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Pictogram Icon as a Learning Media for Deaf Students in Visual Communication Design

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ABSTRACT

In 2022, the total number of deaf or deaf students studying at Sahid University Surakarta will be 14 students. The government itself has mandated the right to education for children with special needs as regulated in Article 54 of Law Number 39 of 1999 concerning Human Rights, namely: Every child who is physically and/or mentally disabled has the right to receive special care, education, training and assistance at cost. state, to guarantee life in accordance with human dignity, self-improvement, and ability to participate in the life of society and the state. The obstacle so far has been communication in delivering material from lecturers to deaf students. This is because: 1) 90% of deaf students in Visual Communication Design cannot read written sentences that are too long. Deaf students of Visual Communications Design are accustomed to using hand sign language, namely a visual language that emphasizes the ease of moving hands, not the order of sentences based on SPOK, 2) The digital application used by deaf students to translate the lecturer's voice does not function properly. This is because sentences/words often appear that do not match what the lecturer in the course said. The aim of designing pictogram icons as a learning medium for Visual Communication Design students is that deaf students can understand and understand information about lectures and can carry them out well, so that deaf students are formed who are able to compete in society. To achieve this goal, the Innovation Development method is carried out using the Lee & Owens Model method which produces pictogram icons which can help simplify verbal and written language into visual language.

KEYWORDS

icon; pictogram; learning media

1. INTRODUCTION

Inclusive education in Indonesia began to be developed since the beginning of 2000. Primary to secondary education schools are the main goal in implementing inclusive education. This is based on the circular letter of the Director General of Basic Education, Ministry of National Education No. 380/C.C6/MN/2003 dated 20 January 2003 concerning inclusive education which contains the provisions of organizing and developing in each district/city at least 4 (four) schools consisting of: elementary school, middle school, high school and vocational school. Inclusive education is a teaching and learning process in an educational unit that provides opportunities for people with disabilities to get the opportunity to study together with non-disabled people. This also happens to deaf students in the Visual Communication Design study program, especially at Sahid University, Surakarta.

In 2014 Sahid University Surakarta opened opportunities for deaf and hard of hearing people to pursue higher education. And the Visual Communication Design and Interior Design study programs that have accepted these students include 4 deaf/hard of hearing students in Visual Communication Design. However, starting in 2020, communication problems emerged in delivering material from lecturers to deaf students. Especially when delivering lecture material in class. This is because: 90% of deaf students in Visual Communication Design cannot read written sentences that are too long. Especially those using the SPOK pattern. They are used to using sign language from Pusbisindo (Pusat bahasa Isyarat Indonesia/Indonesian Sign Language Center) which does not pay attention to SPOK patterns, but is based on the rhythm of hand movements. And they are used to using basic words and words that are often used, which tends to read in writing as meaning denotation rather than connotation. Meanwhile, in the Visual Communication Design lecture material, there are many terms/loan words from foreign languages. This means that much of the lecture material in the Visual Communication Design study program is not well understood by deaf students in the Visual Communication Design study program, especially at Sahid University, Surakarta. So that it can hinder the deaf student in carrying out lecture assignments.

The aim of this research is that deaf students can understand and comprehend information regarding lectures, especially regarding terms/loan words from foreign languages and can carry them out well, so that deaf students can be formed who are able to compete in society. This also means that lecture material presented using visual language can be useful for deaf students, namely: a. arouse student motivation and interest, b. Facilitate data interpretation and condense information, c. Make it easier for students to carry out design, animation, photography or film creation assignments.

Theoretical approach combines visual communication design theory with accessibility principles. The main theories that will be used include semiotic theory and the formation of icons and pictograms and visual learning design theory used in compiling pictogram icons as a medium for conveying lecture material. 2. User Needs Analysis by conducting a user needs analysis involving in-depth interviews and surveys of deaf students to identify specific needs regarding visualization of the material needed for learning. 3 Co-Design is a design process that involves deaf students and JBI (Juru Bahasa Isyarat/Sign Language Interpreters) in making the design. This is useful for ensuring that the resulting pictogram is relevant and effective for the user.

