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IJIE (Indonesian Journal of Informatics Education) is is a scientific journal promoting the study of, and interest in, informatics education. The journal publishes empirical papers on information systems, informatics, the use of technology learning, and distance learning. It is an international journal published by the Informatics Education Department, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Indonesia bi-annually on June and December.

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AUTHOR GUIDELINES

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The manuscript is written on white paper of A4 (210x297 mm2) size, in a single column, single spaced, 12-point (12 pt) Times New Roman font. The margin text is 3 cm from the top, 2 cm from the bottom, and 1.8 cm from the left and right. Smaller lettering size can be applied in presenting table and figure (9 pt). Word processing program or additional software can be used; however, it must be PC compatible and Microsoft Word-based (.doc or .rtf; or .docx). The metric measurement uses IS denomination; usage another system should follow equivalent with IS first mentioning. Abbreviations set off, like g, mg, mL, etc. do not follow by a dot. Minus index (m-2, L-1, h-1) suggested being used, except in things like "per-plant" or "per-plot". Equation of mathematics does not always can be written down in one column with text, in that case, can be written separately. Number one to ten is expressed with words, except if it relates to measurement, while values above them written in number, except in early sentence. The fraction should be expressed in decimal. In the text, it should be used "%" rather than "percent". Avoid expressing ideas with a complicated sentence and colloquial words, and keep concise and clear sentence. With the following systematic:

(1) **Title of the article** should be written in a compact, clear, and informative sentence, preferably not more than 20 words. Name of author(s) should be completely written, especially for the first and the last name. Name and institution address should also be completely written. We choose local names in Bahasa Indonesia for universities in Indonesia. The mention of "graduate program", "undergraduate program", "post-graduate program", "master program", "doctoral program" should be avoided in the name of institution. Manuscript written by a group, author for correspondence along with address is required. The title page (first page) should include the title of the article, full name(s), institution(s) and address(es) of the author(s); the corresponding author mentions the detail email addresses.

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- Article by DOI:
  Jerrentrup, A., Mueller, T., Glowalla, U., Herder, M., Henrichs, N., Neubauer, A., & Schaefer, J. R. (2018). Teaching medicine with the help of "Dr. House." PLoS ONE, 13(3), Article e0193972. https://doi.org/10.1371/journal.pone.0193972
- Book:
  Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.
- Book Chapter:
  Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds). Tropical Forest Community Ecology. Wiley-Blackwell, New York.
- Abstract:
  Assaeed AM. 2007. Seed production and dispersal of Rhazya stricta. The 50th Annual Symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.
- Proceeding:
  Duckworth, A. L., Quirk, A., Gallop, R., Hoyle, R. H., Kelly, D. R., & Matthews, M. D. (2019). Cognitive and noncognitive predictors of success. Proceedings of the National Academy of Sciences, USA, 116(47), 23499–23504. https://doi.org/10.1073/pnas.1910510116
- Thesis, Dissertation:
  Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Brawijaya University, Malang. [Indonesian]
- Online document:
  Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic Escherichia coli predator-prey ecosystem. Mol Syst Biol 4: 187. DOI: 10.1038/msb.2008.24

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TABLE OF CONTENTS

Indonesian Journal of Informatics Education

Research Paper ISSN: 2549-0389

Development of Vocabulary Learning Training Module Using Games for Vocational English Teachers to Improve Teachers' Competency

Noni Melisa Pebrioni
Education Administration Management
Faculty of Teacher Training and Education
Universitas Kristen Satya Wacana
laurentinanonie@gmail.com

Ade Iriani
Education Administration Management
Faculty of Teacher Training and Education
Universitas Kristen Satya Wacana
ade.iriani@uksw.edu

Yari Dwikurnaningsih
Education Administration Management
Faculty of Teacher Training and Education
Universitas Kristen Satya Wacana
yari.dwikurnaningsih@uksw.edu

Abstract:

The purpose of this study was to develop a vocabulary learning training module that contains games that can help vocational English teachers from several vocational high schools in Salatiga. Research and Development (R&D) approach was employed in this study. This study involved seven steps of the Borg and Gall model developed by Sugiyono model (2019): potential and problems, data collection, product design, design validation, design revision, product trial, and product revision. Ten vocational English teachers from several vocational high schools in Salatiga participated in the study. Data collection techniques were done using document study, interviews, questionnaires, and tests. Data analysis was performed with qualitative-quantitative analysis. The results of the study were in the form of a vocabulary training module for English teachers with games. Based on the development of vocabulary training module, the resulting product is training modules that can be used and applied by teachers in carrying out teaching and learning activities in vocational high schools in Salatiga and describe the application of games so that they can be used as a reference in teaching using games.

Keywords: Game, Training Module, Vocabulary.

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Introduction

Language is a tool for communication that is used every day to communicate information. Languages can vary in social life since speakers from various backgrounds and skills use them; the languages that can be found include regional languages, national languages, and foreign languages. Foreign languages, particularly English, have grown in importance in daily life as well as in science and technology, social and cultural sectors. In today's current day, using English is quite simple; there is no need to carry a dictionary everywhere with you because it can be put on a mobile phone via an application. According to Crystal (2010), every language in the world contains thousands of words, and one of the duties of language researchers is to gather them into volumes called dictionaries.

Four skills that must be acquired when studying English: reading skills, writing skills, speaking skills, and listening skills. The four skills are interconnected, and they will be straightforward to acquire if learners have a large English vocabulary. English is a foreign language taught in Indonesia from kindergarten to university level. As a result, it is critical to create educational facilities that are enjoyable for both teachers and pupils. Students' motivation to study may be increased if the vocabulary acquisition approach is implemented properly, and teachers' performance in the teaching and learning process can be enhanced. Nirattisai and Chiramanee (2014) suggest that language teachers have to heed vocabulary learning strategies because teaching vocabulary can help students to learn a new language. To this end, English teachers must have experience in teaching the language so that pupils can understand and utilize it. This is something that vocational high school teachers in Salatiga have experienced and felt.

There are numerous issues that make it challenging for teachers to teach English at vocational high schools. The first problem is that students come from a variety of backgrounds, therefore not all of them can communicate in English. The students' lack of enthusiasm in studying English is the second reason. Furthermore, student motivation is poor since students believe that English courses are unnecessary because they are not included in the national test. Another problem that teachers face is long teaching hours, which forces them to adopt the lecture method rather than other methods. Rusmadjadi (2010) argues that monotonous English teaching prevents students from interacting with one another. According to Mattarima and Hamdan (2011), many English teachers use a teacher-centered approach with minimal opportunities for students to practice their English. According to Simbolon (2014:228), conventional learning is a type of teacher-oriented learning. This is due to the teacher's dominant role in this technique. This argument leads to the conclusion that conventional and typical teacher-oriented learning makes students feel bored, thus it is important to design an engaging learning process. Many language teaching experts agree that playing games is a good way to learn vocabulary, especially in EFL. Djahimo (2018) noted that by using games, teachers might encourage their students to participate in EFL class actively. Furthermore, when both students and teachers do not speak the same language, games may be helpful remedies for communication breakdowns in the teaching and learning process.

As stated by Reigeluth (2013), selecting a process for learning in connection to trained subjects is a teaching strategy. Hattie & Anderman (2019) stated that excellent teaching strategies can not only interest students in learning, but can also strengthen the self-conception of teachers. The teacher is crucial in the development of students' language knowledge. Teachers can use a variety of methods in teaching vocabulary to assist their students increase their vocabulary knowledge. The teacher's approaches and strategies will influence how students acquire words. So it can be concluded that the teaching method is useful for improving the teaching and learning process. In order for teachers to be able to improve their competence regarding teaching methods, training is needed. According to Niazi (2011), training and development refer to learning or transferring the information, skills, and process capacities required to carry out certain tasks or functions to benefit organizations and individuals. Widodo (2015:82) adds that training consists of a sequence of individual actions designed to enhance knowledge and skill in their sector. For a teacher, Noe (2010: 351) says that teacher training is an endeavor to improve teachers' competencies in the areas of expertise, attitudes, and skills. In line with Mawardi (2013:4), teacher training is designed (1) to enhance teachers' performance; (2) improve their technical expertise in a technology way; (3) to equip new teachers' skills; (4) to help teachers solve issues so that effective education is based on their requirements; (5) to build teacher's workforce.

The purpose of this study was to develop a vocabulary learning training module containing games to be used in teaching English vocabulary in vocational high schools. With the development of this module, teachers can choose which games will be used in teaching so that the teaching and learning process will be more interesting and not monotonous. In addition, students are able to learn vocabulary more fun and are directly involved in learning activities.

Research Method

This research belongs to the type of R&D research because it aims to validate and develop products (Sugiyono, 2019:393) in the form of a vocabulary training module with creative methods (games) for teachers in vocational high schools. Since this study purposed in developing the vocabulary module using games for vocational English teachers, Research and Development (R&D) design was implemented. The stages of this research and development (R&D) in this research were operationally adopting the Borg & Gall model which consists of 1) Potential and problems, 2) Data collection, 3) Product design, 4) Design validation, 5) Design revision, 6) Product trial, 7) Product revision, 8) Usage test, 9) Final product revision, and 10) Mass production (Sugiyono, 2019: 298). However, according to the needs of researchers, only 7 stages were used for this R&D. This research was conducted in three vocational high schools in Salatiga. The research subjects were English teachers from those three schools. Data collection techniques and tools using interviews, questionnaires, document studies, and tests. First, interviews were conducted with 10 English teachers to describe learning methods used and to find out the advantages and disadvantages of learning English in schools and the training for English teachers so far. Second, the questionnaire was given to training module validation experts, English language experts (lecturers) as language validation experts, and teachers as trainees. Questionnaires are used to assess products in the form of modules. The test is carried out at the limited product trial stage, to determine if teachers' pedagogic and professional competence has improved as due to the training.

Data analysis technique in this research was qualitative quantitative. Qualitative data were analyzed using the Miles and Huberman technique, namely by simplifying, focusing, and transforming the data from the interviews. Then the data was presented by combining all the information obtained and then drawing conclusions. In quantitative data analysis, non-test and test techniques were used. The test technique was used to see the differences in the competence of participants before and after the training. In the technique test used pretest and posttest. Analysis of quantitative data was analyzed by quantitative descriptive and statistical techniques t-test (different test) with the help of SPSS. Descriptive quantitative was also used in processing non-test data. Likert scale was used as an instrument to measure the variables to be studied.

Result and Discussion

Potential and Problems

At the potential and problem stage, the researcher collected data through interviews and documentation studies. Teachers of English subjects at the vocational school level in Salatiga, Indonesia have knowledge that is linear about the subjects they teach. In addition, the teachers have minimum academic qualifications for undergraduate education with a study program that is under their field, which is English. The researchers collected data from the teachers through interviews. An interview, according to Cohen (2011), is a versatile method for collecting data, allowing for the use of multimodal channels such as verbal, nonverbal, spoken, and audible expression.

First, the researchers interviewed the English teachers to gain information about teaching methods used by teachers, the advantages and disadvantages of those methods, students' responses, and the difficulties teachers face in teaching English, especially vocabulary. The four initial questions in the interview were as follows: 1) What method that do you use for teaching English especially vocabulary?; 2) What are the advantages and disadvantages of those methods?; 3) How do students respond when participating the class?; and 4) What difficulties do the teachers experience in teaching English?. The results of interviews with teachers regarding the methods that are often used were obtained several statements. Some teachers expressed that:

"So far, the reference is textbooks and only occasionally uses games because they have to catch up on material. Sometimes through the textbook I ask students to look up the meaning of the words."

"The curriculum directs to the student center, we try to go to the student center. But because students are used to receiving, so it goes back to the lecturing model."

"The methods that I use are collaborative methods. I use lecture method and sometimes combine with the discussion method"

Based on the results of interviews with the English teachers, the most frequently used method is the lecture method and the other method that teachers use is discussion method. The reason teachers use the lecture and discussion methods more often was reflected in the next question in the interview about the advantages and

disadvantages of the method used so far. The teacher stated:

“For me, the advantage of using the lecture method is that we can finish the lesson plan on time. We use the lecture method more often because if we use other methods such as games, it will take a lot of time to prepare.”

“If we use the student center, there are many problems. For example, students have not been able to take the initiative to find answers about the assignments. Then, we return to the old method, lecture. The weakness of this lecture method makes students less active but students understand more than other methods.”

“Lecture and discussion methods are easy to use. Moreover, discussion will help students feel more comfortable because they learn with their friends but unfortunately, only active students participate in the discussion and the others are passive.

From the interviews showed that all the teachers believe that the lecture and discussion approach is applied more frequently since it is more familiar to them. Due to the fact that alternative techniques such as games need a great deal of preparation and time, the material cannot be presented on time.

Regarding students response, the teacher answers:

“For SMK itself, English is not the main subject so there are some students who are enthusiastic but many are not.”

“For English subjects, in our school it seems that the subjects are not considered, especially not tested for the national exam. In addition they are not interested even though it is an important lesson.”

The last about the teachers’ difficulties in teaching English stated thus:

”The difficulty is that because these students are at the vocational level, according to my evaluation, their interest in learning is lacking so that when teaching new vocabularies, it becomes ineffective. In addition, one class has poor knowledge, some are good, but most of them are not good, so we have a hard time teaching English. For students whose abilities are low, they have no intention of learning anymore.”

“The difficulty is how to increase students' interest and motivation to learn English.”

The results of interviews regarding student responses and problems faced by teachers showed that students are not or less interested and have low motivation to learn English. This is because English is no longer one of the subjects tested on the national exam. From this, the teacher finds it difficult to teach because the teacher must find ways to increase students' motivation and interest in learning English. Moreover, it was found that English teachers in vocational school needed more exciting teaching methods, did not require much time and energy in preparation, and could increase students' enthusiasm for learning.

Vocabulary Training Module Using Games

Based on the potential and problems obtained through interviews, the module will be develop. The researchers designed product development according to the needs of vocational school teachers in Salatiga, Indonesia, namely Vocabulary Training Module (Teaching English Using Games). This module was designed to help teaching activities become fun and also help teachers to find ideas about what games are suitable for their teaching and learning process. This module contains competency standards, basic competencies, learning outcomes, and indicators. The modules developed are arranged in sequence consisting of cover, introduction, table of contents, competency standard and basic competencies, the guideline for module usage, chapters that contain training materials, evaluations, glossaries, and references. This module contains eleven units. In the first units, the description of creativity and games for teaching. The second until eleventh units contain games with all the explanations, such as: description, duration, preparation, and how to play). Each unit also contains evaluation, scoring, and answer keys.

After it became a module, experts validated the design. Validation of the design seeks to give the module that has been developed with input or suggestions. The product validation of the training module development was then assessed by experts using an assessment sheet in the form of a questionnaire. The experts involved in the validation test are Dr. Bambang Ismanto, M.Si and Dr. Mawardi, M.Pd as a training module expert. As for

the English language expert, Prof. Dr. Listyani, S.Pd., M.Hum and Steaven Octavianus, M.Pd. Product validation data were analyzed to obtain scores and averages. In general, the scoring technique used in this research questionnaire used the Likert scale technique. The use of the Likert scale, according to Sugiyono (2013:132), is a scale measuring the perception, attitude, or opinion of a person or group regarding an event or social phenomenon, based on operational definitions that the researcher has set. the validator is asked to give a checklist (√) on the provided marking scale column. The validator's answer to each item of the statement was given a score on a scale of 1 to 5, namely 5 (excellent), 4 (good), 3 (pretty good), 2 (bad), and 1 (very bad). The classification of module quality by training module experts and English language experts (English lecturers) was obtained through calculations with class intervals based on the following categories: 1) 8,1-10 (excellent), 2) 6,1-8 (good), 3) 4,1-6 (pretty good), 4) 2,1-4 (bad), and 5) 0-2 (very bad). An expert or expert judgment can be used to determine the feasibility of a manual product design by computing the percentage score for each assertion. The calculation results for each of these stages are shown in the table below:

Table 1. Training Module Validation Results

Assessment Aspect	The average score of validator 1 & 2	Criteria
Module display aspect	8,25	excellent
Introductory aspects	9	excellent
Utilization aspects	8,17	excellent
Evaluation aspects	8,29	excellent
Average	8,43	excellent

Table 2. English Expert Validation Results

Assessment Aspect	The average score of validator 1 & 2	Criteria
Module display aspect	9,17	excellent
Training material aspects	8,4	excellent
Language use aspects	8,25	excellent
Average	8,61	excellent

In general, the four validators gave an excellent assessment of the development of the Vocabulary Training Module Using Games, with an average of 8,43 and 8,61, indicating that the module product was considered feasible after revisions were made in several sections based on validator input. The updated module design, which was based on ideas from experts and practitioners, was subsequently utilized as a training module for teachers to increase teacher competency in relation to the first product's teaching methods. Next, in the product trial stage, researchers conducted training through Google Meet. This training was carried out separately for each school because the schedules of the teachers are different in each school, so there were three training sessions. The first training on June 15, 2021, at 09:00 for the first vocational high school, then the second training for English teachers at the second school on June 15, 2021, at 11:00 through Google Meet, and the last training for language teachers English at the third school on June 18, 2021, at 08:00 via Google Meet.

First of all, the researcher gave a pre-test that aims to see the perspectives and knowledge of the trainees (English teachers) regarding creative methods in teaching. The researcher discussed the module's contents once the pretest was completed. Furthermore, when the training was done, the researcher administered another exam (post-test) to see whether the trainees' understanding of the creative technique (game) had improved or not. The pre-test and post-test were used to assess the teachers' abilities before and after the training. By comparing the results of the pre-test and post-test, the improvement in teacher knowledge regarding creative methods of learning after participating in the Vocabulary Training Module (Teaching English

Using Games) training was determined with a completeness score of 7. The pre-test and post-test results of the ten teachers who took part in the training were as follows:

Table 3. Pre-test and Post-test Results of Training Participants

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	66.50	10	9.144	2.892
	Posttest	75.00	10	5.270	1.667

The results of descriptive statistics from the two samples studied were the pretest and posttest scores. For the pretest value, the average learning result or Mean was 66.50. Meanwhile, for the posttest score, the average value of learning outcomes was 75. The number of respondents used as research samples were 10 teachers. For the Std. value. Deviation at pretest was 9.144 and posttest was 5.270. Because the average value on the pretest was 66.50 < posttest 75, it means that descriptively there was an average difference between the pretest and posttest. Next, the results of the t-test were as follows:

Table 4 Paired Sample T-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-8.500	4.743	1.500	-11.893	-5.107	-5.667	9	.000

According to the chart above, the value of Sig. (2-tailed) is 0.000 < 0.50. So, the results of the pre-test and the post-test experienced a significant (meaningful) change. Based on descriptive statistics, the pre-test and the post-test proved to be higher in the final test. The statistics presented above demonstrated an improvement in teacher knowledge following participation in the Vocabulary Training Module (Teaching English Using Games) training. After the training was completed, the researcher administered a perception questionnaire designed to evaluate the vocabulary training module. The classification of English teachers' perception questionnaire was obtained through calculations with class intervals based on the following categories: 1) 41-50 (excellent), 2) 31-40 (good), 3) 21-30 (pretty good), 4) 11-20 (bad), and 5) 0-10 (very bad). The field test findings were as follows:

Table 4 English Teacher Perception Questionnaire Results

Assessment Aspect	The average score of validator 1 & 2	Criteria
Module display aspect	42,5	excellent
Training material aspects	44,4	excellent
Language use aspects	42,25	excellent
Average	43,05	excellent

From the table above, it could be seen that the average value of 43.2 is in the 41-50 interval in the excellent category. It can be concluded that, according to English teachers, the Vocabulary Training Module (Teaching English Using Games) could be used by teachers to support the teaching and learning process, especially in teaching vocabulary. During the product trial field, the English teacher also said that it would be better if there were worksheets that could be photocopied directly to make it easier for the teacher. Product revision was the final stage of this development research. When the training module was tested in the previous step, researchers received feedback from English teachers at three vocational schools. During the trial, product modifications were made based on ideas and feedback from training participants. As part of the redesign, worksheets were added to various resources to simplify and minimize the teacher's time spent preparing for teaching and learning activities. It is concluded that this training module is feasible and can be used to assist English teachers in improving their teaching methods as well as developing teachers' creativity to find other creative methods in the teaching and learning process in order to improve students' abilities, needs, and motivation. Even though it is a feasible category, it still requires improvement before the book is actually used.

