programming subjects through educational data mining

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ABSTRACT: This research explores educational data mining (EDM) from a learning course management system (LMS) and academic system at the Faculty of Information Technology at Maranatha Christian University in Bandung, Indonesia. The main objective of this study was to discover whether the students have used the LMS effectively to complete their learning process and enhance academic achievements in their study. As case studies, this research combines data from two programming courses in an informatics Bachelor programme, which are: Introductory Programming (IP) and Algorithm and Data Structures (ADS). EDM techniques are used to extract interesting patterns in the form of association rules. Two sets of interesting rules for the IP course and three sets of rules for the ADS course are obtained. As final results, some suggestions are proposed to enhance the LMS. The main idea is to apply a gamification method in the blended-learning environment to increase motivation of the students to utilise their free time more effectively during study.

Keywords: Blended learning, course management system, educational data mining, association rules, gamification

INTRODUCTION

The usage of information technology in education, especially in e-learning systems, has been widely implemented in all over the world. Such systems offer great flexibilities to share and communicate between students and lecturers in courses. The Web-based learning process has produced a large amount of data that originated from student-lecturer interactions. To explore those data from the educational environment, educational data mining (EDM) has been commonly utilised. With EDM, one can obtain patterns and hidden knowledge in large collections of data to enhance the learning system quality [1][2].

Blended learning is a variant of e-learning, which combines face-to-face instruction with technology-mediated instruction [3]. Some benefits of blended learning are to increase learning effectiveness, convenience and access. This research explores EDM from a learning course management system (LMS) and academic system in the Faculty of Information Technology at Maranatha Christian University in Bandung, Indonesia. The faculty adopt a blended learning system with full face-to-face instruction. In this case, the LMS is used to complete the learning process. The objective of this study is to discover whether the students have used the LMS effectively to complete their learning process and enhance achievements in their study. As case studies, this research combines data from two programming courses in the informatics Bachelor programme, which are: Introductory Programming (IP) and Algorithm and Data Structures (ADS). The IP course is conducted in the first semester and the ADS course in the second semester. The students in the ADS course are a subset of the IP course. The findings from EDM of these data will be used as a foundation to improve the system.

EDUCATIONAL DATA MINING

Data mining has been applied to data from different types of educational systems. Data mining in education is also known as educational data mining. EDM is concerned with developing methods for exploring the unique types of data from educational environments. Those methods are used to improve understanding of students' behaviours and the system environments in which they are involved [4]. The educational system or the environment itself consists of traditional education and computer-based education or Web-based education. The traditional one is still the most widely used educational system [5]. Computer-based education is also called a learning management system (LMS), course management system (CMS) or learning content management system (LCMS) [2][6]. The differences between them are based on the data sources provided.

Those data sources need to be further processed depending on the nature of data and the problems that need to be resolved [5]. Romero and Ventura categorise the works in EDM into two main methods. The first is statistics and visualisation and the second is Web mining (including clustering, classification, association rule mining, sequential pattern mining, text mining and others) [5]. The Web mining methods are quite often implemented in EDM today. In addition, Baker classifies work in EDM into the following categories [4]:

1. Prediction:

    - Classification, regression and density estimation;

2. Clustering;
3. Relationship mining:

    - Association rules mining, correlation mining, sequential pattern mining and causal data mining;

4. Distillation of data for human judgement;
5. Discovery with models.

The first three categories are familiar to most researchers in data mining. EDM is an interdisciplinary area including, but not limited to, information retrieval, recommender system, social network analysis, and so on. In fact, EDM can be described as the combination of three main areas: computer science, education and statistics [5], which could be used as supporting tools in course and students' activity design [8].

Frequent patterns are patterns that appear frequently in a data set and are useful for discovering interesting relationships hidden in large data sets. Such relationships can be represented and uncovered in the form of association rules. Finding frequent patterns is important in mining associations, correlations, classification, clustering, and other data mining tasks. Support and confidence of rules are two measures of association rule. Those measures reflect the usefulness and certainty of the rules discovered. Support shows the frequency of item set that appears in dataset. Confidence shows the frequency of the rule is true or happens. For example, consider an association rule:

```
quiz = complete => grade = excellent [support =2%, confidence = 60%]
```

A support of 2% means that 2% of all the transactions show that students who have completed the quizzes and achieved an *excellent* grade in a course arose together. A confidence of 60% means that 60% of the students who have done the quizzes completely, have also passed the course successfully.

Association rules are considered to be reliable if they satisfy both a minimum support threshold and a minimum confidence threshold, and they are called strong rules. However, the support and confidence measures are insufficient for filtering out uninteresting association rules. To cover this, a correlation measure can be used. One of the simple correlation measures is what is known as lift.