This research has the potential to enrich understanding of the use of pictogram icons in educational contexts, especially for deaf students as a form of visual communication which

has the potential to be an effective learning medium for deaf students. The results of this research can also encourage more inclusive policy making in higher education institutions, especially in the field of visual communication design. This is because findings showing the effectiveness of pictogram icons as a learning medium can serve as inspiration for integrating this method into the visual communication design curriculum. This research also encourages designers to pay more attention to the needs of users with hearing impairments which can become the basis for further development of pictogram icons that are not only aesthetically functional but also inclusive and easy to understand by all groups, including deaf students.

2. METHODOLOGY

In solving the problems posed using qualitative research methods. This is where research looks for cause-and-effect relationships by looking at the symptoms, conditions and social phenomena that occur. The research method will be carried out in several stages, including;

a. Data source

This research is about icons and pictograms in the form of infographics as a visual strategy for lecture material for students and will use resource persons who are people/figures who are considered experts in the field of visual icon language, sign language as well as respondents from several deaf students in the Visual Communication Design study program, Sahid University, Surakarta. Library sources will come from research journals related to infographic icons and other related written data.

b. Data collection technique

The observation process coincides with the interview process by systematically recording events, behavior and objects seen. Interviews with icon designers and Sign Language Interpreters were conducted to identify visual types and characters that are easy to understand and understand and attract interest in reading. Deaf/hard of hearing students were interviewed to find out their perceptions and conceptions about visual language.

c. Data validation

Data validity in qualitative research uses data triangulation to ensure the objectivity of the research results (H.B.Sutopo 2002: 78). Data triangulation is the use of various types of data to see more sharply the relationship between various data to prevent errors in analyzing the data. Triangulation method by finding intersections/meetings/similarities between observation data, interviews and literature.

d. Data analysis

The research uses an interactive analysis technique using three variables. Regarding literature study data, observations, and interview results, namely data presentation, data reduction, and drawing conclusions. Interaction analysis is carried out in order to obtain objective results and obtain similarities in the statements of several sources in order to look for intersections or relationships in the data from three sources to obtain a common thread from the data obtained by using emic research to find the common thread, namely based on knowledge and experience of the perpetrator or user.

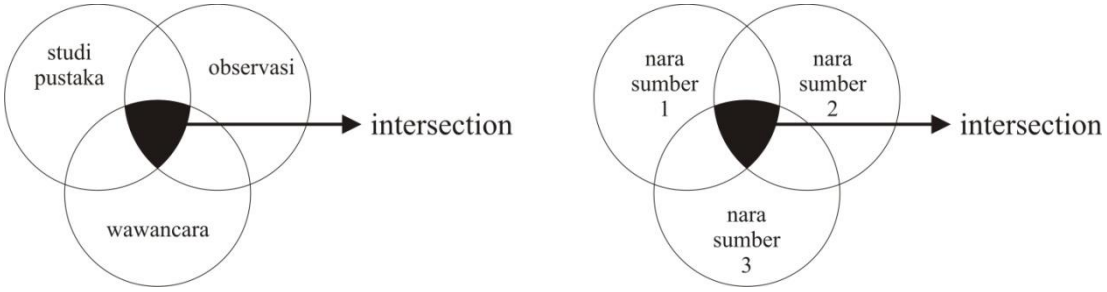

Figure 1. Interactive analysis model
(Source: Evelyne, 2021: 6)

3. RESULTS AND DISCUSSION

Design is work that emphasizes functional aspects that attract attention and are easy to understand. Visual communication design works prioritize visual elements as a medium for communicating with users. Therefore, it requires visual language as a communication medium. This visual language is closely related to signs. The signs displayed are in accordance with the knowledge possessed by the user. Therefore, a special approach is needed in visual modeling, especially for learning media for deaf/deaf students in the Visual Communication Design study program, Sahid University, Surakarta. There are several things to pay attention to when developing a visual strategy for learning media for deaf/deaf students in the Visual Communication Design study program, Sahid University, Surakarta, as follows:

3.1. Function of Icons as Learning Media

The visual design used as a learning medium is a visual display, namely a sign that is able to represent a word. This is because the problem of deaf/hard of hearing students in the Visual Communication Design study program, Sahid University Surakarta is that they do not or do not understand long sentences and only understand basic words. The basic words here are words without connotative affixes and endings.