The research results showed that so far English teachers at several vocational high schools in Salatiga more often use discussion and lecture methods in teaching and learning activities and less use creative methods such as games as learning methods. Based on the results of interviews, the teachers stated that the discussion method has advantages such as helping students to be more active but not all students are actively involved in discussions. In line with the opinion of Buchari Alma (2012) that the advantage of the discussion method is that it can help students to be active in solving a problem together and also instill tolerance in opinion. While the weakness are the discussion takes a long time and only a few students dominate the discussion. Another method used by English teachers from three vocational schools in Salatiga to teach is the lecture method. The English teachers explained that the lecture method was easier to use because it did not take as much time as the game method. In addition, teachers are also required to complete the lesson plans on time. Djamarah and Zain (2013) said that the lecture method has several advantages and disadvantages. The advantage of the lecture method is that the teacher is easy to master the class and easy to prepare and implement. However, if the lecture method is used frequently and for too long, it will be boring, making students passive and unmotivated to learn. This study also discovered that teachers struggled with teaching English. The most significant barrier is students' lack of English understanding, and the most essential factor is students' learning motivation. According to Hayikaleng, Nair, and Krishnasamy (2016), motivation is an essential factor in students' success in learning English. When pupils lack drive, they do not succeed in studying English. To enhance student motivation, the teacher must employ more engaging learning approaches that stimulate students' attention.

From the findings of the potential and difficulties, a vocabulary learning training module integrating games was created. By developing a training module like this, in the future, teachers may adopt games as a teaching technique to make the teaching and learning of English more enjoyable and easier for students to comprehend. Based on previous studies, Musbalat (2012), Silsüpür (2017) Marius (2018), and Masruddin (2019) believe that when students attain learning goals in a pleasant setting, their motivation and confidence are increased. Furthermore, the result shows that training used to help teachers develop their competency, this is in line with Noe (2010), Simamora (2010), and Mawardi (2013) stated that teachers are trained to improve their knowledge, attitudes, and competencies. Moreover, training helps teacher to enhance the quality and quantity of production, decrease learning time to meet set performance requirements, foster greater loyalty, attitude, and collaboration, fulfill human resource planning, and aid in self-improvement and growth.

With training modules, it helps teachers get ideas to find other simple games and helps them to implement them better in their respective classes. For the development of training modules, certain stages are required. the potential and problem analysis stage and the data collecting stage is carried out to use the results for the following stage. The study continues to the next stage after discovering the problem and the necessary data. In the product design stage, the researchers built a training module focusing on vocabulary using games. It was created to suit the demands of the user to construct the training module. After the development of the product by the researchers, the following stage was design validation. Four experts assessed the module created by the researchers in this context. The following stage was a product trial. During the trial stage, ten English

teachers assisted. At this point, the ten teachers took a pre-test and a post-test to evaluate if there was a change in their understanding of creative learning techniques before and after the training. After completing the post-test, the teachers evaluate the module by filling out a questionnaire. English Teachers' questionnaire consisted of four items: module display features, introduction aspects, usage aspects, and assessment aspects. The last stage was product revision. The researcher developed the evaluation to obtain data on the vocabulary training module. Based on the responses of English teachers in the field trial, the module proved suitable for use in teaching and learning English, particularly for vocabulary. According to the stages in this research, the training module has been constructed to meet the qualities of a good module. By using the games in this training module, the implementation of teaching English vocabulary would achieve optimal growth, therefore improving educational quality, teacher competency, and student skills.

Conclusion

Based on the description of the research and development findings, it is possible to conclude that the method used by English teachers at several vocational high schools in Salatiga is the lecture and discussion approach. The reasons for applying these two approaches more frequently are that time is limited, teachers are obliged to finish lesson plans on time, and using other methods such as games needs quite a long preparation, which the teacher does not have the time or energy to prepare. Furthermore, issues that emerge throughout the teaching and learning process include students' reactions to English subjects. English is not one of the topics evaluated in the national exam, therefore students are less interested. Furthermore, students' low motivation and enthusiasm in studying result in poor learning results.

The necessity for the creation of training modules that use simple games and require less preparation is a way for teachers to improve their English teaching skills. The product, in the form of a Vocabulary Training Module (Teaching English Using Games), is acceptable for usage after expert validation. This product is produced through R & D steps by analyzing the potential and problems faced by schools through in-depth interviews with English teachers in several vocational high schools in Salatiga.

The Borg and Gall research and development (R & D) approach, as described in Sugiyono (2019), was used to create a product in the form of a training module for English instructors. However, this research has a limitation in that the research's time is very short, when an ideal research and development (R & D) should take at least a year. Due to the restrictions encountered, this research was only completed to the seventh stage. As a result, the next researcher is expected to be able to conduct study till stage 9 or 10 in order for the analysis and research outcomes to be more thorough.in-depth.

This module's development is confined to stage seven, and it has not yet achieved a large-scale trial or mass product. Moreover, this module was also only tested on English teachers at three Salatiga vocational high schools, thus if it is to be extended to other schools, it must be adapted to the needs of that school.

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Conceptual IoT Implementation in Post-Pandemic School Activities: A Case Study in Elementary Schools

Septi Yulisetiani
Elementary Teacher Education
Faculty of Teacher Training and Education
Universitas Sebelas Maret
septi.yulisetiani@staff.uns.ac.id

Puspanda Hatta
Informatics Education
Faculty of Teacher Training and Education
Universitas Sebelas Maret
hatta.puspanda@staff.uns.ac.id

Abstract:

Many studies empirically discuss the use of technology in overcoming pandemics in education. Generally, research discusses the use of technology in online teaching and learning activities. When viewed from the information technology layer, these studies focus on discussing the use of the software layer. This study examines conceptually about the utilization of the hardware layer in information technology, especially *Internet of Things* infrastructure which is used to help the community in carrying out their daily activities in the new normal era. Conceptual ideas are applied by taking a case study in education, especially in the elementary school environment. The urgency is that there are many stakeholders in the elementary school environment, especially children who need extra attention and supervision in carrying out post-pandemic activities outside the house. These stakeholders are a group at risk of being exposed to the virus because the majority have not received protection in the form of vaccination and the level of adherence to health protocols is low. This creates a risk for vulnerable groups, namely children, families, and teachers. It is necessary to integrate cyber physical systems that help minimize these risks. This conceptual idea describes the concept of IoT technology to minimize the risk of virus transmission and the strategies that allow it to be applied in the elementary school environment. With a top-down approach, it describes how the IoT system protects children and teachers from going to school, doing activities in the school environment, participating in learning in class, to completing learning.

Keywords: Elementary School, Internet of Things, Information Technology, Post-Pandemic

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Introduction

Restrictions on community activities due to the Covid-19 pandemic have been running for almost two years since early January 2020. The government has begun to relax the rules on activity restrictions and has begun to reopen public facilities and services in several sectors such as schools, shopping centers, tourist attractions, offices, and other non-critical places (Sundawa et al., 2021). All sectors such as business, economy, education, tourism, and the creative industry must recover soon (Bryant et al., 2020; Handayani et al., 2021). However, the opening of these public service facilities will be carried out in stages to prevent an increase in cases of virus transmission (Pratama et al., 2021). In the education sector, the opening of school facilities services is also implemented gradually (Safira & Ifadah, 2021). At the elementary school education unit level, it was initially doubtful to hold face-to-face schools because according to the cluster distribution data shown in Figure 1, elementary school education units accounted for the highest transmission cases.

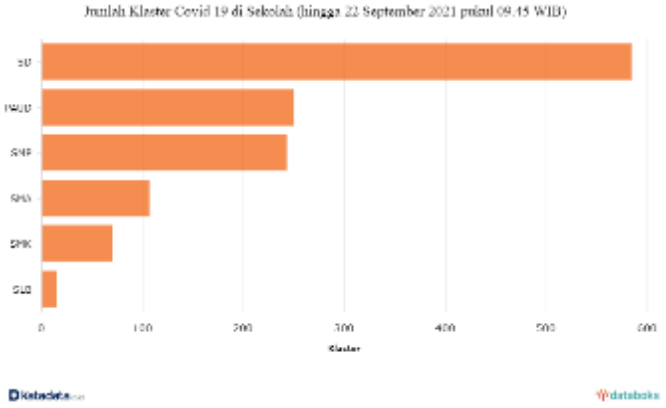

Figure 1. Distribution of clusters of Covid-19 transmission at every level of education
(ref:https://databoks.katadata.co.id/datapublish/2021/09/23/imbas-ptm-1299-sekolah-jadi-klaster-covid-19

Online learning is mandatory at all levels of education to minimize the spread of COVID-19. In supporting online learning activities, many online platforms were used, one of which is Google Classroom proposed by the Ministry of Education and Culture of the Republic of Indonesia. However, the sudden change from offline to online learning makes it difficult for students, especially elementary school students, to use the platform (Fauziah & Nurwulan, 2021; Zulherman; Zain, 2021). Elementary schools cannot rely solely on online learning because of various limitations ranging from ownership of digital devices to the digital competence of elementary school students, so it is still necessary to carry out face to face learning or online learning with various active learning methods (Hatta et al., 2020). Several studies also show that face-to-face learning provides better learning outcomes than online learning (Stevens et al., 2021). Viewed from the availability of human resources and users (in this case students), the elementary school environment also faces the risk of transmission because its human resources are prone to being exposed to the virus in terms of age.

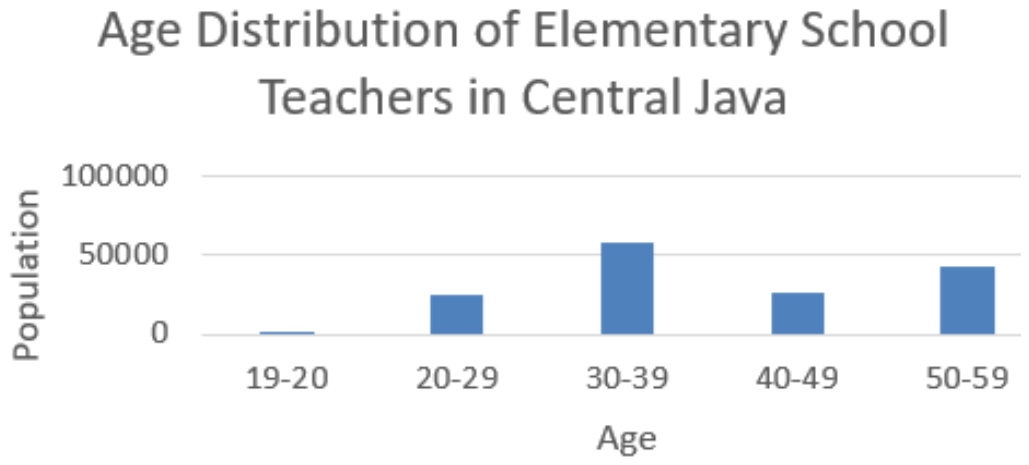

Figure 2. Distribution of Teachers Age in Central Java, Indonesia
(sumber: http://statistik.data.kemdikbud.go.id/index.php/page/sd

Figure 2 takes a sample of data for the Central Java region because it is one of the provinces with the worst virus spread rate in Indonesia (Fransiska, 2021). The diagram in Figure 2 shows that the largest population of teachers is in the age range of 30-39, followed by the range of 50-59, and the third of 40-49. The population is clearly larger than teachers in the age range of 20-29, who are claimed to have good immunity and the majority do not have comorbidities. The most of the covid patients were over 40 years old. Furthermore (Aritonang et al.,2020). The mortality rate for Covid patients was dominated by this age (Rory et al.,2021). This is in contrast to the three age ranges above, which are individuals at risk of contracting the virus. However, with various considerations, face to face learning must still be carried out with strict health protocols.

The level of compliance with health protocols in the school environment is also an important issue (Ludvigsson, 2020), especially in the elementary school environment. Various efforts in the form of written and mandatory policies regarding health protocols did not really increase the level of compliance. Another technology-based method is needed to overcome this problem. This study describes the application of information technology, especially the Internet of Things, to support a smart school environment that is able to maintain and force the people in it to implement health protocols. Such an application was done with a conceptual elaboration model accompanied by a study of the successful application of IoT in the environment before and after the pandemic. This article describes how IoT involves people in the environment they are in, and how the IoT works to form a force compliance system for the health protocol aspects of people who carry out activities in elementary schools during the post-pandemic period.

Related Works

Internet of Things (IoT) is a data communication concept where a certain object has the ability to transmit data via a network and without any interaction between humans or from human to computer device; communication occurs between machines (Atzori et al., 2010). Internet of Things is often identified with the use of wireless devices as communication devices to deliver data in internet communication lines. IoT devices can also include the use of sensor technologies that transmit data to each other that is used for the communication process.

In the last ten years, IoT has begun to be applied in various fields, starting from applications in the field of defense and public security (Fraga-Lamas et al., 2016); industry and manufacture (Wollschlaeder et al., 2017); smart city infrastructure fully supported by automation technology (Zanella et al., 2014); health care services and medical records; optimization of agricultural management through smart agriculture (Tzounis et al., 2017); service automation in offices, schools, and universities (Sharma et al., 2020; Tokarz et al., 2020); and context-aware setting towards a smart environment in general (Al-Fuqaha et al., 2015).

There has been no research that discusses conceptually in the form of literature reviews, critical reviews, ideas, or case studies on the application of IoT in the elementary school environment. Seeing the background on the level of compliance with health protocols in the elementary school environment during the post-pandemic period (Lee & Raszka, 2020; Ludvigsson, 2020), this idea is needed as a guide for creating an IoT system framework as well as a guide for further development. This article reviews the implementation of IoT infrastructure in the elementary school environment. The discussion is about the application of IoT for environmental sensing, context-aware systems, object detection, automation, and notification of the role of each environmental sensor to an integrated system whose data can be utilized by stakeholders. This IoT case study is expected to help minimize pandemics in the elementary school environment.

Before entering the discussion about the application of IoT at the elementary school level, it should be noted that IoT has been applied in the educational environment. In the educational environment, IoT is applied as the main supporting device for smart school infrastructure. Smart school refers to the integration of information technology in the form of a cyber physical system that supports the automation of the school environment in the form of environmental sensing, automatic classroom management, automatic class attendance, remote laboratory, laboratory automation, electrical automation, smart doors, and several other environmental automation based on electronic devices controlled through the internet (Kassab et al., 2020). For example, the application of IoT for building automation and electronic devices in an educational laboratory environment is proven to be able to streamline electrical power consumption (Hatta & Budianto, 2019). In addition, there are also examples of successful applications of IoT for automatic attendance systems and automated payroll systems in higher education environments that have received good

responses from users (Al_Janabi, 2020). In terms of supporting practical laboratory facilities, IoT can also have an important role. IoT can be applied as a remote laboratory, especially for practical facilities in the fields of mechanical engineering, robotics, and control engineering. Through a remote laboratory, students can remotely control practical devices, this is very useful during a pandemic (Tokarz et al., 2020).

So far, the application of information technology as one of the tools to suppress the pandemic in the world of education, the majority talk about its advantages in supporting online learning such as the use of e-learning tools and their learning strategies (Rahma et al., 2020; Zulherman; Zain, 2021).. By referring to the research background and relevant research that has been described previously, the novelty aspect of this article is to take the discussion domain of one of the contemporary information technology products, namely IoT, and conceptualize it to be applied in elementary schools as the urgency of its application in elementary schools has been described in the research background. This research can also be used as a reference for further research on how IoT influences interdisciplinary fields: health, social-humanities, and education.

Research Method

This study used a qualitative approach with a literature review research design and a case study. The research steps are shown in Figure 3, starting with a literature review, selecting case study sites, designing an IoT framework, analyzing the results of the design and validation, and drawing conclusions. This study used secondary data, namely by conducting a literature review on scientific articles published and indexed on the reputable scientific article indexing engines, Scopus and DOAJ. Articles that are used as references are articles published in the 2010-2021 period. The keywords used during the search stage were internet of things, internet of things smart school, internet of things education, internet of things pandemic new normal covid-19.

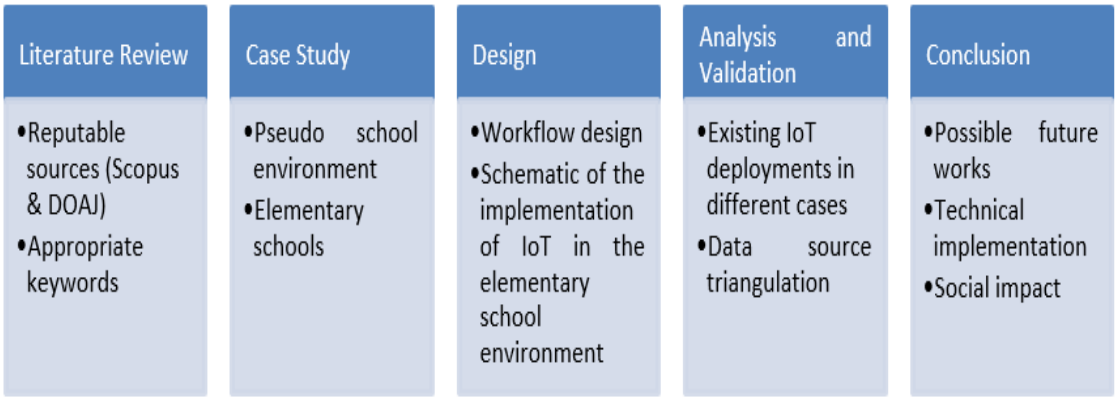

Figure 3. Research Design

After filtering the articles according to the discussion and data as needed to conceptualize the IoT infrastructure, the next step was to choose case study locations. Since elementary schools have a low level of awareness of health protocols and a high transmission rate because the students, teachers, and staffs had not been vaccinated and many were in the vulnerable age range, elementary schools were used as the case study place for the application of IoT.