The lift between the occurrence of A and B can be measured by the formulae in Equation (1).

```
lift(A, B) = P(A∪B) / P(A).P(B)
lift(A, B) = P(B|A) / P(B)                                    (1)
lift(A, B) = confidence(A= B) / support(B)
```

If the lift's value is less than 1; then, the occurrence of A is negatively correlated with the occurrence of B. If the lift's value is greater than 1; then, A and B are positively correlated. It means that the occurrence of A implies the occurrence of B. If the result is equal to 1, the A and B are independent, and there is no correlation between them [7].

METHODOLOGY

The study was based on data from two courses of programming subjects. The first course is Introductory Programming (IP) and the second is Algorithms and Data Structures I (ADS). Both courses are closely related, the IP course is a prerequisite of the ADS course. Students that follow the ADS course come from attendees of the IP course.

Students' activities data have been extracted from the LMS. Activity data attributes for each student are access time, Internet protocol address, user identity, action and activity information. As shown in Table 1, a group of attributes has been selected for EDM. These attributes consist of:

a) activity data from the LMS, such as user identity, access time, action and material;
b) academic data, such as course final grade and GPA of first semester;
c) session time, transformed from access time and course schedule;
d) activity level, transformed from activity frequency of a student.

Table 1: Students' activities data set.

Attribute name	Description	Possible values
Time	Access time	[Morning, afternoon, night]
Session	Session time	[In course, free time]
Action	Type of action	[resource view, doing exercise, quiz attempt]
Material	Material resources	Depend on the course
Activity	Activity level	[Low, medium, high]
Grade	Course final grade	[Excellent, good, fair, poor]
GPA	GPA of first semester	[Excellent, good, fair, poor]

The data set was built from 68 students from the IP course and 55 students from the ADS course. The students' activities data set was made up of 438 rows for the IP course and 990 rows for the ADS course. For the access time attribute, the morning session is from 5.00 am until 11.59 am, the afternoon is from 12.00 pm until 06.00 pm and others considered to be night. For the session time attribute, free time is the time outside the lectures. The activity level is counted as the frequency of students' activities in one semester in a course. This study explored students' activity data sets through association rules mining to obtain interesting rules. The rules can be utilised to improve the learning system and to encourage the students to be involved in more actively during the sessions. The experiment was conducted twice, one for each student's activities data set from the IP course and the other for data set from the ADS course.

RESULTS AND DISCUSSION

A histogram of students' access time of the IP course and the ADS course are shown in Figure 1. Most of the students' preferences access time are in the morning for both courses. In the IP course, more students have more preferences to access the system at night than in the afternoon, but *vice versa* in the ADS course. In Figure 2, the histogram of students' session time shows that most of the students prefer to access the LMS outside of the course, which is in their free time for both courses.

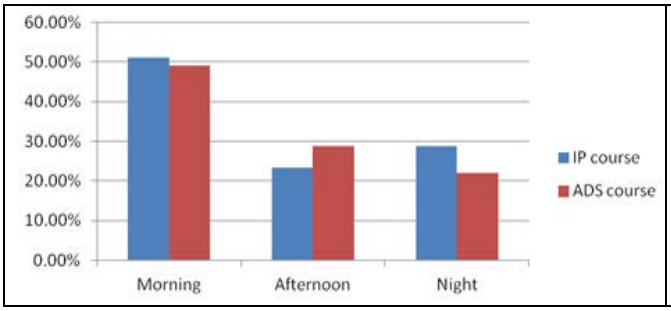

Figure 1: Histogram of access time.

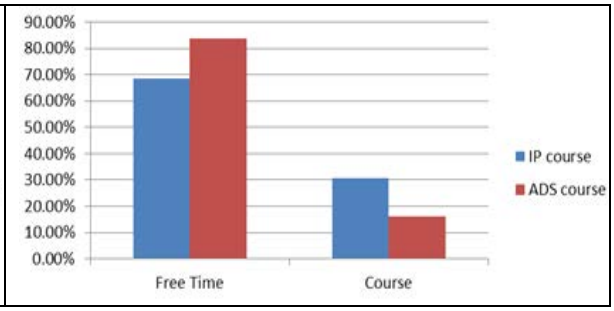

Figure 2: Histogram of session.

In Figure 3, the histogram of the students' final grade describes the grade distribution in each course. The IP course grade is dominated by fair, followed by good, excellent and poor. However, the excellent grade dominates the ADS course, followed by fair, good and poor. Students that follow the ADS course must pass the IP course. This condition might have caused the distinction of grade distribution between both courses.