Data from 15 deaf/hard of hearing students in the Visual Communication Design study program, Sahid University Surakarta who are still active with their hearing ability level in dB (decibels) according to Winarsih (2007), grouped into several categories, namely:

Table 1. Table of deafness level of deaf/deaf students

	Man	**Woman**
Hearing loss 15-30 dB		
Hearing loss 31-60 dB		1
Hearing loss 61-90 dB	2	1
Hearing loss 91-120 dB	5	2
Hearing loss is more than 120 dB	3	1
Total	**10**	**5**

Source: 2018-2022 observation results

Loss of 15-30 dB, mild hearing losses or mild deafness; ability to perceive normal human speech sounds. Loss of 31-60 dB, moderate hearing losses or moderate hearing loss; the ability to perceive human speech sounds is only partial. Loss of 61-90 dB, severe hearing losses or severe deafness; the ability to perceive human speech sounds is non-existent. Loss

of 91-120 dB, profound hearing losses or very severe hearing impairment; the ability to perceive human speech sounds is completely absent. Loss of more than 120 dB, total hearing losses or total deafness; the ability to perceive human speech sounds is completely absent.

Based on table 1, it is known that 14 students had a loss of 61 dB to more than 120 dB, so this made them have problems understanding written sentences as follows:

Table 2. Table of levels of deaf/hard of hearing students

Kesulitan	Man	Woman
Understanding SPOK sentences		1
Paragraph written sentences	2	1
The word means denotative	8	2
Words with Connotative Meaning		1
Total	**10**	**5**

Source: 2018-2022 observation results

Based on table 1, it is known that 14 students had problems understanding sentences in paragraph form which had a SPOK pattern and had a connotative meaning. D Denotative meaning is the real meaning, the meaning that corresponds to what is written. Meanwhile, connotative meaning is an implied meaning or a figurative meaning. Deaf/hard of hearing students are accustomed to reading signs/signs visually. Whether reading lips, reading body language or reading hand signals. However, of the 15 deaf/deaf students in the Visual Communication Design study program, Sahid University, Surakarta, only 8 understand how to communicate well using hand sign language. Thus, this creates another model of visual communication media that can provide an understanding of lecture material that can be seen, read and studied repeatedly. A visual display that can replace a word or sentence in one visual display. One way is to visualize icons. Icons are representations/translations of words/sentences that have similarities/similarities (Batista et al., 2019). Icons enable people to understand information effectively (Andang & Puji Prabowo, n.d.).An icon combined with several symbols or signs will form a pictogram. Pictograms can make boring information or material more interesting and easier to remember. Pictograms are used to visualize data, presentations and information more easily to understand (Rahmah & Kusmiyarsih, 2023).

3.2. The basic concept of forming icons as a learning medium

Problems in understanding lecture material for deaf/hard of hearing students in the Visual Communication Design study program, Sahid University, Surakarta due to obstacles in understanding the material in written form with paragraphs and SPOK structure. This requires a visual display of icons that can translate a word/short sentence in one visual display.

For example, in data analysis material. Data analysis is the main thing used in developing the concept of Visual Communication Design. Data analysis is mandatory in every design or design of visual communication. In data analysis, there is segmentation which functions to find the character of the target consumer, USP (Unique Selling Preposition) which functions to find differentiation and ESP (Emotional Selling Preposition) which functions to generate the desired emotions in the minds of consumers regarding the product or message conveyed through visuals.