The next stage was to design the IoT infrastructure framework. The framework design used the workflow design approach (Raibulet & Arcelli Fontana, 2018). By employing three actors in the workflow design, namely students, teachers, and stakeholders. To show how it works, the work steps start from the scenario of students and teachers leaving for school, entering and engaging in school activities, and having teaching and learning activities in the classroom and laboratory. Stakeholders obtain all activity data of IoT devices that interact with teachers and students which are processed in the cloud infrastructure.

After designing the framework, the next step was to analyze and validate the framework design. Validate data sources by comparing the findings of previous studies contained in scopus indexed journal articles. The analysis was carried out by identifying and determining the type of IoT technology in the design framework, then the application was triangulated with the application of IoT that already existed in secondary data sources. The last stage in this study was drawing conclusions that lead to recommendations for the next possible research in terms of technical implementation and the social impact of the application of the IoT.

Results and Analysis

This section describes sequential start from the proposed framework, a description of the IoT infrastructure and its supporting components given a numbered index, as well as how sensors and actuators work in the school environment when responding to system users (in this case teachers, students, and stakeholders). The next sub-section is to analyze the possible implementation and the way IoT components work which are explained by triangulation of data on secondary data relevant to this study.

Proposed Framework

The proposed framework was designed based on a pseudo-case study, which means that it can be applied to the majority of elementary school environments. Pseudo case studies are taken based on references from previous research. The application of IoT concepts in virtual schools. Because this research conceptualizes the application of IoT for an ecosystem in which there is a lot of human interaction, references are also taken on the application of the IoT concept to public facilities (Saheb & Mamaghani, 2021). The pseudo case study was chosen because there was no research sample that discusses the complete application of IoT integration in the elementary school environment. Previous studies that have been reviewed have only discussed the application of IoT in partial handling (sub system) of the pandemic, for example, only discussing the detection of masks or body temperature. There had been no research that discusses the complex integration of IoT for handling pandemics in the elementary school environment. Because it took a pseudo case study, the design of this proposed framework can also be applied to various school environments that have the same characteristics (having entrance gates, indoor areas, outdoor areas, and crowded activities). Figure 4 below is a conceptual design of IoT infrastructure applied to elementary schools in the post-pandemic era.

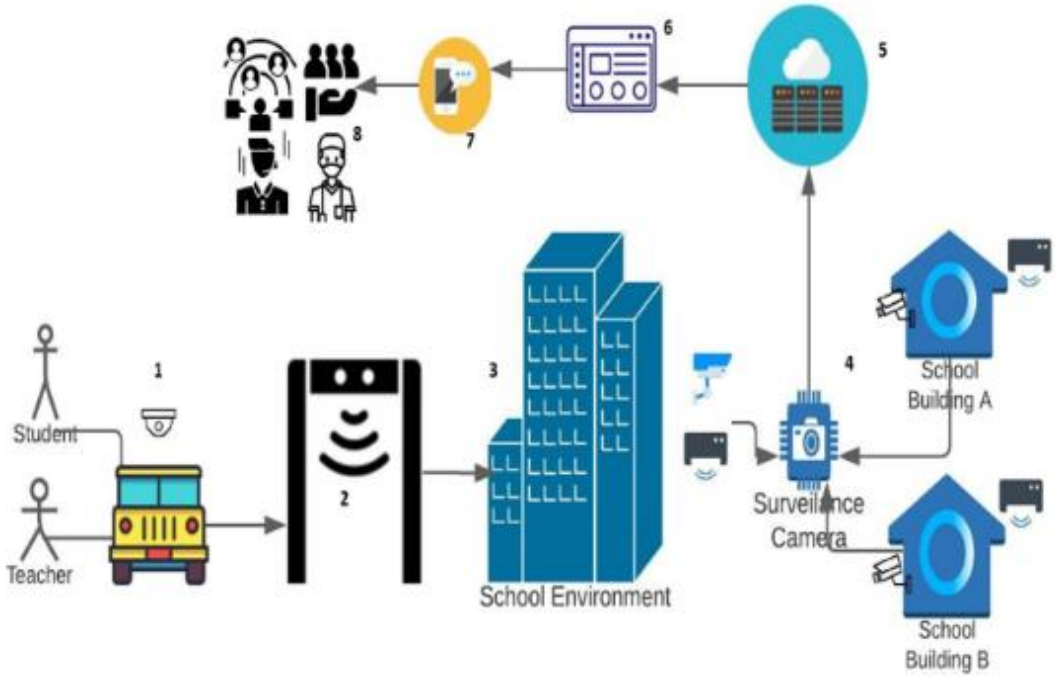

Figure 4. Conceptual Model of IOT in Primary School Post Pandemic

Figure 4 above describes the conceptual model of the IoT framework that can be applied in elementary schools in the post-pandemic era. In the figure, a small numbering indexation is provided to describe the IoT infrastructure in the form of sensors. These sensors work on each teacher and student activity. The ecosystem can essentially be used for anyone who has activities in the school environment, but in the conceptual design, only two actors are described, namely teachers and students, who carry out full activities in the school environment. Students are not limited to students who go to school by the school bus but also those who go by themselves and are dropped by their parents that can use this system from number 2 (smart school gate) before entering the school environment. Screening of activities that can be

monitored by the IoT infrastructure will continue after the teacher or student enters the school gate. After the teachers and students enter the school gate, the next task is the activities around the school environment as shown by index number 3 in Figure 4. In these activities, teachers and students also interact with the existing IoT ecosystem. Proceed to activities in the school room, students and teachers follow and carry out classical teaching and learning activities or practicum in the classroom and laboratory (shown by index number 4). A detailed explanation of each component depicted in Figure 4 is provided in Table 1. The IoT infrastructure that can be applied to the school environment include the following elements.

Table 1. Mapping and Identifying IoT Technologies in Conceptual Model

Index Number	IoT Infrastructure/Feature	Device Involved	Technology Readiness
1	• Smart Vehicle/Bus	• Arduino UNO • Digital temperature sensor and LCD • IP Camera for face mask detection	• TRL Level 9
2	• Smart School Gate	• Arduino UNO, Raspberry Pi • IP camera for mask detection • Body temperature sensor • Automatic hand sanitizer • Sanitation tunnel (if possible) • UV Sanitation (if possible)	• TRL Level 9
3	• Entire school environment (outdoor area)	• Arduino UNO or Raspberry Pi • IP Camera for mask detection and social distancing • Automatic hand sanitation • UV sanitation	• TRL Level 9
4	• School environment (Indoor area, classroom, and laboratory)	• Arduino UNO or Raspberry Pi • Surveilance camera • Indoor air quality monitoring • Mask detection • Contactless attendee • Automatic hand sanitation	• TRL Level 9
5	• Cloud IoT data processing	• ISPs, broadband network access • Cloud servers/VPS • Operating system	• TRL Level 9
6	• Data dashboarding	• Web interface • Database	• TRL Level 9
7	• Notification sent to stakeholder	• Mobile phone	• TRL Level 9
8	• Stakeholder and decision maker	• Policy for safety, tracking, and compliance management	• TRL Level 9

In table 1, we divide the IoT infrastructure into six main indexes that have their respective roles. The first index, IoT infrastructure is placed on student shuttle vehicles (if the school uses shuttle vehicles). The second index, IoT infrastructure is placed at the school entrance gate. The targets of technology in the second index are teachers and students who will enter the school gate. The third index, IoT infrastructure is placed in the outdoor environment of the school. The target of technology in the third index is people who are active in the outdoor environment at the school. The fourth index, IoT infrastructure is placed in the indoor environment (classrooms, teacher offices, and laboratories). The targets of technology in the fourth index are people who are active in the school rooms: teachers, employees, and students. The fifth index is a cloud-based computer network infrastructure that is used as a data processing platform obtained from environmental sensing in the first to fourth indexes. The captured data are then displayed statistically on the dashboarding data in the sixth index. The data will be sent to stakeholders, namely the regional COVID-19 task force, teachers at the managerial level positions, and other stakeholders. Technology Readiness Level, hereinafter abbreviated as TRL, is the level of maturity or readiness of a technology research and development result that is measured systematically so that it can be adopted by users, either by the government, industry or society. TRL Level 9 means the System is truly tested through successful operation.

The explanation of each IoT infrastructure mentioned in Table 1 will be described in more detail in the following sub-topics.

1. Body Temperature Sensor

   Measurement of body temperature can be the basis for determining the health level of students who will go to school using a pick-up vehicle. Knowing a student's body temperature is a reference to find out whether the student is experiencing the initial symptoms of COVID-19, namely fever. Body temperature measurements generally use an infrared thermometer and are carried out manually by officers. In the measurement process, the obstacle that occurs is that the officer must be close to an object that might increase the risk of being infected with the COVID-19 virus and will cause an increase in cases. By making a body temperature measuring device using IoT technology and then placing it at the main entrance, namely on public transportation and school entrance gates, the body temperature of teachers and students can be monitored (Yousif et al., 2021).. If the body temperature exceeds the threshold, then the teacher or student is not allowed to enter the school environment.

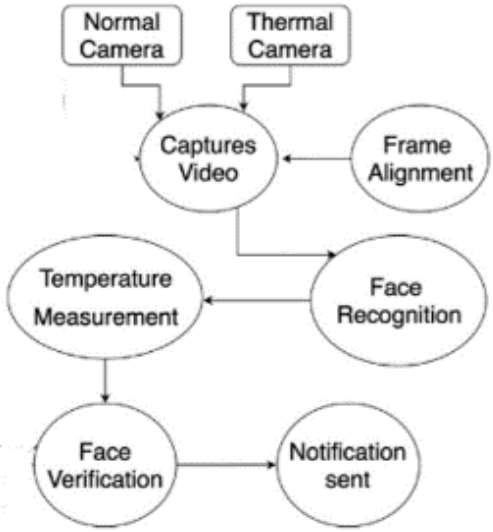

Figure 5. Body Temperature Detection Workflow

Thermal sensors are integrated in the camera that detects students or teachers when they are about to cross the gate. The data captured by the camera is the face of the person scanned by the camera. Data are captured using face detection technology. The flow of how the system works is as follows. People's faces are captured by thermal cameras and normal cameras, then formatted in the form of video capture. At that time, frame alignment occurred to detect people and classification based on the temperature obtained. The system will display the status of people whether they have a fever or not.

2. Mask Detection

   The detection system for wearing masks does not absolutely prevent the spread of COVID-19 in the elementary school environment. However, it can give positive results as a controller for compliance with the use of masks in the environment (Bonal & Meti, 2021). The mask detection system can be integrated with smart homes using IoT. Mask detection is carried out via an IP camera that will send an alert if there is a violation of the mask use protocol (Cerit & Bayir, 2020). Previous research throughout 2020-2021 has succeeded in applying AI technology with deep learning methods applied to IoT infrastructure; this technique plays a major role as the basis for mask detection technology (Alsaydia et al., 2021; Elsayed et al., 2021; Gedik & Demirhan, 2021; Kumar et al., 2021; Lad et al., 2021).

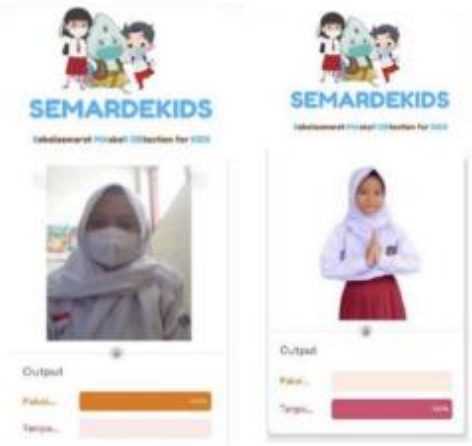

Figure 6. Mobile Based Mask Detection for Primary School Student

The application of mask detection is one of the most popular studies on the topic of preventing COVID-19 based on IoT technology in the 2020-2021 period. Various public areas such as airports, train stations, shopping centers, and other public areas have implemented this mechanism. In the elementary school environment, the mask detection system can be applied to various crowd-prone locations such as school entrance gates and the entrance of every important room in the school (Varshini et al., 2021),: classrooms, teacher rooms, laboratories, and some other indoor areas (Takrim et al., 2021), canteens, and outdoor area.

3. Disinfectant Tunnels

To treat infections that are spread through contact with contaminated surfaces, disinfectant tunnels can be applied. A disinfectant tunnel is more complex than hand sanitizer, because it not only disinfects hands, but all surfaces of objects. It can also be determined whether to use water-based or fogging-based sanitation. The disinfection material can be sodium hypochlorite solution with a concentration of 0.1%; it can eradicate the virus within one minute (Panda et al., 2021).. Another compound that can be used in the tunnel is povidone iodine, which has the same properties as sodium hypochlorite but with a safer effect on people (Mohtar et al., 2021).

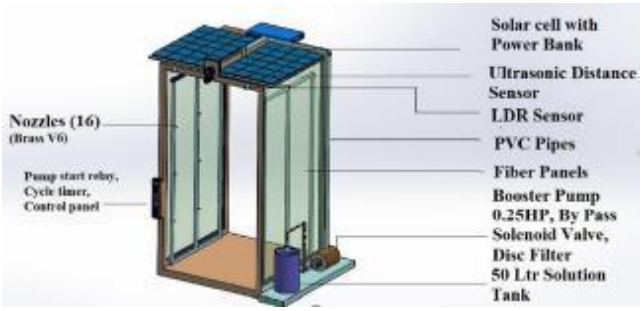

Figure 7. Example Prototype of Disinfection Tunnel (Pandya et al., 2020)

Placing the disinfectant tunnel at the school entrance gate is enough, because the cost of making it is not cheap and the manufacturing stages are quite complex. Disinfectant tunnels can be integrated with IoT to automatically disinfect people detected passing through the tunnel (Pandya et al., 2020).. In a more advanced application, disinfectant tunnels can be integrated with body temperature and face mask detection facilities and automated through IoT devices (Bhogal et al., 2021).

4. UV Disinfection Machine

The increasing COVID-19 threat in public facilities with the interaction of object exchange is the basis for the idea of making UV disinfection. UV disinfection can be applied in classrooms, teacher rooms, laboratories, and several other indoor facilities, as is described in the previous research on the application of UV machines in public spaces (Sonawane et al., 2021). The simplest use is to install a UV

lamp as a means of passive and constant disinfection in indoor spaces; this will help disinfect the surface of objects (Lualdi et al., 2021).

Figure 8. Example of UV Disinfection Lamp

Another form of UV disinfection is for surface sterilization or a toolbox for conveyor-shaped disinfection that can be controlled via IoT devices (Yadav et al., 2021). The application of this conveyor disinfection model is more expensive than UV lamps as it can be applied to conveyor machines in public transportation stations. It can also be applied to the school cafeteria. The disadvantage of this UV conveyor is that it is more expensive than UV lamps.

5. Indoor Air Quality Monitoring

During a pandemic, good air circulation can help prevent the virus from entering the body through breathing. Indoor air is potentially more polluting than outdoor air. This air quality monitoring system has been implemented in the hospital environment because hospitals with isolation facilities became one of the clusters for the spread of the virus (Kenarkoohi et al., 2020). Previous research also discusses the application of a data driven air quality prediction system in the university environment (Tagliabue et al., 2021). Referring to the previous research, the air quality monitoring system is also very possible to be applied in the school environment, especially elementary schools. In the elementary school environment, most activities are carried out in classrooms or other indoor spaces. Thus, it is necessary to pay attention to air quality and circulation to reduce the possibility of virus transmission in the room.

Figure 9. Low Cost Air Monitoring using Arduino and Raspberry (Faiazuddin, 2020)

Air quality monitoring system can be implemented with low cost by using Arduino microcontroller board (Kaliszewski et al., 2020) or to be more advanced, by using a Raspberry Pi microcomputer (Faiazuddin, 2020) as shown in Figure 9. The two mechanisms can be controlled through a series of IoT infrastructure to produce an intelligent air monitoring system. By looking at the population and activities in elementary schools, which are quite dense and intensive, if the air quality monitoring system is further developed, it can be used as a predictive analytic engine (Mumtaz et al., 2021) or early warning system

(Peladarinos et al., 2021) to detect the potential for transmission in the elementary school environment. This will greatly assist in handling the outbreak and controlling the transmission of COVID-19.

6. General Building Automation for Classrooms and Laboratories

The last sub-system from this proposed framework is general building automation based on IoT. General building automation includes smart doors, automatic lamps, automatic air-conditioners, and other forms of home or building automation. Building automation in the context of use in the school environment is not much different from building automation in the office environment. The concept of building automation that can be applied to this framework includes, among others, the contactless attendee management system (Yousif et al., 2021), automatic classroom, laboratory, and office doors (Hatta & Budianto, 2019; Varshini et al., 2021) and laboratory automation that prioritizes remote activity and contactless features (Bindu et al., 2021; Tokarz et al., 2020).

The main purpose of general building automation in the classroom, office, and school laboratory is solely to reduce people's contact with the surface of room facilities, not to prevent full virus transmission. Compliance with applicable health protocols is still required, assisted by an automatic compliance management system from the five aspects of the IoT sub-system that have been discussed previously.

Conclusion

This article describes a conceptual framework about contemporary technologies that are integrated into the IoT system as an infrastructure to help prevent the transmission of the COVID-19 outbreak in the elementary school environment. The elementary school environment requires special attention regarding its relationship with the possibility of the formation of new clusters of the spread of the COVID-19 virus. This makes the development of the IoT framework as described above necessary. Based on a literature review of secondary data taken from indexed articles of reputable publications, many similar systems have been developed, but they do not specifically address the application in elementary schools. The results of the review show that a similar system can be applied in elementary schools because the majority of systems are stated to have technology readiness at level 9 (TRL level 9) and a good success rate of application in each application domain, although it does not eliminate the virus. Future studies are needed on the successful implementation of social aspects such as the level of technology acceptance, ease of use, user experience, and usability. In addition, the success of implementing this system in reducing the rate of transmission of COVID-19 in the elementary school environment also needs to be measured comprehensively.