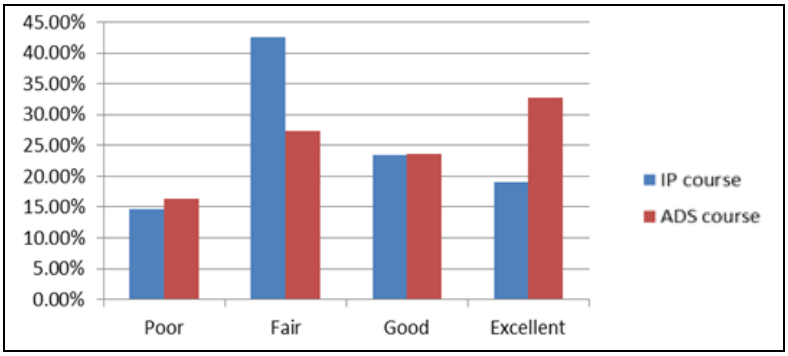

Figure 3: Histogram of course grade.

Using association rules mining against the students' activity data set, two sets of interesting rules for the IP course and three sets of rules for the ADS course were obtained. The data mining tools used during the experiments were WEKA version 3.8.1 and the Microsoft Azure Cloud Machine Learning System. To determine whether a rule is interesting, three parameters were considered: support, confidence and lift. The minimum support is set at 0.05, the minimum confidence was 0.75, and the lift had to be greater than 1.0. In Figure 4, an excerpt of the ADS data set is shown.

A set of rules about students' access time based on their grade in free time sessions is described in Table 2 for the IP course and in Table 3 for the ADS course. The preferred time to access learning resources of the IP course was at night for students that have fair, excellent and good grades. The alternative access time was in the afternoon. The preferred time to access learning resources of the ADS course was at night for those achieving a good grade, in the morning for those achieving an excellent grade and in the afternoon for those achieving a poor grade. Students, that access learning resources in free time, indicate that they have willingness to learn more outside the class.

	StudentID	Access Time	Session	Action	Material	Activity	GradeASD	GPA
2	1672051	Afternoo	Free Time	resource view	Slide List Linier	Medium	Good	Excellent
3	1672051	Morning	In course	resource view	Slide List Linier	Medium	Good	Excellent
4	1672051	Morning	Free Time	resource view	Slide ADT Stack	Medium	Good	Excellent
5	1672033	Afternoo	Free Time	resource view	Slide Sorting Lanjut	High	Fair	Fair
6	1672033	Morning	Free Time	resource view	Slide List Linier	High	Fair	Fair
7	1672033	Night	Free Time	resource view	Slide Stack Queue dengan List	High	Fair	Fair
8	1672033	Night	Free Time	resource view	Slide Variasi List	High	Fair	Fair
9	1672009	Afternoo	Free Time	resource view	Slide Sorting Lanjut	High	Fair	Good
10	1672009	Morning	In course	resource view	Slide Sorting Lanjut	High	Fair	Good

Figure 4: An excerpt of the data set.

	StudentID	Access Time	Session	Action	Material	Activity	GradeASD	GPA
2	1672023	Afternoon	Free Time	resource view	Slide Sorting Lanjut	Low	Excellent	Excellent
3	1672023	Afternoon	Free Time	resource view	Slide Sorting Lanjut	Low	Excellent	Excellent
4	1672066	Morning	Free Time	resource view	Slide List Linier	Low	Excellent	Excellent
5	1672066	Night	Free Time	resource view	Solusi Kuis2	Low	Excellent	Excellent
6	1672066	Afternoon	In course	resource view	Slide List Linier	Low	Excellent	Excellent
7	1672066	Morning	Free Time	resource view	Latihan Stack	Low	Excellent	Excellent
8	1672066	Morning	Free Time	resource view	Slide ADT Stack	Low	Excellent	Excellent
9	1672058	Night	Free Time	resource view	Solusi Kuis2	Low	Excellent	Excellent
10	1672058	Night	Free Time	resource view	Latihan Queue	Low	Excellent	Excellent

Figure 5: Some outliers of the activity data set.

Table 2: Rules of students' access time of the IP course based on GradeIP.

Rule #	Rule	Parameters		
		Support	Confidence	Lift
1	GradeIP = Fair, Time = Night => Session = Free Time	0.137	1.000	1.446
2	GradeIP = Fair, Time = Afternoon => Session = Free Time	0.087	0.93	1.35
3	GradeIP = Excellent, Time = Night => Session = Free Time	0.059	1.000	1.446
4	GradeIP = Excellent, Time = Afternoon => Session = Free Time	0.059	0.963	1.392
5	GradeIP = Good, Time = Night => Session = Free Time	0.050	1.000	1.446

Table 3: Rule of students' access time of the ADS course based on GradeADS.

Rule #	Rule	Parameters		
		Support	Confidence	Lift
1	GradeADS = Good, Time = Night => Session = Free Time	0.118	1.000	1.19
4	GradeADS = Excellent, Time = Morning=> Session = Free Time	0.098	0.87	1.03
5	GradeADS = Poor, Time = Afternoon => Session = Free Time	0.057	0.95	1.13

Activity level is the frequency of student access to learning resources. Having high activity in free time sessions indicates willingness to learn more outside the class. A set of rules about students' activity based on their grade in free time session is shown in Table 4 for the IP course and in Table 5 for the ADS course.