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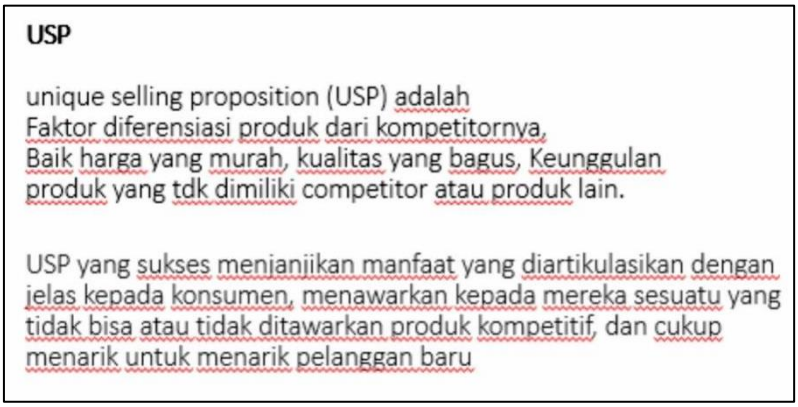

Figure 2. Visual Communication Design lecture material about USP
(Source: Evelyne, 2020)

However, deaf students who are used to using sign language, which is a visual language, will find it easier to understand if the definition of the data analysis section uses visual language or pictures or illustrations.

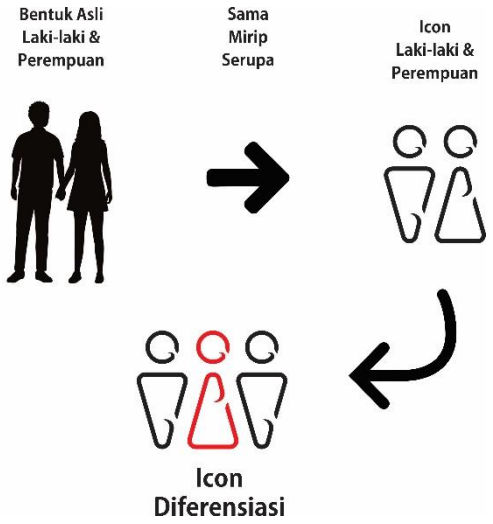

Figure 3. Differentiation Icon Design for USP Material
(Source: Evelyne, 2020)

The material in Figure 3 is simplified by using visual language, namely in the form of icons, focusing on the core material regarding USP, namely the differentiation/difference of the product from its competitors, which contains product advantages and promises of benefits that competitors do not offer. And the icon shape to explain the USP becomes:

Figure 3. Form of content about USP
(Source: Evelyne, 2020)

3.3. Configuration of visual elements that form learning media

Based on Figure 2 above, it shows that 100% is dominated by writing. The illustrations/pictures on the slide do not help explain further the presentation of the writing in paragraph form on the left.

Based on this, for deaf/deaf students it is necessary to simplify the content of the material on the slides. This simplification is done by selecting words/sentences with core information. So, make sentences that are not too long but informative and do not cause misunderstandings. Therefore, this form of simplification uses a pictogram form which focuses on illustrations/images.

Simplifying sentences in the form of icons arranged into pictograms by reducing the number of words and focusing on the core information to be conveyed, bolding important words and using sans serif fonts/letters. The use of sans serif fonts/letters is because the character of the sans serif type is impressive, flexible, relaxed and easy to read when arranged in long sentence form (Wang et al., 2018). And to avoid discomfort, eye fatigue and stay focused when reading the words/sentences displayed, the font size used is 18pt – 20pt. This is done so that the function of using typography in completing textual word elements can improve cognition and understanding of the message. (Poon, 2021) The use of typography can also have the effect of understanding information well by paying attention to design principles, thereby displaying visuals that are not only attractive, but also pay attention to comfort in reading which is able to generate a sense of trust in the information conveyed (Thiessen et al., 2020) relevant information.

4. CONCLUSION

This research can make a significant contribution to the field of education and visual communication design by developing innovative and accessible pictogram icon-based learning media. This is because it involves deaf students in the design process, so it is hoped

that it can produce more effective and inclusive learning media to improve the quality of learning in a way that suits the needs of deaf students in the Visual Communication Design study program. Further research can be carried out to explore the use of pictograms in other courses or study programs. Apart from that, research can also focus on developing more comprehensive evaluation methods to measure the effectiveness of this learning media.