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Instructional Design to Improve Students' Entrepreneurial Affective

Dini Erlinawati
Informatics and Computer Education Department,
Faculty of Teacher Training and Education,
Sebelas Maret University
dinierlinawati123@student.uns.ac.id

Basori
Informatics and Computer Education Department,
Faculty of Teacher Training and Education,
Sebelas Maret University
basori@fkip.uns.ac.id

Puspanda Hatta
Informatics and Computer Education Department,
Faculty of Teacher Training and Education, Sebelas Maret University
hatta.puspanda@staff.uns.ac.id

Abstract:

Technological developments require the world of education to do work effectively and efficiently. Vocational High School is one source that will meet the needs of the industrial world in the future, for that it must be prepared with expertise and knowledge. This study aims to (1) determine the learning design that can improve students' entrepreneurial attitudes and (2) determine students' entrepreneurial affective. The research method is a qualitative case study with data collection techniques through observation, interviews and documents and using a purposive sampling technique. The data were analyzed by the model from Miles and Huberman includes data reduction, data display and conclusions. The results revealed that (1) the instructional design for improving the students' entrepreneurial affective at SMK N 1 Sawit is through PKK (Creative Products and Entrepreneurship) subjects and development in this study through Digital Marketing training guidance (2) Knowing entrepreneurial attitudes students from the influence of the applied learning design is good, namely (a) student interest in entrepreneurship through PKK is half-assed while through design guidance and digital marketing training increases; (b) Teachers foster students' creative and innovative attitudes through projects or assignments that contain ideas and create a product, while through digital marketing training guidance through content creation, product design, accounts, etc.; (c) The teacher gives positive advice when students experience failure by providing motivation and guidance; (d) Teachers increase their risk-taking attitude by determining projects or tasks that have a high risk and through the courage to build a shop in the marketplace.

Keywords: Entrepreneurship, Instructional Design, Entrepreneurial affective, Covid-19.

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Introduction

Vocational High School is an educational institution that have responsibility for improving and creating graduates or skilled human resources as provisions in the working field (Edi et al., 2017). The learning strategies to encourage students in improving their entrepreneurial skills to match with the industry 4.0 are Dual Education (Sulistyowati, 2017) and Creative Products and Entrepreneurship subjects (Cabrera Marino, 2017). Those learning strategies cannot be implemented optimally at SMK N 1 Sawit due to the Covid-19 pandemic. The Dual Education is not implemented and the Creative Products and Entrepreneurship subjects are conducted online. These conditions have an impact on schools, especially several students who are less interested in entrepreneurship and they do not have a job idea related to their skills after graduation. For these reasons, the Covid-19 pandemic is a significant challenge in the educational institution in developing and innovating entrepreneurial competencies through the digital revolution as a strategy to generate students who are ready to be entrepreneurs (Secundo et al., 2021).

Entrepreneurship course is considered as one of the important ways to influence the country or industrial competitiveness, thereby providing an opportunity to develop into a more competitive educational environment during the Covid-19 pandemic (Liguori & Winkler, 2020). It should be done because the vocational education results compared to the working field demands still have gaps. It is evidenced by the knowledge level and mastery of students' skills that have not conform to the needs of the working field (Atmawati et al., 2017). The Indonesian Central Statistics Agency (BPS) informed that the number of unemployed in Indonesia since February 2020 is 6.88 million. From this data, the SMK graduates are the highest at 8.49% (BPS, 2020). This number is relatively large considering the resources or SMK graduates potential to work or become entrepreneurs is very high because of their skill gained at school.

Entrepreneurship has an important role in economic prosperity, economic stability and the most innovative power to influence the health of a competitive economy. Entrepreneurship is recognized as a source of economic growth and the main factor affecting on socio-economic welfare of the community (Ahmed et al., 2020). It is relevant to the Vocational High Schools (SMK) goals namely organizing students as graduates who are ready to work and have special skills related to their fields, involve entrepreneurial affective in order to create an independent, innovative and creative attitude in arraying provision to work (Zulaidah & Widodo, 2020). Entrepreneurship course becomes responsibility of families, schools, communities, and the government which is conducted in the family, community, and school environment for a lifetime as mentioned in the education involves informal (family), formal (school) and non-formal (community) education (Inang et al, 2019). There are some authentic qualities of entrepreneurs; however, the personality characteristics do not explain entrepreneur's activity and success. Thus, other factors can contribute to entrepreneur's activity and increase the success. For example, a person does not understand how to write a business plan or identify opportunities since was born. These skills are taught and improved through education (Peschl et al., 2020).

Entrepreneurship course is an instrument to increase entrepreneur activities (Ahmed et al., 2020). For this reason, teachers need an instructional design contained entrepreneurship course or entrepreneurial activities in growing the entrepreneurship interest and affective in terms of the practice effect in order to achieve the goals. The instructional design that can improve entrepreneurial affective is a current requirement. This is intended in order the students gain competence before they get into the working field or creating jobs. The various viewpoints related to instructional design to improve students' entrepreneur affective include entrepreneurship course, digital technology-based learning, technopreneurship-based learning, training-based learning, practicum-based learning, project-based learning, teaching factory learning and or cooperative learning. The entrepreneurship encourages various benefits, such as increased working opportunities, reduced dependence on one industry, increased capital flows that improve the business environment, increased prospective businesses, outsourcing utilization to provide effective operation and development of new ideas and innovations (Zanabazar & Jigjiddorj, 2020).

The investment in entrepreneurial affective is very important to increase entrepreneurs and reduce unemployment. Besides providing skills, the investment in entrepreneurial affective is also a tool to embed entrepreneurship values (Hermanto, 2016). Based on the previous description, the researcher conducted a study related to instructional design that can improve the entrepreneurial affective of the case study of SMK N 1 Sawit students related to the phenomena and needs of instructional designs.

Research Method

This research used qualitative research with case study design. The purpose of case study research is to provide descriptions, examine theories and generate theories (Prihatsanti et al., 2018). In this research, researchers examined instructional designs to improve students' entrepreneurial affective, a case study at SMK N 1 Sawit by purposive sampling technique. The data collection technique is observation, interviews and documents with credibility or internal validity tests. The credibility or internal validity tests are conducted with extended observations, increased persistence, triangulation, FGD, negative case analysis, and using reference materials (Sugiyono, 2018:269). In addition, the data analysis used Miles and Huberman as follows:

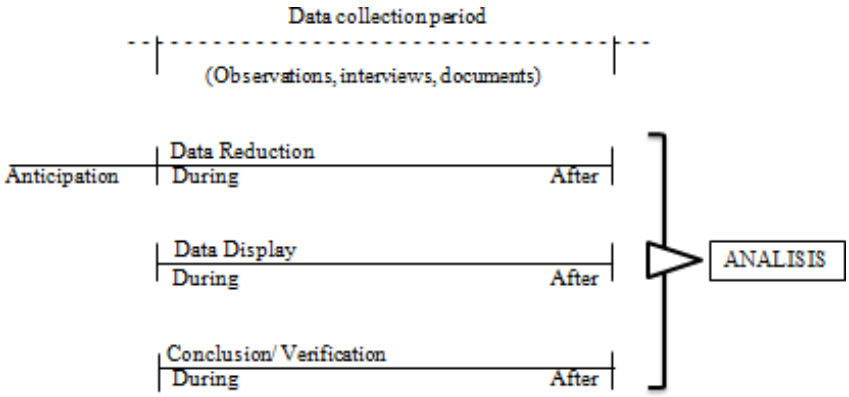

Figure 1. Data Analysis Component

Result and Analysis

The researcher explored data sources through primary data involve observations and interviews and secondary data involves reviewing journal, documents, and books. The data and analysis results was following:

The observation results are used to support respondent data during interviews related to instructional designs that can improve students' entrepreneurial affective. Data analysis technique on observation was descriptive analysis technique. The report contained an explanation of what was seen, heard and felt during the observation. It was conducted to gain a real and detailed picture of the case study at SMK N 1 Sawit. The researcher observed how SMK N 1 Sawit applied instructional designs to improve students' entrepreneurial affective through unstructured observations.

The online instructional design for PKK (Creative Products and Entrepreneurship) subjects at SMK N 1 Sawit is the covid impact on entrepreneurship course. As a result, UP and PKL are not implemented with the assignment evaluation system and product manufacture. Students' interest in entrepreneurship course is due to collecting entrepreneurship assignments, but they not creating ideas to create products.

This interview results are used as the main data by exploring information on respondents related to instructional designs that can improve students' entrepreneurial affective at SMK N 1 Sawit. The researcher conducted the data reduction process, by selecting or focusing on the main and important things by summarizing and displaying several indicators of the interview results.

The interviews results related to instructional design variables to improve entrepreneurial affective consisted of 4 indicators as follows:

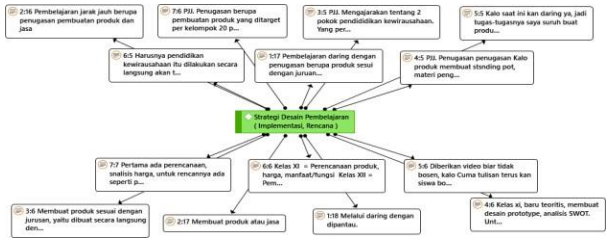

Figure 4. 1 Entrepreneurship course Strategy

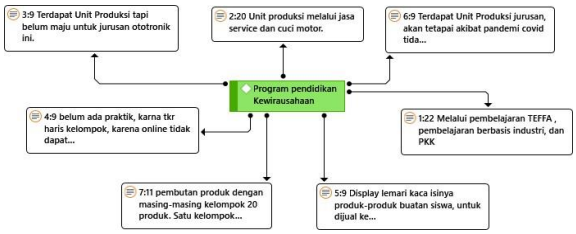

Figure 4. 2 Entrepreneurship course Effect

Figure 4. 3 The Covid-19 Impact on the Instructional Design Implementation

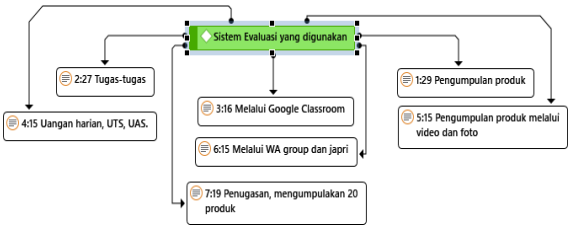

Figure 4. 4 Evaluation System

The interviews results related to the variable of students' entrepreneurial affective consisted of 4 indicators as follows:

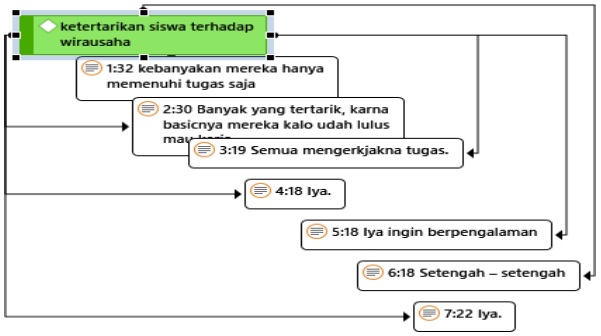

Figure 4. 5 Student Interest in Entrepreneurship

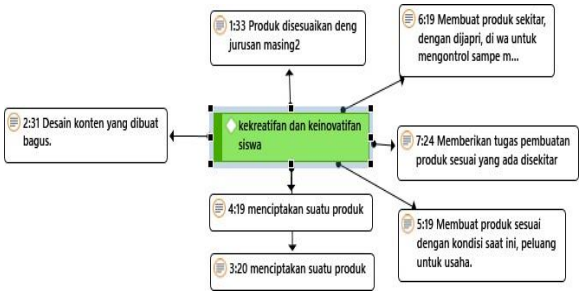

FIgure 4. 6 Student Activity and Innovation

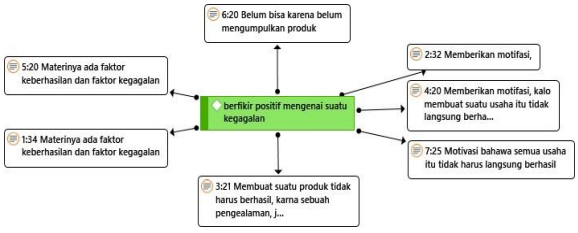

Figure 4. 7 Positive Thinking to Failure

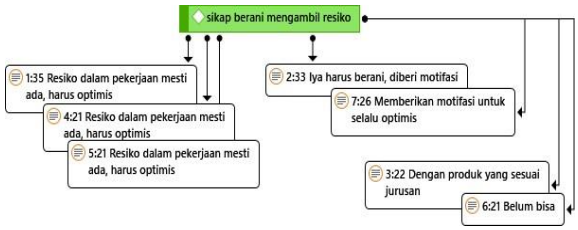

Figure 4. 8 Brave to Take Risks

Document analysis were conducted as a complement to the interviews and observations results. The document data collection conducted through journals and syllabus review of PKK (Creative Products and Entrepreneurship) subjects. The data collection journals conducted to determine instructional designs that can improve students' entrepreneurial affective compared to the previous studies. The review of 60 journals results related to instructional design are entrepreneurship course, digital technology-based learning, technopreneurship-based learning, training-based learning, practicum-based learning, project-based learning, and teaching factory learning or cooperative learning. While the study of the syllabus document results were conducted to observe the basic competencies that must be achieved in the Creative Products and Entrepreneurship subjects.

Digital Marketing Guidance and Training Description

Digital marketing guidance and training is held face-to-face in the Computer Laboratory for 3 days with 40 students of SMK N 1 Sawit which is divided into 2 sessions each day. The documentation of its implementation is in the appendix. The following is a schedule for the implementation of digital marketing guidance and training along with details of the material to be delivered at SMK N 1 Sawit:

a. May 4, 2021

Divided into two sessions, namely the first session at 09.00 – 12.00 WIB with 20 students and the second session at 12.30 — 15.30 WIB with 19 students. The material for the first day is multimedia (Logo design, product photos and post content using Canva).

b. May 5, 2021

Divided into two sessions, namely the first session at 09.00 – 12.00 WIB with 19 students and the second session at 12.30 — 15.30 WIB with 21 students. The material for the second day is digital marketing (mindset & marketing strategy, competitor research, social media marketing, and marketplace marketing).

c. May 6, 2021

Divided into two sessions, namely the first session at 09.00 – 12.00 WIB with 21 students and thesecond session at 12.30 – 15.30 WIB with 19 students. For the third day, the material is practicing how digital marketing works (learning by buying your friends' products, logging in, how to manage banking, withdrawing the proceeds from sales).

The results of this digital marketing guidance and training are that students gain experience and knowledge about digital marketing, how to design content, how to post, create social media marketing accounts and marketplace marketing. Screenshots related to the accounts that have been created by participants are as follows:

Figure 2 Implementation Documents and Training Modules

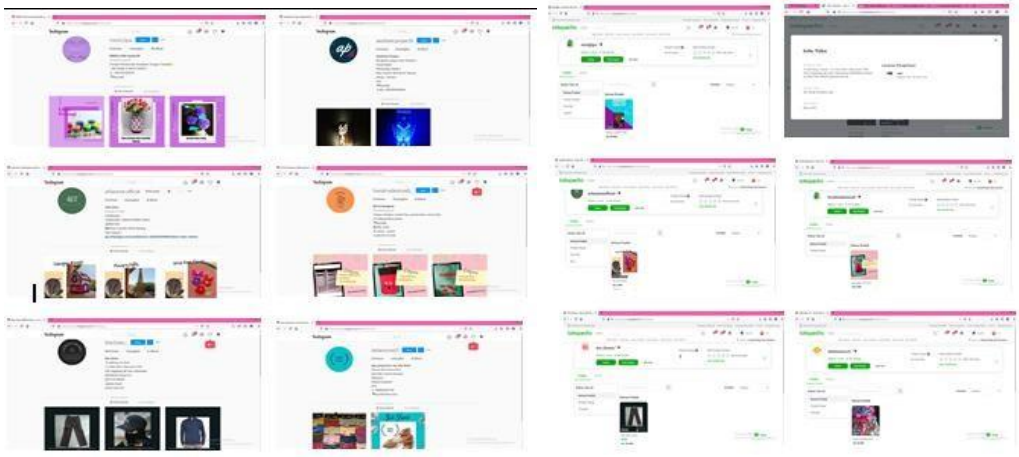

FIgure 3 Creating Social Media Accounts and Marketplace Marketing Results

Discussion

Instructional design to improve the students' entrepreneurial affective: Case Study at SMK N 1 Sawit Boyolali

The entrepreneurship course implementation at SMK N 1 Sawit includes PKK (Creative Products and Entrepreneurship), UP (School Production House and Manufacturing Departement), and PKL (Professional Placement) subjects. However, the Covid-19 pandemic leaded UP and PKL (Professional Placement) cannot be implemented so the entrepreneurship course implementation was only through online PKK (Creative Products and Entrepreneurship) subjects. Creative and entrepreneurial products can show students' attention to entrepreneurship or entrepreneurship activities because they acquire entrepreneurship knowledge and skills, namely practical materials and activities (Sudirman et al., 2019). The learning model at SMK N 1 Sawit is related to the applicable curriculum.

Programs to implement the entrepreneurship course are Production Units, Teaching Factories and product exhibitions. However, it was not implemented during the COVID-19 pandemic. The Covid-19 pandemic had an impact on the instructional designs implementation at SMK N 1 Sawit. The learning process was conducted online so it does not work optimally. Guidance and supervision is conducted through Google Classroom and WhatsApp. Teachers are difficult to practice and entrepreneurship course such as PKL and UP is not implemented. One of the impacts of PKL is learning of entering the working field or the industrial world (Rudhiani, 2020). The information and communication technology plays an important role as a foundation in the educational institution today. Students who have high technological literacy can feel this benefits. There are 3 factors for implementing online learning during COVID-19, namely teachers, learning, and technology (Latip et al., 2020). The digital technology provides entrepreneurship opportunities, such as marketing products or services online

Based on the data reduction results of the four indicators, it can be concluded that the instructional design that can improve the entrepreneurial affective of students at SMK N 1 Sawit is digital marketing training. Digital marketing is marketing through technology and digital media, social networks and social media that have a potential to assist entrepreneurs in selling their products or services via the internet in order to reach a wide area with low budget (Buchari, 2020). Digital marketing is appropriate to be applied because SMK N 1 Sawit has product-based entrepreneurship learning. However, the product is made and collected by students to fulfill the PKK (Creativity and Entrepreneurship Products) subject assignments. For this reason, the digital marketing training is needed so the students can sell their products.

It was supported by Munarsih dan taman-teman (2020), they mention that the digital marketing training grows students' special skills and entrepreneurship spirit, so they can manage the sources. It can reduce the unemployment because students are expected to create their own business after graduating. Jena (2020) also mentioned that to improve entrepreneurial affective, various innovative technology-based curricula and pedagogies are applied. In addition, the use of an economic digitalization learning model focused on students' entrepreneurship intentions can improve students' entrepreneurial affective (Ben Youssef et al., 2020).