Table 4: Rule of students' activity of the IP course based on GradeIP.

Rule #	Rule	Parameters		
		Support	Confidence	Lift
1	GradeIP = Fair, Activity = High => Session = Free Time	0.240	0.761	1.100
2	GradeIP = Excellent, Activity = Medium => Session = Free Time	0.096	0.933	1.349
3	GradeIP = Excellent, Activity = High => Session = Free Time	0.059	1.000	1.446

In the IP course, students that had high activity, achieved fair and excellent grades. Some excellent students also had medium activity. In the ADS course, students that had high activity, achieved good, fair and excellent grades, while students that had medium activity, achieved fair, good and poor grades.

Table 5: Rule of students' activity of the ADS course based on GradeADS.

Rule #	Rule	Parameters		
		Support	Confidence	Lift
1	GradeADS = Good, Activity = High => Session = Free Time	0.168	0.85	1.02
2	GradeADS = Fair, Activity = High => Session = Free Time	0.129	0.89	1.06
3	GradeADS = Fair, Activity = Medium => Session = Free Time	0.124	0.87	1.04
4	GradeADS = Good, Activity = Medium => Session = Free Time	0.106	0.88	1.05
5	GradeADS = Excellent, Activity = High => Session = Free Time	0.078	0.87	1.03
6	GradeADS = Poor, Activity = Medium => Session = Free Time	0.057	0.95	1.13

Table 6 and Table 7 describe a set of rules about students' access time and activity of the ADS course based on their GPA. The preferred time for accessing learning resources for good GPA was in the morning and at night. Some of fair GPA students preferred to access the LMS in the afternoon, while excellent GPA students accessed at night. In Table 7, only good GPA students had high activity, while medium activity was noted by good and fair GPA students.

Although there is an assumption that students who have an excellent grade will also have high activity in learning, the activity data set shows some outliers. In Figure 5, there were some students who achieved an excellent grade and GPA, but had low activity. This does not mean that the students were not willing to use the LMS. It is likely that they have downloaded some study materials only once or copied them from their classmate and, then, they studied the material at their favoured time, outside the system.

Table 6: Rule of students' access time of the ADS course based on GPA.

Rule #	Rule	Parameters		
		Support	Confidence	Lift
1	GPA = Good, Time = Morning => Session = Free Time	0.160	0.91	1.09
2	GPA = Good, Time = Night => Session = Free Time	0.110	1.00	1.19
3	GPA = Fair, Time = Afternoon => Session = Free Time	0.090	0.92	1.09
4	GPA = Excellent, Time = Night => Session = Free Time	0.083	1.00	1.19

Table 7: Rule of students' activity of the ADS course based on GPA.

Rule #	Rule	Parameters		
		Support	Confidence	Lift
1	GPA = Good, Activity = Medium => Session = Free Time	0.174	0.91	1.09
2	GPA = Good, Activity = High => Session = Free Time	0.168	0.93	1.11
3	GPA = Fair, Activity = Medium => Session = Free Time	0.063	0.90	1.07

Some suggestions can be proposed to enhance the learning system. The main idea is to apply a gamification method in the blended-learning environment. The gamification method is expected to be able to increase motivation of the students so that they to utilise their free time more effective in study. The suggested main features are given in Table 8.

Table 8: Suggested main features of the gamification method.

Rating	Every student gives a rating about material/resources, such as difficulty level and fills in a questionnaire of a course.
Achievement	Achievements, which have been reached by the students based on their activities. These are shown using colour, emoticon, certificate and sound chat.
Notification	Notifications are given during login, such as about quiz, pre-test, post-test, new resources.
Event	To give variations in activities for the students, such as games about the study materials, create drag and drop quizzes.
Leaderboard	To show prestige of some students, such as top ten students based on their achievement.
Tournament	To organise a competition and provide some additional challenges in the learning environment. Tournament could be used to measure students' involvement, groups' creativity and engagements to each other.
Forecasting	To forecast the final grade based on students' activities and achievements. This feature is shown after the mid semester examination. The feature can be used to give suggestions about the resources that must be learned more intensive to reach a better grade.

CONCLUSIONS

In this research, EDM techniques have been explored to find interesting rules in a student activities data set. The study reveals that there are strong correlations between students' access time, their activities in the LMS and their final grade. It is important to create an LMS which could attract students' enthusiasm in taking extra efforts for the success of their

study. A gamification method in the blended-learning environment is suggested as the final finding of this research. The gamification method is expected to be able to increase motivation of the students to utilise their free time more effectively during study.

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