REFERENCES

Andang, B., & Puji Prabowo, D. (n.d.). City's iconic architecture as designer's reference for creating visual identity; case-study of iconic buildings in semarang.

Batista, C. R., do Valle Filho, A. M., Mafioletti, A., & Novakoski, M. H. (2019). Icon Design for a Tourism Mobile App (pp. 325–330). https://doi.org/10.1007/978-3-030-23522-2_42.

Kibar, P. N. & A. B. (n.d.). Fostering and assessing infographic design for learning: the development of infographic design criteria. https://doi.org/10.1080/1051144X.2017.1331680

Poon, S. T. F. (2021). Typography Design's New Trajectory Towards Visual Literacy for Digital Mediums. Studies in Media and Communication, 9(1), 9. https://doi.org/10.11114/smc.v9i1.5071

Rahmah, F. N., & Kusmiyarsih, S. (2023). Pictogram Media in Thematic Learning to Improve Student Understanding in Madrasah Ibtidaiyah. ELEMENTARY: Islamic Teacher Journal, 11(1), 125. https://doi.org/10.21043/elementary.v11i1.19719

Thiessen, M., Beier, S., & Keage, H. (2020). A Review of the Cognitive Effects of Disfluent Typography on Functional Reading. The Design Journal, 23(5), 797–815. https://doi.org/10.1080/14606925.2020.1810434

Wang, J., Yin, J., Deng, S., Li, Y., Pu, C., Tang, Y., & Luo, Z. (2018). Evaluating User Satisfaction with Typography Designs via Mining Touch Interaction Data in Mobile Reading. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, 1–12. https://doi.org/10.1145/3173574.3173687

The Application of Flipped Learning Model to Cognitive Learning Outcomes and Laboratory Practical Skills

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ABSTRACT

The world of education has developed very rapidly, so that new methods are needed to support the effectiveness of learning process in the classroom, such as ideas related to new educational models and unique ways to continue to communicate with students, inform, collaborate and assess the learning process so that learning becomes fun, without reducing the essence of education. The aim of the research was to determine the effect of implementing the flipped learning model on the cognitive learning outcomes and laboratory practical skills of nursing students at Sahid University, Surakarta. This research used a quasi-experimental design with a pre-post non-equivalent control group design, the research sample was taken using a purposive sampling technique. The sample in this research was student of class A as a class using the Flipped Classroom model and student of class B as a class using a conventional model with a total of 74 students. The results of this research showed that the Paired Sample T-Test test results were $p < 0.05$ which indicated that there was an influence from the application of the Flipped Classroom and conventional models on student cognitive learning outcomes and the average learning outcomes with the application of the Flipped Classroom were higher than those with the application of the conventional model. The conclusion of this research is that it is necessary to apply the flipped learning model because it can improve student learning outcomes in creative thinking.

KEYWORDS

Flipped Classroom, Students, Nursing, Cognitive, Laborator Skills

1. INTRODUCTION

A quality learning process can occur when the lecturer makes a good, relevant and innovative learning plan so that it has an impact on the quality of effective learning outcomes(Du et al., 2022).The rapid development of technology has influenced learning models from traditional ones to more innovative digital-based learning models such as learning methods with flipped learning models(Collins & Halverson 2018). flipped learning model is a learning model that combines learning in the classroom with learning outside the classroom with the aim of maximizing learning activities using video learning media (Alamri, 2019)

According to Alamri (2019). flipped learning models can increase students' learning motivation by 66%. This learning motivation is able to increase students' cognitive learning outcomes by 46.7%. Students are encouraged to study independently through learning videos before attend the class. Students are encouraged to study independently through learning videos before attend the class. In this flipped learning model, teachers can record their own videos and deliver learning material using various technology applications (video recording software) (Zainuddin & Perera, 2018).