This digital marketing training aimed to improve the entrepreneurial affective of SMK N 1 Sawit students. The training was conducted related to the schedule of the vice principal and teachers. The school supported this training by providing room and other equipment so that it held successfully. Digital marketing training was conducted to increase students' knowledge about the entrepreneurship needs. From the beginning, the digital marketing has the opportunity to develop the business world with a target market that has been transformed into digital media (Hendarsyah et al., 2020). In addition, the digital marketing is useful for completing the knowledge gained from PKK subjects and motivating students to be entrepreneurs. The results of the questionnaire before students attended the digital marketing training showed that 2 students quite agree, 17 students agree and 19 students strongly agree that entrepreneurship through digital marketing provides knowledge to be an entrepreneur. The results of questionnaire after students attended the digital marketing training showed that 26 students quite agree, 10 students agree and 3 students strongly agree.

The students' entrepreneurial affective based on the applied instructional design

The students' interest in entrepreneurship can be seen from their way in responding the teacher, for example how to communicate, attendance, responses and feedback. The results of data reduction from observations and interviews showed that students were less interested in entrepreneurship through PKK.

Some students are interested in entrepreneurship and the rest were not. However, most of them only fulfilled the responsibility to conduct assignments. The student interest in entrepreneurship increased because of the instructional design of digital marketing training. It is evidenced by the results of interviews and questionnaires. It was similar with (Chabib & Sulistyawoti., 2021), who said the online business for students is a strategy to create entrepreneurial interest. Students can learn to use mobile phones and social media to start a business after they graduate. The results of the questionnaire before students attended the digital marketing training showed that a student strongly disagree, 3 students disagree, 11 students quite agree, 17 students agree and 6 students strongly agree that they were interested in entrepreneurship. The results of questionnaire after students attended the digital marketing training showed that 13 students quite agree, 14 students agree and 12 students strongly agree.

Entrepreneurship is the process of working something creative (new) and innovative (different) that it provides more value in managing risks, optimizing resources and creativity to produce useful products and businesses for others and themselves (Hendarsyah et al., 2020). The teacher's effort increasing the students' creativity and innovation is asking students to create a product, such as creating products based on the environment, creating products related to their department and creating creative content related to product promotion. In the digital marketing training, the way to develop student creativity and innovation is creating content, logos, product designs, digital marketing accounts, and many others. In creating digital information content about products and services, the content should be created and developed through creativity and innovation (Hendarsyah et al., 2020). The results of the questionnaire before students attended the digital marketing training showed that a student strongly disagree, 11 students quite agree, 19 students agree and 7 students strongly agree that they had creativity and innovation. The results of questionnaire after students attended the digital marketing training showed that a student strongly disagree, a student disagree, 10 students quite agree, 16 students agree and 11 students strongly agree.

The teachers' efforts to offer positive advices for failed students are providing motivation, enthusiasm and analyzing the success and failure factors. Grades are one way to analyze whether the students think positively about failure or not. In digital marketing training, the way to develop a positive attitude towards failure is motivating and guiding students. When the students are failed, the teacher can provide solutions and guidance. The results of the questionnaire before students attended the digital marketing training showed that a student strongly disagree, 11 students quite agree, 19 students agree and 7 students strongly agree that they had creativity and innovation. The results of questionnaire after students attended the digital marketing training showed that a student strongly disagree, 1 student disagree, 10 students quite agree, 16 students agree and 11 students strongly agree.

Entrepreneurial affective or interest is an ability to conduct something in fulfilling the needs, solving problems, advancing business, creating a business with a pleasure. Someone who has entrepreneurial knowledge will not fear to take risks when starting a business (Hendrawan & Sirine, 2017). The way of SMK N 1 Sawit teachers develop students' courage to take risks is giving them projects or assignments that have a high risk. In addition, teachers should always motivate students and say that job has risks. Students must be brave and optimistic. The way to discover students who dare to take risks is assessing their courage when answering questions. In addition, they should be brave to build a shop in the marketplace even though there are competitors. The students' boldness to take risks is an active willingness to follow business opportunities even though they contain risks (Wahyuni et al., 2018). The results of the questionnaire before students attended the digital marketing training showed that a student strongly disagree, 2 students disagree, 12 students quite agree, 19 students agree, and 4 students strongly agree that they have creativity and innovation. The results of questionnaire after students attended the digital marketing training showed that 2 students disagree, 14 students quite agree, 18 students agree, and 5 students strongly agree.

Conclusion

Referring to the results of this research and discussion, Learning designs that can improve the entrepreneurial attitude of Case Study students at SMK N 1 Sawit Boyolali are those that have been implemented through PKK subjects (Creative Products and Entrepreneurship) while in the development of this research through Digital Marketing guidance and training. It can be concluded that the design of digital marketing guidance and training can provide additional entrepreneurial knowledge and skills. Thus, the entrepreneurial attitude of students can be known. entrepreneurial attitudes students from the influence of the applied learning design is good, namely (a) student interest in entrepreneurship through PKK is half-assed while through design guidance and digital marketing training increases; (b) Teachers

foster students' creative and innovative attitudes through projects or assignments that contain ideas and create a product, while through digital marketing training guidance through content creation, product design, accounts, etc.; (c) The teacher gives positive advice when students experience failure by providing motivation and guidance; (d) Teachers increase their risk-taking attitude by determining projects or tasks that have a high risk and through the courage to build a shop in the marketplace.

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E-learning Adoption and Use Hype Cycle during Covid-19 Outbreak (A Longitudinal Survey)

Nurdin Nurdin
Postgraduate Studies
Universitas Islam Negeri (UIN) Datokarama Palu
Email: nnurdin@iainpalu.ac.id

Sagaf S. Pettalongi
Faculty of Islamic Teaching and Training Education
Universitas Islam Negeri (UIN) Datokarama Palu
Email: sagaf@iainpalu.ac.id

Askar Askar
Faculty of Islamic Teaching and Training Education
Universitas Islam Negeri (UIN) Datokarama Palu
Email: askar@iainpalu.ac.id

Hamka Hamka
Faculty of Islamic Teaching and Training Education
Universitas Islam Negeri (UIN) Datokarama Palu
Email: hamka@iainpalu.ac.id

Abstract:

Both students and lecturers experience e-learning adoption and use hype, and it has replaced the conventional learning method due to the covid-19 outbreak. However, it is limited known how the e-learning adoption rate is changed and improved during the covid-19 outbreak. This study conducted a monthly longitudinal survey from late March to late June 2020 to find out the e-learning adoption and use hype rate. We randomly distributed 130 questionnaires to students and teaching staff within four faculties at State Islamic University (UIN) of Datokarama Palu. Our study found that during the early covid-19 outbreak, e-learning was reluctantly adopted by both students and lecturers due to a lack of familiarity and technological skills. However, after the third round survey, we found that the hype of e-learning use reached its peak for both students and lectures. In the final round survey, the lecturers' hype to adopt and use e-learning was increased to a plateau of productivity where mainstream adoption starts to take off, and e-learning has been used for more teaching productivity purposes. However, the economy's perception was becoming more challenging to students due to the higher cost of Internet connection, while institutions did not fully provide free Internet access. We also found that there is a perception of the students that e-learning is less meaningful compared to face-to-face learning mechanisms. The limitation of this study is that the study was conducted only in one Islamic higher education institution and the covid-19 outbreak is still ongoing. Therefore, further studies might be required to study more samples and more extended periods to produce more valid results.

Keywords: E-learning adoption, E-learning hype, E-learning lifecycle, E-learning use.

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Introduction

The emergence of computers and the Internet has caused rapid development in educational technology. Internet is one technology that plays a significant role in all aspects of life, and it seems to have become a basic human need of all ages. Globally, there are about 4.66 billion internet users at this time, with 4.32 being mobile phone users and 4.2 billion being social media users (Johnson, 2021). This fact implies that nearly more than two-thirds of the world population are active Internet and mobile phone users. As such, the use of information technology within an educational institution is also rapidly increasing.

Similarly, in Indonesia itself, the development of technology and information has also progressed very rapidly.(Nurdin, 2018; Nurdin & Yusuf, 2020). According to BPS data, Indonesia's population is currently around 270 million, of which 71 percent are of productive age between 15-64 years (BPS, 2020). Of the total productive age, around 39 percent of the millennial generation is aged between 24-39 years or approximately 105 million people. The rapid increase in the adoption of information and technology in business and education, especially by the millennial generation, is due to the high adoption of supporting devices such as the Internet and smartphones. Currently, there are 197 million Internet users in Indonesia, and there are 210 million Smartphone users (Statista, 2021).

Along with the rapid advancement of technology and information, learning media has also experienced very significant development. This can be seen from the increasing number of methods or learning media by utilizing Internet-supported devices. Information technology has also replaced existing technology a few years ago, including replacing conventional learning methods. The technology includes hardware and software that support the use of various e-learning applications.

With the emergence of e-learning as a form of innovation in learning, students cannot only access learning material, but they are also experiencing changes in the learning process. With e-learning, the students become more independent, active in observing, demonstrating, practicing, etc. Besides that, teaching materials can also be virtualized as attractively as possible with various forms to make students more comfortable and exciting during the learning process. Besides that, e-learning is also very suitable to be applied during the covid-19 pandemic because it does not require face-to-face meetings.

When the covid-19 pandemic began in March 2020, e-learning becomes popular due to offline learning methods being restricted by the government. All students and teachers were imposed on working at home to avoid the contagious virus. At the beginning of e-learning, both students and teaching staff felt mixed feelings, such as information technology literate and the cost of Internet connection. After a few months of interaction with e-learning, students and teaching staff become familiar. Still, other challenges were emerged, such as declining in learning motivation and the high cost of Internet connection.

However, the changes of students and teaching staff perception on the use of e-learning during the covid-19 pandemic are limited known. Few researchers have studied how the e-learning use perception is changed during the covid-19 pandemic. This study, therefore, uses technology lifecycle theory to understand students and teaching staff perception on the use of e-learning during the covid-19 pandemic. This study is expected to shed light on how users' perceptions are changed during the covid-19 pandemic regarding e-learning in a higher education institution.

Literature Review

E-learning Lifecycle

A literature review shows that the definition of a complete e-learning framework has been proposed by many scholars (Kumar Basak, Wotto, & Bélanger, 2018; Moore, Dickson-Deane, & Galyen, 2011). Some scholars use the term e-learning, another use term online learning, while the rest also use distance learning to discuss e-learning. However, the basic principle of e-learning involves computer and Internet use (Michael, 2010; Nurdin & Aratusa, 2020). The use of e-learning received little attention in developing

countries before the covid-19 pandemic. However, the use of e-learning has significantly increased during the covid-19 pandemic due to the limitations of direct learning.

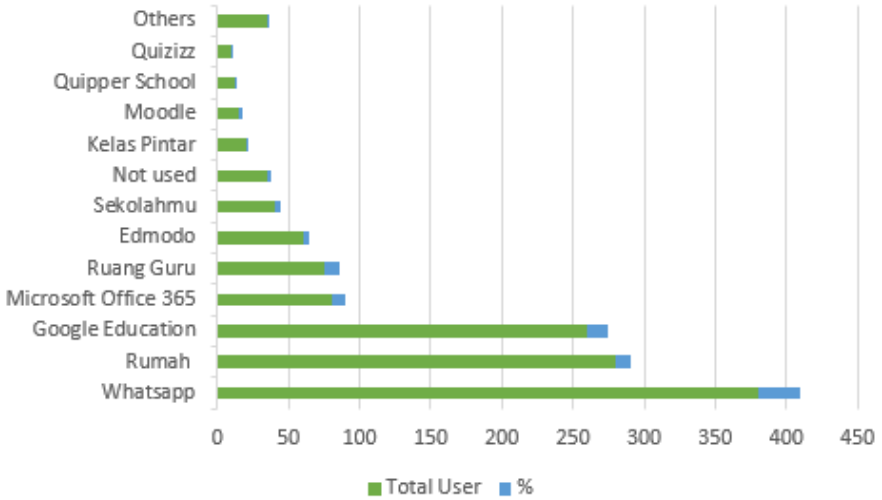
The use of e-learning has also been conceptualized with various frameworks. Among proposed frameworks, Marcos (2007) presents a workflow-based, pedagogical-centered e-learning scenario with different levels that include the main learning product and actors. However, the mandatory instructional perspective restricts the model so that it does not deal with individual learning objects. Meanwhile, de Maros, et al., (2007) present a learning object lifecycle comprising the main processes (creation, storage, search, delivery, licensing, and digital rights management), but the payment and pricing issues are not addressed.

The lifecycle use of e-learning has also been discussed by many scholars from education technology backgrounds (Abdous, 2009; Dori & Shpitalni, 2005). The e-learning lifecycle reflects a global use case that closely resembles an e-learning lifecycle that includes main actors and processes. However, such an e-learning lifecycle does not comprise each learning object cycle, but it merely presents the use of e-learning from beginning to the end and then re-use again. It is argued that the e-learning conceptual model could be more accurately described using the concept of lifecycle rather than using the concept of a framework. The e-learning lifecycle concept stresses the cycle use of e-learning from the beginning to re-use again and again over time (Abdous, 2009).

E-learning Use Trend in Indonesia

The use of information technology supports the use of e-learning in Indonesia. Indonesia is currently the third-largest Internet user in Indonesia, and about 204 million Internet users are in Indonesia (Nurhayati-Wolff, 2021). Most Internet users or about 71 percent productive age between 15-64 years (BPS, 2020). Around 39 percent of the young generation aged between 24-39 years or approximately 105 million people from the total productive age. Most of the young generation are also smartphones users, which is about 210 million users (Statista, 2019). The use of Smartphone support e-learning activities at all level of education institutions in Indonesia. Previous studies have also found that Smartphone has been used as major learning aid for e-learning purposes (Anshari, Almunawar, Shahrill, Wicaksono, & Huda, 2017; Faisal, Fernandez-Lanvin, De Andrés, & Gonzalez-Rodriguez, 2020)

Most of these users are very attached to the Internet and smartphones (Thorsteinsson & Page, 2014). Orlikowski & Scott (2008) referred to this kind of attachment(2008) as "entanglement of technology," which refers to the entanglement of humans with technology. The phenomenon of the attachment of humans and technology has caused changes in behavior in conducting business and financial transactions. Various business organizations have exploited this condition to offer new methods of trading and payment. As the significant rise in Internet and Smartphone use, e-learning use also shows a significant rise among the young generation. The use of e-learning involves various platforms, as shown in the following picture 1.



Source: (Kemendikbud, 2020)

Figure 1. E-learning Platforms Use in Indonesia

The figure shows that WhatsApp is the most commonly used (28,14%) teacher to deliver online learning. Next in rank is the Learning House platform (288 people: 20.78%), Google Suite For Education (269 people: 19.41%), Microsoft Office 365 (89 people: 6,42%), Teacher's Room (71 people: 5 ,12%), Edmodo (66 people: 4.76%), Online Learning Sekolah.mu (46 people: 3.32%), Smart Class (29 people: 2.09%), Moodle (26 people: 1, 88%), Quipper School (20 people: 1.44%), Quizizz (14 people: 1.01%). Other platforms are the learning management system developed by the school, Zoom Cloud Meeting, That Quiz, Schoology, Kahoot, Zenius, Candy CBT, Cisco Webex Meeting, Classdojo, Kejar.id, Padlet, Quick Edu, Start Meeting, Talk Fusion as many as 39 people (2.81%) and 39 people (2.81%) who have not used the online learning system (Kemendikbud, 2020)

Research Method

This study aimed to find out the lifecycle use of e-learning during the covid-19 pandemic from April to June 2020. This study employed a longitudinal case study (Cook, Parker, & Pettijohn, 2004; Martin & Hand, 2009). The longitudinal study was intended to find out the e-learning use phenomena from university students' perspective during three month period. In this study, the use of e-learning was measured using variables perceived of use, perceived of ease, perceived of benefits, and perceived of economics (Hamid, Razak, Bakar, & Abdullah, 2016; Verma & Sinha, 2018). The sample of this study involved 130 students and teaching staff from four faculties at State Institute for Islamic Studies (IAIN) Palu. We analyzed the key factors influencing the use of e-learning through empirical research and analyze the behavioral intentions of users. Therefore, the students were randomly selected as the survey subjects in this study. There were 20 items divided into four parts, which were measured by a five-point Likert scale (Nurdin, Pettalongi, & Mangasing, 2019). A total of 130 responses were collected in this study. After preliminary screening, invalid questionnaires with insufficient response times and random filling were rejected, and 97 valid responses were included for an effective response rate of 97%. In this paper, the sample data were analyzed statistically using SmartPLS 3.0 (Liao, Palvia, & Chen, 2009).

Result and Analysis

Respondents Demographic

The following figure shows the respondent from each faculty at State Institute for Islamic Studies from four faculties. The figure shows that most respondents come from the Tarbiya faculty, while the lowest respondents come from postgraduate studies. The data reflect the number of students from each faculty where Tarbiyah faculty has the highest student rate, while postgraduate studies have the lowest number of students.

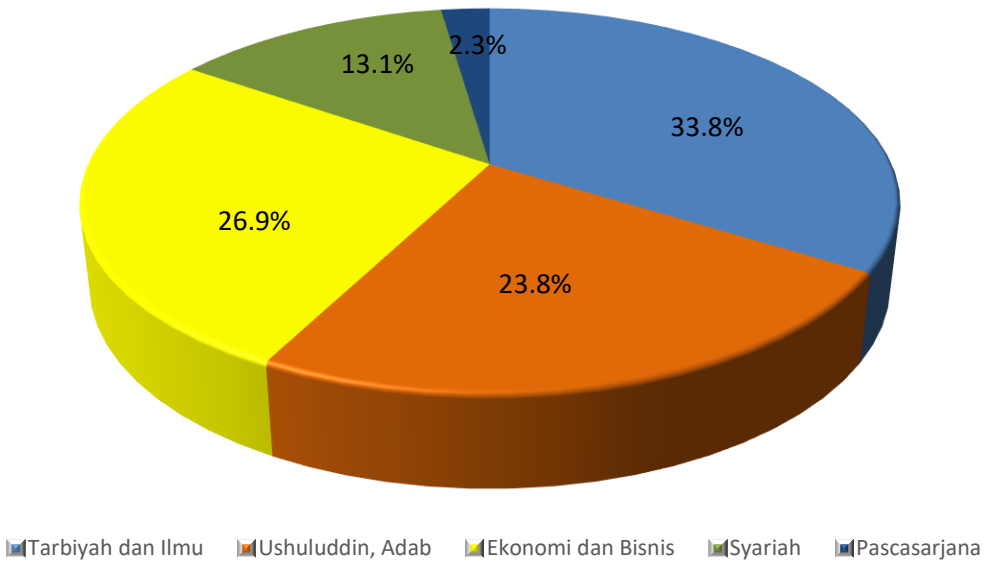


Figure 2. Respondents Distribution According Faculties

Meanwhile, the respondent distribution according to the studies program can be seen in the following figure 3

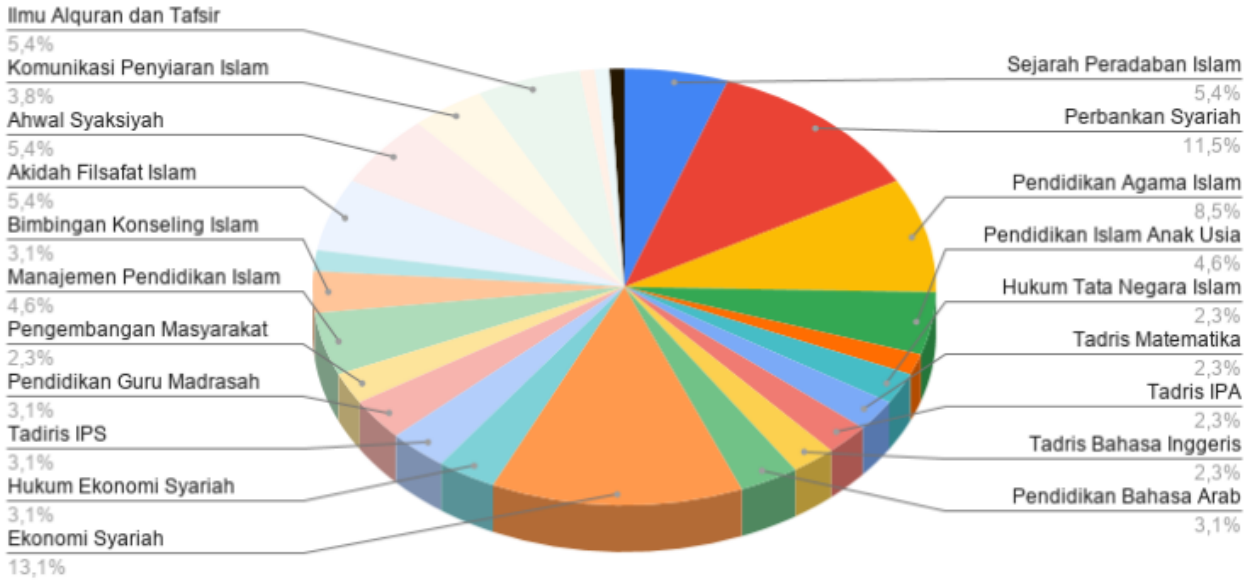


Figure 3. Samples Distribution According Studies Program

The data from figure 3 shows that the respondents come from 20 studies program from four faculties. The distribution of sample follows the number of students at each studies program.

Platform Used for E-Learning

Several internet applications have been used for e-learning activities in IAIN Palu. The applications included social media and formal e-learning platforms developed by the IT team members. However, most e-learning platforms are social media-based platforms, as shown in the following figure 4.

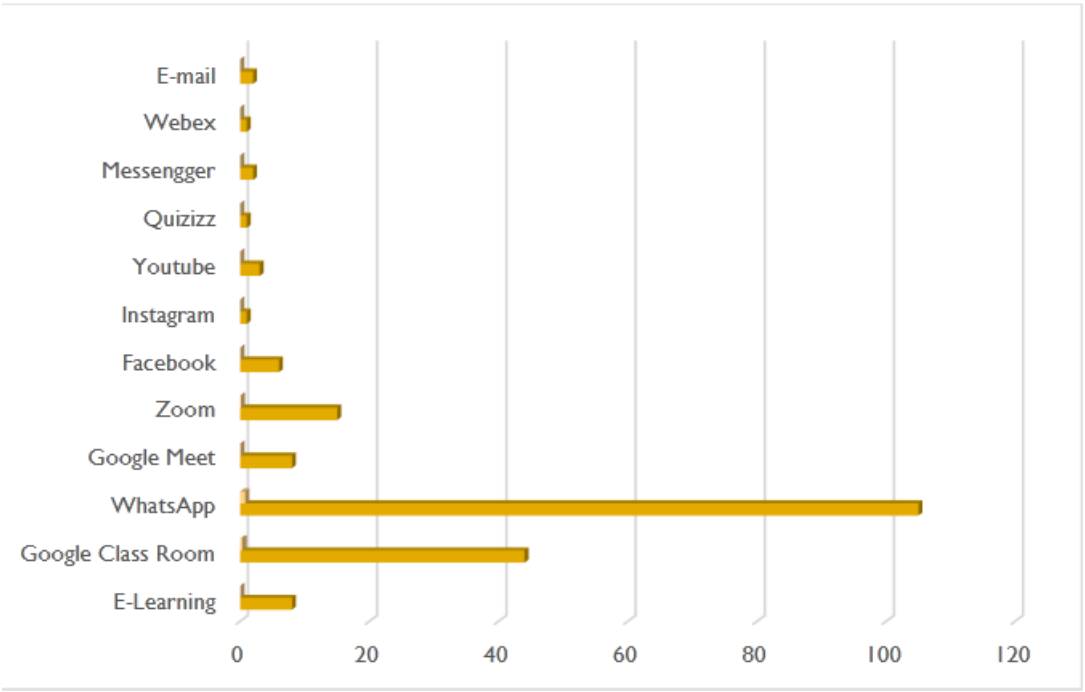


Figure 4. Platforms used for e-learning

Figure 4 shows that the most favorable platform for e-learning at IAIN Palu is WhatsApp, and the second favorite e-learning platform is Google Class Room., Meanwhile, Zoom, Google Meet, and e-learning

developed by the internal IT team are at the third, fourth, and fifth favorite e-learning g platforms. Instagram, Quizizz, and Webex are the less favorite e-learning platforms. The use of WhatsApp and Google Class Room as major e-learning platforms has been found by previous studies (Azhari & Fajri, 2021; Jabbar, Malik, AlFarsi, & Tawafak, 2021). Economic reasons might cause the reasons to use WhatsApp and Google Class Room because they are freely available and easy to access. Even though Zoom is one of the most popular applications used in meeting and online learning (Cuaca Dharma, Asmarani, & Dewi, 2017; Mpungose, 2021), the application is not free for longer meetings and online learning. The cost has become a major concern of students and teaching staff at IAIN Palu during the covid-19 pandemic.

Compared to the ear before the covid-19 pandemic, the use of e-learning is not popular with both students and the teaching staff of IAIN Palu. For example, the students and teaching staff using e-learning can be seen in the following figure 5.

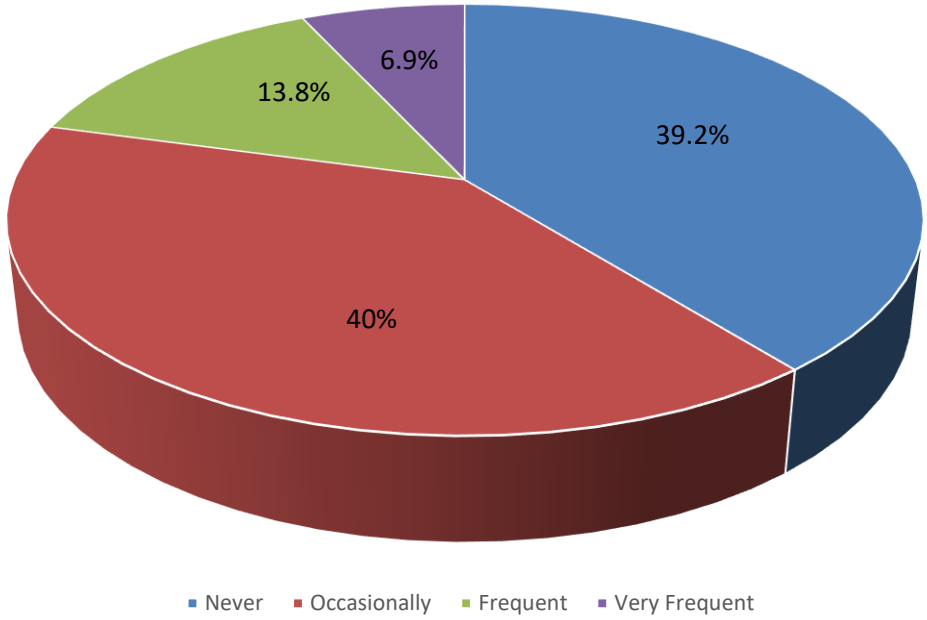


Figure 5. Teaching staff and students use of e-learning before the covid-19 pandemic

Before the covid-19 pandemic, the intensity of use of e-learning was very low. Most students and teaching staff never use e-learning or use e-learning just sometimes. The lack of use of e-learning in developing countries has been addressed in previous studies (Shantha, 2008). Lack of e-learning use is mostly caused by technology literate, financial support, trust, cultural issue (Almaiah, Al-Khasawneh, & Althunibat, 2020). In addition, most of the teaching staff in Indonesia lacked the skill of using e-learning platforms, which hindered them from interacting with e-learning applications (Rahayu, 2019). Meanwhile, students are mainly concerned with the financial cost of e-learning because most education institutions in Indonesia do not have free internet access.

Regarding the purpose of e-learning, most students (95 %) use e-learning to discuss learning material delivered by their lectures and accomplish assignments. This phenomenon is common during the covid-19 pandemic, where lectures give students more tasks to discuss learning material through e-learning systems (Daniel, 2020). The aim is to make students learn independently and engage longer with the learning material during studying at home. The purposes use of e-learning can be seen in the following figure 6.

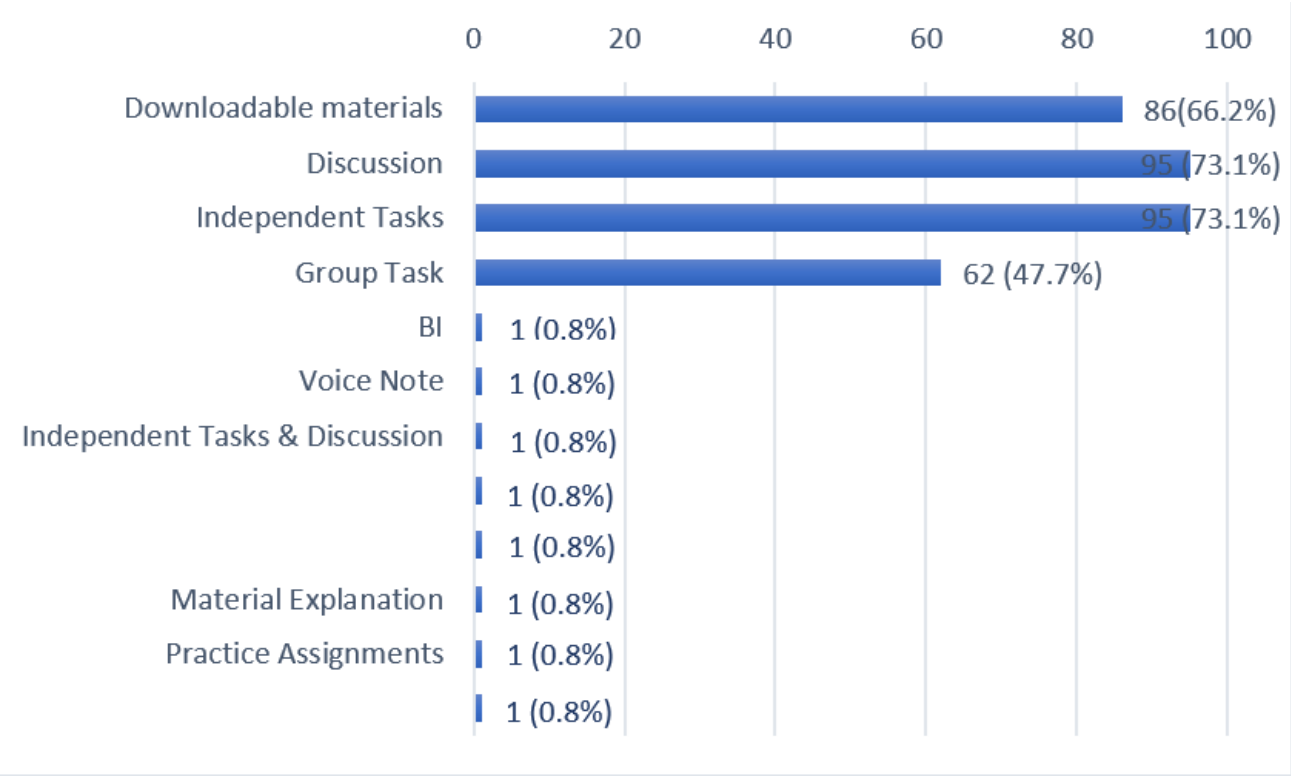
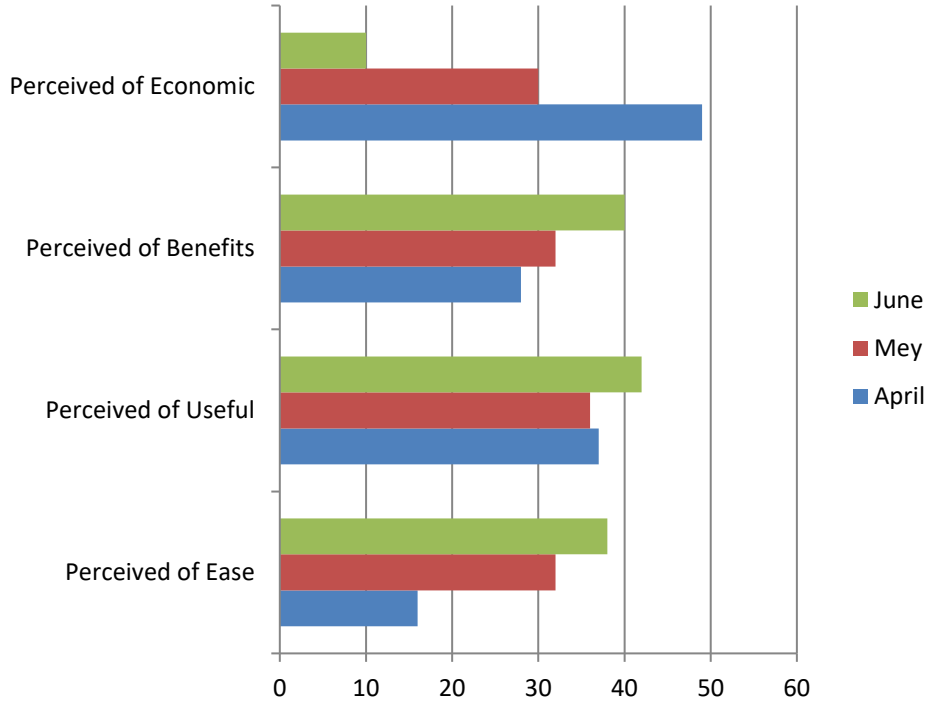


Figure 6. The purposes use of e-learning platforms

Meanwhile, the use of e-learning for practicum purposes is rare. This might imply that teaching staff prefers to use e-learning platforms for theoretical teaching rather than practical purposes. In other words, more conceptual material is taught than practical material through e-learning systems. Thus, the impact of the teaching mode might reduce students' practical material in learning during the covid-19 pandemic teaching process. Such findings highlight the need for educational institutions to ensure mechanisms are in place which facilitates active and ongoing student and teacher engagement with practical knowledge to increase students' experience with teaching material (Webster, 2019).

E-learning Perception Lifecycle Use

The first-round survey we conducted in mid-April 2021 involved 130 samples consisting of students and teaching staff. The data shows that few students and teaching staff (about 11%) consider e-learning is easy to use. However, they agree that e-learning is very useful (28%) for them during the covid-19 pandemic. Most of the students and teaching staff (38%) also agree that the cost for e-learning was not a problem for them, and they also agree (22%) that the e-learning system gave them ultimate benefit because they couldn't attend offline classes. The results of the survey can be seen in the following figure 7.



Source: Survey results on April, May, and June 2020

Figure 7. E-learning use perception lifecycle

The financial cost has become a problem to access online resources (Dhawan, 2020; Sharma, 2011). This study found that students experienced more on paying Internet connection fees at early period covid-19 pandemic between March and June 2020. At that time, the cost was not covered by the institution, while online learning had begun to intensify. As a result, the student's perception of the economic aspect of e-learning sharply decreased at the end of the survey.

Conversely, students' and teaching staff's perception of ease of use of e-learning was lower at the beginning of the survey because most were not familiar with e-learning platforms. However, after the third round survey, their perception of ease of use was increased because they got acquainted with the e-learning. Perceived ease and use increase users' intention (Al-Busaidi, 2013; Cho, Cheng, & Lai, 2009). Our findings confirmed the effect of virtual competence and revealed a nuanced mechanism by which experiences with ICT affected e-learning outcomes. We discussed the implications of this in e-learning practice (Wan, Wang, & Haggerty, 2008).

Perceived benefit of e-learning (Liaw, 2008; Wan et al., 2008), when people perceived benefit, it will increase their satisfaction (Liaw, 2008). The results showed that perceived self-efficacy is a critical factor that influences learners' satisfaction with the e-learning system. Perceived usefulness and perceived satisfaction both contribute to the learners' behavioral intention to use the e-learning system. Furthermore, e-learning effectiveness can be influenced by multimedia instruction, interactive learning activities, and e-learning system quality (Liaw, 2008).

Conclusion

Our study found that the motivation to use e-learning during the covid-19 pandemic is dynamic, influencing it during the covid-19 pandemic. Perceive of ease and usefulness is gradually increase along with the longer time of e-learning use. The experience of the benefit of e-learning use is supported by the availability of e-learning platforms that help students and teaching staff to use e-learning. On the other hand, however, the perceived economy in using e-learning was gradually declined during the period of the study. This implies that the longer e-learning is used, the cost of e-learning becomes more expensive for

students because education institutions might not fully provide an Internet connection. Future research should focus on how the economic perception is declined while other variables are increased.

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Information Overload: Clarifying the Problem

Wendi Zarman
Department of Computer System
Universitas Komputer Indonesia
wendi.zarman@email.unikom.ac.id

Abstract:

This research goal is to clarify three main problems. Firstly, what is the definition of information overload. Secondly, does the abundance of information necessarily cause information overload. Thirdly, to what extent this phenomenon is considered a problem for a human being, especially in the current age when internet data grow exponentially. In this case, it is related to the huge amount of electronic data from information technology. For that, library research using the qualitative method is applied. Several related works of scientists are examined to solve the problem. The result shows that, first, information overload definition is the inability of an information recipient to process excessive information. In the human context, this condition brings about a negative impact on the recipient. Second, the abundance of information is not the only cause of the problem but is also related to the attention investment and the capacity of the recipient. Thus, the issue is not merely about the data quantity. Third, information overload is a subjective experience that is related to the characteristic of the recipient. It means that some may consider it a problem, while others may not. The understanding of the phenomenon helps us to deal with information in the various fields, like education, business, works, health, etc.

Keywords: Information Overload, Information Technology, Internet.

DOI: http://dx.doi.org/10.20961/ijie.v5i2.56922

Introduction

The issue of information overload cannot be separated from the increasing human interaction with information technology devices connected to the internet. A computer, smartphone, or tablet that is connected to the internet for twenty-four hours has become a standard gadget for the present time people. The DataReportal website states that the number of active internet users worldwide in 2019 is close to 4.4 billion (57% of the world total population) or an increase of 77% from the previous five years which was only 2.85 billion users (Kemp, 2019)

However, the emergence of this phenomenon is not solely due to the growth in the number of internet users, but more importantly, is because of the growth of internet data that continues to increase exponentially. Data Never Sleeps 5.0, an infographic released by United States data and software company Domo, reported that 90% of data stored on the internet in 2017 was generated in the last two years (2015-2017). It is estimated 2.5 quintillions ($2.5x10^{18}$) bytes of new data are generated everyday (Domo, Domo, 2017). The data growth is not slowing down, yet the rate is expected to continue to rise in the coming years.

The rapid growth of data can not be separated from the increasingly easy and fairly small cost of producing content on the global communication network. In addition, the popularity of websites or social media applications has encouraged its users to produce and share more digital content in various formats (texts, photos, sounds, and videos) into social media. Nowadays, posting digital content on social media has become a daily activity of many people around the world. This excitement has a significant impact in driving the growth of digital data. The Never Sleeps 7.0 data infographic released in 2019 reported that there were 511,200 tweets on Twitter, 55,140 photos on Instagram, 231,840 calls on Skype, and 18,100,000 texts posted to the internet every minute (Domo, Domo, 2019).

With the increasing role of information technology in various fields, the problem of information overload needs more attention from scientists since there are relatively infrequent empirical research has been carried out (Suhaimi & Hussin, 2017) This paper objective is to clarify some of the main problems of information overload in relation with human as subjects and objects of information. For that, several questions are needed to be answered. First, what is the general definition of information overload? Second, is the excess of data or information on the internet the only cause of information overload? Is there any other factor that gives rise to information overload? To clarify the problem, we analyze qualitatively several works of scientists discussing the problem like Floridi, Levy, Hoq, etc.

Research Method

This research is library research using a qualitative method to obtain a basic and general description of the information overload phenomenon. We use the method to acquire the basic and general description of this digital-age problem. To comprehend the phenomenon, we examined the works of several researchers working on the issue that is related to the consequence of the rapid growth of internet data, particularly resulted in the last decade. Based on these studies, we investigated several basic problems ranging from the historical background of the emergence of the information overload phenomenon, its definition, and the main factors that may cause a person to experience it. Several internet data sources, particularly from Domo, are presented to depict the rapid growth of internet data. The results of the research are then narrated descriptively.

Result and Analysis

The use of the internet in almost all human activities ranging from education, business, research finance, health, communication, transportation, and entertainment has driven data growth. Previously, the advancement of data production was dominated by organizations such as government, companies, community organizations, or news agencies such as newspapers, magazines, and book publishers. Now, the growth of internet data is also driven by communication activities among individual internet users. The high participation of internet users has resulted in a new genre of internet users called prosumer. A prosumer is a group of users who act as producers and consumers as well. The availability of data duplication tools such as the copy, paste, and share buttons on every application or software enables internet users to create a huge number of new data often takes only a few clicks (Floridi, 2017). This is the reason why internet data grows exponentially and triggers information overload.

Nevertheless, information overload is not an exclusive phenomenon of the nowadays information age. Several decades before the internet emerged and was used massively, the term information overload has already mentioned by Bertram Gross in his work *The Managing of Organizations* (1964). This term was later popularized by Alfin Toffler in his book *Future Shock* (1970). Long before that, despite not using the term information overload, this phenomenon has been predicted to appear due to the rapid growth of books after Johannes Gutenberg invented the printing machine in the mid-15th century (Hoq, 2014). The possibility of the emergence of information overload in the future expressed French philosopher, Denis Diderot in *Encyclopédie*, "…the number of books will grow continually, and one can predict that a time will come when it will be almost as difficult to learn anything from books as from the direct study of the whole universe" (Wikipedia, n.d.).

However, information overload that occurred in the past is quite different from what happened in the current information era. That difference comes from the difference in the perception and utilization of information in the first period is different from the present. In the past, information was perceived as an immeasurable quality, and human attitudes and actions towards information were generally limited to documentation and recording. Meanwhile, in the 20th century, information was perceived as a quantifiable object measured in bits (Rosenberg, 2003). With the support of technology, information transforms into a resource that creates a competitive advantage. It is not only capable of producing a partial benefit but even transforms the whole society. Therefore, information must be managed in the way that people traditionally manage the capital, land, and workers (Allen & Wilson, 2003).

Now, we need to previously discuss the very basic problems: what is the definition of information overload, and what is the nature of it? Although its existence has been accepted, the general definition of information overload has not been agreed upon by scientists. For instance, in business research, there are at least seven definitions of information overload have been given (Roetzel, 2019). Therefore, the author will cite several fairly general definitions and use them as the starting point for discussing this issue further.

The Cambridge Online Dictionary addresses the definition of information overload as a situation in which you receive too much information at one time and cannot think about it in a clear way (Cambridge Dictionary, n.d.). According to Levy, information overload is a condition in which an agent or recipient has—or is exposed to, or is provided with—too much information, and suffers negative consequences as a result (Levy, 2008). From these two definitions, it is quite clear that information overload occurs when a person experiences an excess of information. Both also explain the consequences of this situation—that is, "cannot think it is a clear way" and "suffer negative consequences"—although it still needs further elaboration.

Based on Levy's definition above, it can be concluded that the nature of information overload is about a condition of the recipient (not the situation outside) who is exposed to too much information that hurts the recipient. The negative impact may range from inconvenient feelings to mental illness, like depression, stress, feeling exhausted, and other uncomfortable circumstances due to the inability to perceive (or process) the information received.

In addition, these negative consequences also relate to the inability to take the right choice regarding a particular issue. In the context of one social life, like in education for students or at work for employees, negative consequences mean the failure to complete a given task and the inability to make the right decision. Therefore, there are two basic issues here. They are the excessive of data and its negative consequences. In other words, this issue can be viewed from two different sides. Firstly, from the incoming information itself, and secondly, from the human being side as information recipient.

First, from the information side. In the context of the use of information technology such as in work, business, and education, information overload is not only merely related to the abundance of data in the sense of the quantity of digital data expressed in bits. Hoq mentioned several other causes cause information overload. (Hoq, 2014) Another reason is the variety of information channels that must be accessed. As is known, information is currently accessed through various devices (hardware) and applications (software). This diversity of sources makes information processing a fairly complex activity. Therefore proper information management is needed so that these channels can be used effectively.

In addition, information overload is also related to the amount of irrelevant data. The root of the problem lies in the role of the internet which is designed as a repository of information that enables to store of all kinds of information practically limitless. Therefore, adding "unlimited" data is inevitable. This is where the problem begins. The huge number of data makes the evaluation process to find the right data more difficult. Some search engine applications such as Google, Yahoo, or Bing have been created to overcome these obstacles. Although the ability of these applications to track information continues to increase, discovering

the right information still requires human judgment. Information overload can also arise due to a lack of time available to process data.

Second, from the human side as the information recipient. Empirical experience shows that the emergence of this phenomenon is not solely due to the abundance of information. The “overload” term is not only about how much information a recipient receives, but also about his response towards the incoming information. As long as he does not pay any attention to it, or consider it unimportant, the recipient will not experience information overload. Therefore, there must be other conditions that stimulate information overload. Levy said that one of the conditions is that there must be an attention investment on the information received. (Levy, 2008)

The amount or level of attention invested by an information recipient depends on the importance or significance of the information received. The more important the information, the greater the attention investment will be, and vice versa. Internet users particularly those who use social media applications will not be pressured just because of the many notifications on their accounts, as long as there is no interest for them to perceive all of the information. People who actively use the internet, particularly those who hourly access social media such as Facebook, Twitter, Instagram, Whatsapp Group, and others may not necessarily experience information overload even though they are bombarded with various kinds of information all the time. It is similar to reading through billboards of ads that stand on the side of a city big roads.

Conversely, it is important for high lever employers like managers of a nowadays large company to pay attention to all information relating to their work. Thus, in this case, the attention investment is in general high. That is why the growth of information that exceeds the processing capacity establishes the occurrence of information overload. There is a lot of employment in the 21st century that demands a lot of utilization of information stored on the company's local network or the internet. This situation requires proper management of information. However, utilization of various information management systems may indeed help, but the very high data growth makes this application soon be obsolete. Thus the requirement for the new improved method for managing the information continues to exist. This makes information overload an important issue in the digital world.

In addition to attention investment, there is also another subjective factor called recipient capacity. The word *capacity* here means the recipient’s ability to process information in a unit of time. Empirically, each person’s capacity to process and manage information depends on various factors, such as intelligence, age, education, experience, health, and others. It means that too much for someone is not necessarily too much for others. Therefore, information overload is a subjective experience of each person.

Conclusion

The rapid growth of information on the internet has given rise to information overload. In general, information overload is the inability of an information recipient to process excessive information. In the context of information technology, information overload is caused by a huge amount of irrelevant channels and digital data, particularly data from the internet. The scientists recognize the phenomenon and consider it unfavorable, and even harmful at a certain level. Recent research confirms that the phenomenon may hurt people like stress, fatigue, depression, and other mental illness. Furthermore, information overload also leads to a negative impact on one social life. It obstructs him/her to make decisions and finishing his/her tasks. Recent studies address that this issue is not solely related to the quantity of information expressed in bits. It means that this problem should be seen from two sides, namely the information itself and human beings as the information recipients. From the human being’s side as a recipient, information overload relates to the attention investment and the capacity of the information recipient. For that reason, information overload is a subjective experience that depends on the characteristic of the recipient. Hopefully, the understanding of the information overload contributes toward better information management in the various fields, like education, business, works, health, etc.

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Hand Detection on HSV Color Space Model and Syntactic Extraction of Fingertip by Thinning Method for Hand Gesture Recognition

Febri Liantoni
Department of Computer and Informatics Education
Universitas Sebelas Maret
febri.liantoni@gmail.com

Yusfia Hafid Aristyagama
Department of Computer and Informatics Education
Universitas Sebelas Maret
yusfia.hafid@staff.uns.ac.id

Nurcahya Pradana Taufik Prakisya
Department of Computer and Informatics Education
Universitas Sebelas Maret
nurcahya.ptp@staff.uns.ac.id

Abstract:

In the discussion of computer vision, detection and recognition is an interesting topic to discuss. Advanced computer vision technology requires a high-level interaction method above the text-based console interaction. Hand detection and gesture recognition is one of the interaction cases in computer vision. In this study, an experiment of hand detection and syntactic hand gesture recognition method are discussed. HSV (Hue Saturation Value) space color model is used as the basis of hand detection and segmentation. Then, the thinning method is used to get the endpoint features of each fingertip.

The proposed design is designed to meet with real-time video processing. The experiment intended to find some issues usually happened when the ZS thinning method is used to gain detection and recognition. The result shows that the proposed design can detect and recognize some gestures, but unstable hand movement may lead to a fault called the extra endpoint. In this research, extra endpoints are considered as a challenge that must be anticipated when using the thinning method, especially the ZS algorithm to perform syntactic hand gesture recognition.

Keywords: Endpoint, Hand Gesture, HSV, Thinning, Recognition

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Introduction

Detection and recognition are interesting topics to discuss in the field of computer vision. An advanced human-computer interaction technology needs a higher level of interaction style than console text-based interaction. In this case, one interesting topic to discuss is hand detection and hand gesture recognition as the base of those interaction models. Both hand detection and hand gesture recognition are important techniques to do an advanced interaction model. In real-time processing, the need for fast detection and recognition method is inevitable. In this case, every implemented algorithm must be able to do fast pixel-based processing. Implementing fast pixel-based processing, the designed system should be able to produce a high frame rate.

Hand detection and recognition can be implemented in various fields of Information and Communication Technology. For example, Sutoyo et al. (2015) utilized the human hand gesture as a method to operate computers for presentation purposes. Makahaube et al. (2021) also used the hand gesture to implement the interaction between human and automated education service kiosks to reduce the direct interaction between humans and the machine during the Covid-19 pandemic era.

In the implementation of the hand gesture recognition process, several methods can be used to do gesture recognition. For example, Silvia & Husni (2014) used hand contour information to do the detection processes. Huu & Phung Ngoc (2021) use a support vector machine and histogram-oriented gradient to do the detection and classification of hand gesture recognition. Eshitha & Jose (2018) used an artificial neural network to do hand gesture recognition. Both researches by Eshitha & Jose (2018) and Huu & Phung Ngoc (2021) used machine learning to implement hand gesture detection and recognition. The syntactic method especially, the thinning method also can be implemented as a method to capture the hand gesture pose due to the output characteristic of the thinning algorithm itself. The thinning algorithm can give a one-pixel width image generated from the original binary image. It can be seen in the example given by Sudarma & Putu Sutramiani (2014) which use thinning method to clarify the curvature of Balinese scripts. Therefore, the thinning algorithm should be able to extract the one-pixel width skeletal information of hand gestures from the proper binary images too. Moreover, some of the thinning algorithms have parallel nature such as the one proposed by Zhang & Suen (1984). It can be executed in parallel which may result in a faster process.

In this research, we proposed the use of a combination of several techniques that can be implemented to do hand detection and some hand gesture recognition in real-time video processing in detail. In section I, the research background detail has been explained already. Based on the literature review, every related work is discussed in section II. Meanwhile, section III discusses the contribution of this research. Section IV discusses the method to perform the research. Section V describes the design of the system. The results of the experiment are discussed in Section VI. Section VI discusses the conclusion of the research.

Related Work

In the past research, several background-foreground segmentation algorithms were introduced. These algorithms can be used as a hand detection method. Kim et al. (2005) proposed a codebook segmentation method. This algorithm needs a training phase in every pixel to do detection. This training phase takes advantage of the background's quasi-periodic movements to build a background model. ROI (Region of Interest) detection can be done by comparing every pixel to those background models. A clear example of quasi-periodic movements is the periodic movement of leaves on the tree. Periodically they are going up and down. Sometimes, they move to the left and right because of the wind. Sobottka & Pitas (1998) describes the use of HSV (Hue Saturation Value) color space to do detection. It can be implemented by defining the search region. Proper parameter initialization is needed to define the best search region in a fixed range. In this case, ROI must be in a fixed range of HSV color too. Meanwhile, Santosh et al. (2013) discuss the use of GMM (Gaussian Mixture Model) to detect a moving object. So, GMM can be implemented to detect pedestrians or running a car on the toll road. It is because they never stop to move, so those movements can be detected by GMM. In the case of hand detection, skin color has a fixed range of search regions. Those fixed ranges of search regions are the main feature of skin that can be detected through proper search region parameter initialization. Based on those skin color properties, in this research, we would like to use a method discussed by Sobottka & Pitas (1998). Compared to the other segmentation method mentioned earlier, HSV color space segmentation is the most proper method to do hand detection. Sobottka & Pitas (1998) prove that HSV color space segmentation is able to detect the skin color of the face in a fixed range region. By that evidence, there is a high possibility that it can be used to detect the skin

color of the hand too. In that case, HSV color space segmentation will be used as a hand detection method in the next discussion.

Thinning algorithms can be classified into three categories (L. Lam & Suen, 1992). There is sequential, parallel, and non-iterative thinning. The most cited work of thinning method can be found in literature about a fast parallel algorithm for thinning digital patterns (Zhang & Suen, 1984). In this research, we will use the term of Zhang Suen (ZS) algorithm to mention those aforementioned works. ZS algorithm is belonging to the parallel thinning algorithm. It means that every pixel can be processed in parallel. If the hardware supports parallel programming, pixel processing can be done quickly. In this case, the hardware resources can be exploited to get a good performance. ZS algorithm is simple, efficient, and resistant to noise. Given a binary image, this algorithm is able to give a one-pixel width horizontal and vertical skeleton as the result. But on diagonal shape, it can't produce a pure one-pixel width skeleton. Based on the previous experiment which was done by Lam & Suen (1995), the ZS algorithm can perform fast image processing. The research that was done by Shimizu et al. (2000) and Qin et al (2013), proposes the use of thinning algorithm to get some representative skeleton pattern of character. The thinning algorithm can be used not only for the binary image of character pattern recognition but also for the other binary images. For example, literature by Abu-Ain et al (2013) proposed a thinning algorithm and use it to perform thinning for some binary images.

In the case of hand gesture recognition, the use of the thinning method is supported by the existence of the endpoint feature. By a thinning method, a representative skeleton can be produced from a representative binary image. A representative skeleton will give correct information about the existence and the position of an object's endpoints. A classification of an object can be deduced from the existence of an endpoint pattern. From the previous explanation, the use of thinning algorithm gives several advantages, especially for the ZS algorithm. Based on the aforementioned information, the ZS algorithm will be used to do a thinning on the binary image of the hand gestures as the ROI. The only thing needed from the skeleton is the endpoints information that will be used to do classification. So, the diagonal pixel width problem of ZS thinning will be ignored. As long as the algorithm can produce the endpoint and do fast image processing, the other feature can be ignored. In this research, endpoint features can represent fingertips' position.

Thinning method alone cannot be used to perform hand gesture detection and recognition. Some several methods and algorithms can help to improve the thinning result during the thinning process for example HSV color space segmentation, ZS algorithm itself, morphological operation, and gaussian blur.

HSV Color Space Segmentation

HSV color space Hexa core cone-shaped as illustrated in
(left). Hue (H) is represented as angle, the purity of colors is represented as saturation (S), and the degree of grayscale is represented as value (V) (Sobottka & Pitas, 1998). As illustrated in

, H value varies from 0^0 to 360^0, S varies from 0 to 255. It can be normalized into 0 to 1. V also varies from 0 to 255 too. So, its range can also be normalized into 0 to 1. Search region represents a fixed range region that is constrained by the maximum and minimum value of each needed parameter variable.

(Sobottka & Pitas, 1998) did an extensive experiment on HSV segmentation. $S_{min} = 0.23$, $S_{max} = 0.68$, $H_{min} = 0^0$, and $H_{max} = 50^0$ are the result of the experiments. Bvv values signing those values as input parameters, white skin as well as human sallow skin of human can be detected. V_{min} and V_{max} values are ignored. But those parameters are not tested yet on the other skin color.

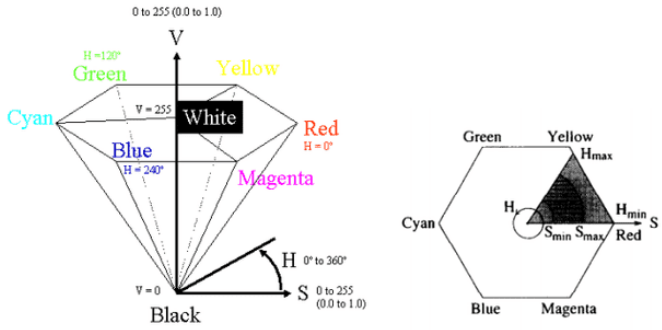


Figure 1. HSV Color Space (left) and search region (right)

Based on our experiment, those assigned parameter values cannot handle brown skin color perfectly. Given that condition, in the next discussion, all of the defined parameters will be assigned manually depending on the skin color to get a better detection result of ROI. The overall detection process can be illustrated as a flowchart in Figure 2. The input image must be in the form of HSV color space.

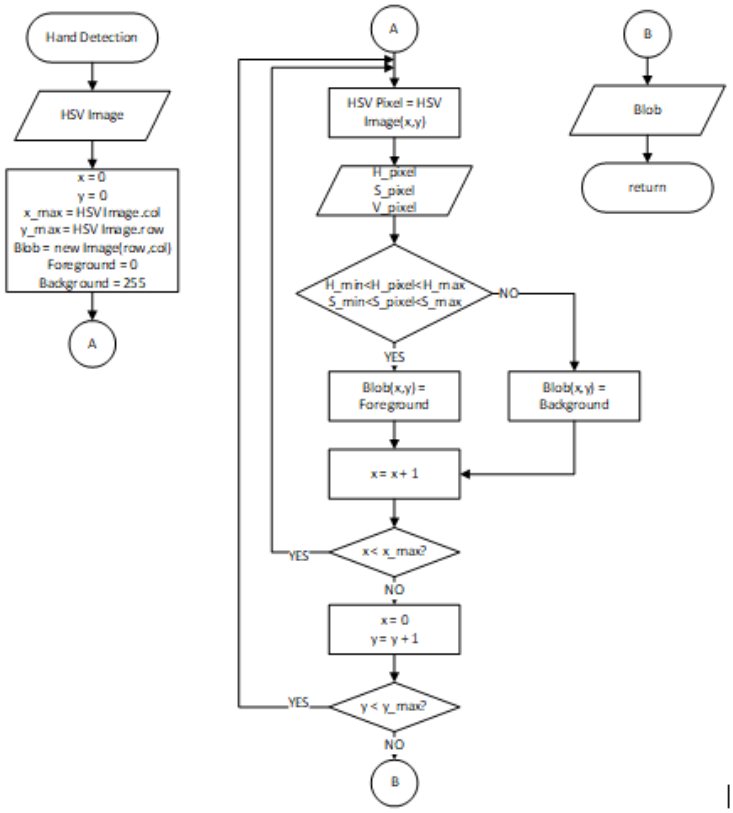


Figure 2. Hand segmentation flowchart in HSV color space

Zhang Suen (ZS) Algorithm

ZS is an algorithm that can be applied to do a thinning pattern of the digital image. The objective of thinning is to obtain a skeleton pattern of a binary image. To preserve the pixel connectivity, ZS does two sub-iterate processes access (Zhang & Suen, 1984). ZS operates on a black pixel $P1$ having 8 connected neighbors. The 8 neighboring pixels structure can be illustrated in Figure 3.

P9	P2	P3
P8	P1	P4
P7	P6	P5

Figure 3. The 8 neighboring pixels structure of the ZS algorithm

$A(P1)$ is the transition number of a white to a black (0 to 1) pixel in a sequential order $P2$, $P3$, $P4$, $P5$, $P6$, $P7$, $P8$, $P9$, and then back to $P2$. The transition number from the example in Figure 5 is 3, so $A(P1) = 3$.

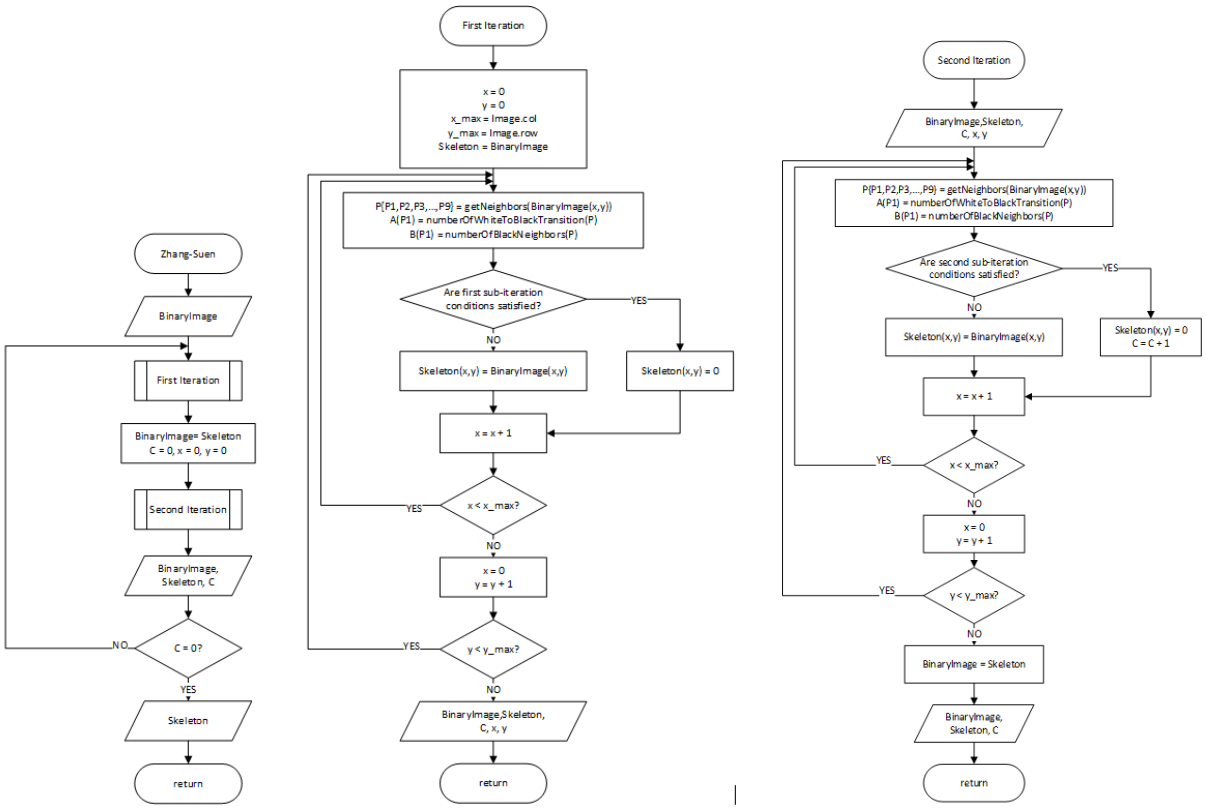


Figure 4. ZS thinning algorithm flowchart

$B(P1)$ denotes the number of black (openseighbors of $P1$. For the example, $B(P1)thea$ of given example in Figure 5 is 4 because $P1$ has 4 black neighbors.

1	1	0
0	1	0
1	0	1

Figure 5. The example of 8 neighboring pixel sequence

The overall process of the ZS algorithm can be illustrated by the flowchart in Figure 4. To process a binary image, the ZS algorithm divides the operation into two sub-iterations. Each of the sub-iterations is applied for every pixel in the mentioned binary image. Those sub-iterations can be done by processing all of each pixel in a sequential or parallel way. But, the result of that operation should be stored in a different image, so the value of the processed image will not be changed during the iteration. In the first sub-iteration, five conditions must be considered.

1. $P1 = 1$
2. $2 \leq B(P1) \leq 6$
3. $A(P1) = 1$
4. $P2 * P4 * P6 = 0$
5. $P4 * P6 * P8 = 0$

If a pixel met all those conditions, then change it into white (0). Vice versa, its value will not be changed. In the second sub-iteration, the following conditions must be considered.

1. $P1 = 1$

2. $2 \leq B(P1) \leq 6$
3. $A(P1) = 1$
4. $P2 * P4 * P8 = 0$
5. $P2 * P6 * P8 = 0$

If a pixel met all of those conditions, then change it into white (0). Otherwise, its value will not be changed. Both of the sub-iterations must be done until no pixel can be changed anymore.

Morphological Operations

The morphological operation has two kinds of basic operation. Those two operations are dilation and erosion (Young et al., 1998). Dilation can be denoted by the following equation:

$$D(A,B) = A \oplus B = \bigcup_{\beta \epsilon B} (A + \beta)$$

end erosion can be denoted by the following equation:

$$E(A,B) = A \ominus \tilde{B} = \bigcap_{\beta \epsilon B} (A - \beta)$$

where A denotes a binary image and B denotes the structuring element. The principle of dilation is expanding the area of ROI using a structuring element. Otherwise, the principle of erosion is to narrow the area of ROI using a structuring element. Let A an example of binary image shown in Figure 6 be (a). Then, let B be an example element structuring element shown in Figure 6 (b). The result from dilation of B on A can be shown in Figure 6 (c), otherwise the result from erosion of B on A can be shown in Figure 6 (d). Those two mentioned operations can be combined to form another morphological operation. The open morphological operation can be done by doing erosion first, then dilation later. Vice versa, the close morphological operation can be done by doing dilation first, then erosion later. Based on the literature by Jamil et al. (2008), the morphological operation can be used to do noise removal on a 2D binary image.

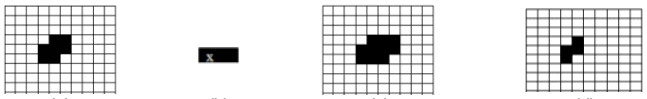


Figure 6. The illustration of morphological operations

Gaussian Blur

Trabelsi & Savaria (2013) and Ritter & Wilson (2000) describe that a Gaussian filter is one of several noise removal or smoothing techniques. In 2D image processing, a Gaussian filter uses a convolution technique to process 2D images (Trabelsi & Savaria, 2013).

Originality

In this research, HSV color space segmentation and ZS Algorithm are used to create a syntactic recognition model. This research includes detailed information about the way to implement the logic from scratch and includes possible fault behavior during the detection and recognition process. HSV color space segmentation is used to separate the ROI and the background. In this case, the ROI is a human hand bare skin. ZS algorithm is used to get the skeleton model of the ROI. Using the aforementioned model, the number of fingertip feature points existing in the ROI can be extracted.

Research Method

This research was conducted in several phases. They are literature review, design, development, and observation on the result in sequence. The literature review phase is focused on finding possible algorithms, system design possibilities, and the theories related to the research. The design phase is focused on designing the sequence of the system's input, process, and output, constructing the several algorithms into sequences, and documenting the sequences into some diagrams based on the theoretical information conducted during the literature review phase. The development phase focused on implementing the design

phase through coding activities. The observation phase aims to find the fault behavior possibilities in the implementation of the system.

Proposed Design

To do detection and recognition, several parts should be done. Sequentially, several parts of the process can be shown in a block diagram shown in Figure 7. Every part of them will be elaborated by a flowchart in Figure 8.

Figure 7. Block diagram of the proposed design

In the data acquisition block, the sample of data will be captured from a video or camera with a fixed resolution. The captured image sample usually uses an RGB color space as the default format.

In preprocessing block, the RGB data sample will be converted into HSV color space. The Gaussian filter will be used to do a smoothing task and noise removal of those HSV images, so the application produces an HSV image with a more clear color region. By those clear differences in the color region, the segmentation (hand detection) process may produce a better quality of the binary image. The hand detection steps have been explained already in Figure 2. The result of this hand detection process is a binary image consisting of black and white pixels only. Those binary images should be refined more through morphological operation, so the application can produce noise-free binary images. After that ZS algorithm will be used to do a thinning to the existing binary image. The thinning process can be seen through a flowchart in Figure 4. A skeleton will be produced from the previous process. So, a skeleton will be the final result of this preprocessing block.

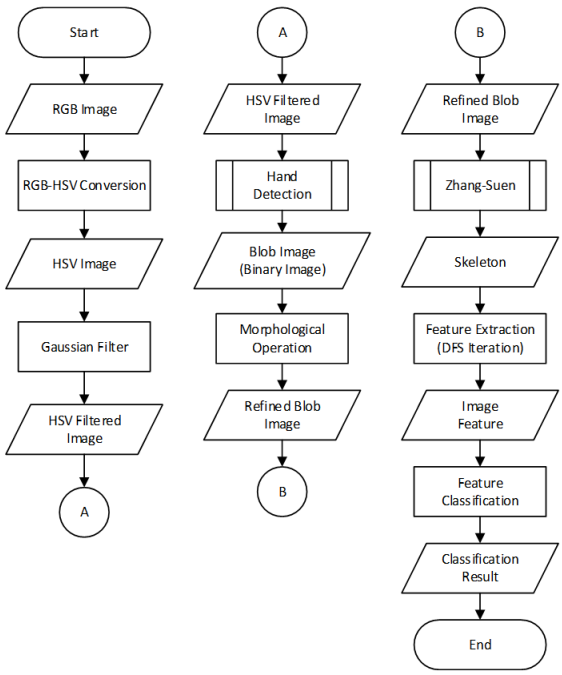


Figure 8. Flowchart design of hand detection and gesture recognition

In the feature extraction block, a specific skeleton will be selected. The skeleton will be iterated using a DFS algorithm. In every iteration, the algorithm will verify whether the inspected pixel is an endpoint or not. If an endpoint detected, then the pixel coordinate will be collected in a fingertip coordinate list. Otherwise, it will be ignored. So, a list of endpoint coordinate is the final result of this feature extraction block. This list represents the coordinate location of every fingertip detected by the application in the input image.

Syntactic classification block will classify the detected gesture based on the number of endpoints detected in a skeleton. The number of a detected endpoint can be counted by calculating the size of mentioned endpoint list earlier.

In the result block, the classification result will be shown by the application. The endpoint location will be printed on the default input image. Those printed marks are a sign of detected fingertip.

All those mentioned blocks will be executed sequentially. In each frame change, those blocks of operation will be executed again until the frame is stopped.

Result and Analysis

An experiment is conducted to validate the detection and recognition result process. The experiment also intended to find several kinds of faults usually happened when the ZS thinning method is used to gain the detection and recognition result.

Figure 9. Application UI Result

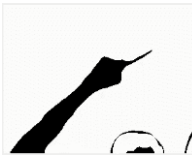
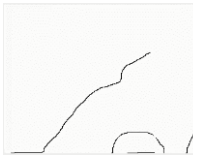
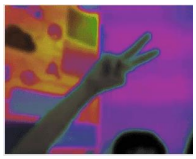
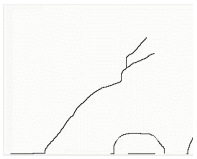
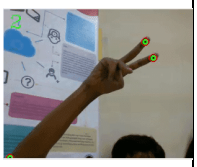
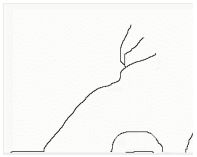
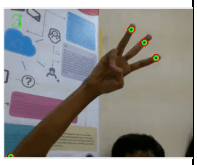
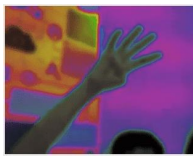
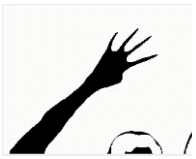
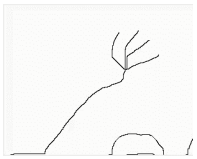
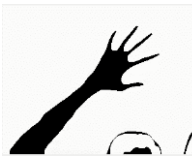
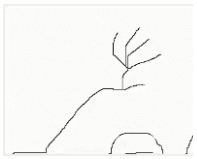
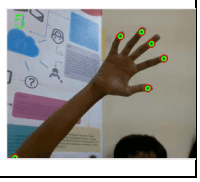
Figure 9 describes the application UI result in general. The experiment is conducted by verifying some gestures described in Figure 10. The tested data is an image with a size of 320×240 pixels which is captured frame by frame from a webcam in real-time. This experiment is conducted to know the capability of the proposed design in detection and recognition cases.

(a) (b) (c) (d) (e)

Figure 10. Gesture Classification (a) one, (b) two, (c) tree, (d) four, (e) five

Results of the first conducted experiment can be seen in table 1 and table 2. By ZS thinning, each gesture can be detected and recognized in an ideal condition. The ideal condition here means that the segmentation algorithm on HSV color space can produce a representative binary image of the detected hand. Hand segmentation on the HSV color space model can work if the background image color is simple and contrasts with the ROI color. Imperfect detection may result in a skeleton that is different from the actual expectations. A bad skeleton will lead to several fault results. From the observation, two kinds of fault can happen during the detection and recognition process. This fault is caused by unstable hand movement.

Table 1. Result of the experiment

Gesture	HSV	Binary	Skeleton	Result
One				
Two				
Tree				
Four				
Five				

The first type of fault is caused by an imperfect detection of hand. A hole with an irregular shape and angle inside the detected region is the result of this imperfect detection. This irregular shape of the hole may result in some unexpecendpointsints. An unexpected endpoints called by ethe Xtra endpoint, as illustrated in Figure 11. In this case, those extra endpoints are the result of some sharp angle inside the detected region preserved by the thinning algorithm.

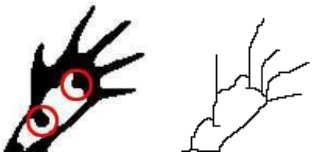
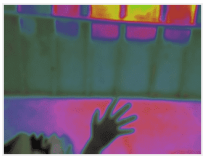
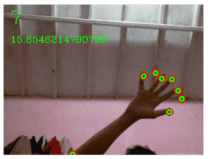


Figure 11. The cause of extra endpoints

The second type of fault is caused by a combination of unexpected background noise with the binary image of the detected hand. This combination may result in a bad shape binary image. Some regions of a binary

image with a sharp angle resulting from background noise will be preserved by the thinning algorithm. This condition led to the formation of an extra endpoint too.

Table 2. Result of the experiment

Fault Type	HSV	Binary	Skeleton	Result
1st fault				
2nd fault				

Both the first and second faults produce some extra endpoints. In the case of fingertip counting, these extra endpoints lead to the wrong result, because these extra endpoints will be added to the list of the endpoint. In the end, these extra endpoints will be counted as fingertips too. To prevent this condition, the formation of extra endpoints should be anticipated in the first experiment.

Conclusion

This research proposes a design of syntactic method on hand detection and gesture recognition using a sequence of some algorithm. HSV color space segmentation is implemented as a hand detection method based on skin color in the HSV color space model. ZS algorithm is implemented as a thinning method to get a skeleton from an object. Unstable hand movement may lead to a fault called by the extra endpoint. Extra endpoints are considered a challenge that must be anticipated when using the thinning method to perform syntactic recognition.

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