The flipped learning classroom learning method provides a student-centered approach in meeting the demands of today's nursing education and the diversity of current health services. The changes that occurred in the world of nursing after implementing the flipped learning method were that students were more active in learning, theory was taught in an applied form and lecturers provided facilities for students to think critically rather than just providing theory in front of the class (Youhasan et al., 2021)

Learning process at Sahid University in Surakarta has not implemented the flipped learning method and is still using conventional learning methods where lecturers carry out face-to-face learning in the laboratory for basic nursing practicums, but the procedures cannot be put into practice correctly, even though the lecturers have explained and demonstrated them first. The lecturer in charge of nursing courses stated that laboratory meeting sessions were not effective in improving students' laboratory skills because students did not yet understand the procedures and functions of each material that would be demonstrated so that their competency was not achieved optimally.

Based on this background, this learning method is very effective in improving the cognitive and laboratory skills of nursing students and has not yet been implemented at Sahid University, Surakarta, because of this reason the research team, will conduct research on the Effectiveness of Implementing the Flipped Learning Model on Cognitive Learning Outcomes and Laboratory Practical Skills Nursing Student at Sahid University, Surakarta.

2. METHODOLOGY

2.1 Research Design

The design of this research is a quasi-experimental design with a pre-post non-equivalent control group design.

2.2 Population and Sample Used

Sampling used a purposive sampling technique using class A as the class with the application of the Flipped Classroom learning model and class B with the application of the conventional model as the control. The sample in this research was 65 students in the

second semester of the Nursing Science Study Program at Sahid University, Surakarta, with 33 students in the Flipped Classroom class and 32 students in the conventional class.

2.3 Data Collection Techniques

Using purposive sampling technique. Data collection will be conduct from May to June 2024. Before the intervention is given, researchers provide informed consent to respondents. Then the outcomes were measured and respondents were given intervention 6 times for the flipped classroom learning model. Cognitive learning outcomes are measured based on the final semester exam scores, while laboratory practical skills use the existing nursing practicum SOP checklist questionnaire that applies in the nursing laboratory at Sahid University, Surakarta.

2.4 Tools and Instruments Used

This research using the existing and applicable nursing practicum SOP checklist questionnaire in the nursing laboratory at Sahid University, Surakarta. Data analysis was first carried out with a normality test, then a bivariate test was carried out using the paired t-test.

2.5 Data Analysis

Data analysis was first conduct with a normality test, then a bivariate test was carried out using a paired t-test, after the data was collected, the completeness of the data was re-checked, data entry, tabulation and data analysis were conduct with the SPSS package program.

3. RESULTS AND DISCUSSION

3.1 Result

Preparation for lectures is conduct by looking at the learning objectives and competency achievements of the Semester Learning Plan (RPS) that has been prepared. Microbiology teaching material in the Medical Surgical Nursing II course has 6 meetings and 1 week before the meeting the material is given to students. The learning material provided is in the form of material on slides, learning videos, and articles that correspond to the learning topic in the related article. Articles related to the topic of learning disease systems in medical surgical nursing II are provided with the aim that from an early age students are taught to learn in accordance with evidence based. The pre-test is given before each meeting and the post-test is given after the lecture is finished.

Characteristics of respondents based on gender in classes using the Flipped Classroom and conventional applications are dominated by female students. The Flipped Classroom class consists of 3 male students and 30 female students. Meanwhile, in the conventional class the number of men and women was 6 and 26 students respectively (Table 1).

The normality test on student pre-test and post-test data using the conventional and Flipped Classroom models showed that the data was normally distributed ($p>0.05$) (Table 2).

The average scores for students' pre-test and post-test cognitive learning outcomes using the Flipped Classroom model were 55.22 and 81.07, respectively. Meanwhile, the average conventional learning results were 52.40 in the pre-test results and 69.40 in the post-test results. The results of the Paired Sample T-Test show that $p < 0.05$, which indicates that there is an influence from the application of the Flipped Classroom and conventional models on student cognitive learning outcomes. However, the average learning outcomes using the Flipped Classroom application are higher than those using the conventional model (Table 3).

Table 1. Characteristics of respondents based on gender

Characteristics	Group			
Gender	Flipped classroom		Conventional	
	Frequency	Percentage	Frequency	Percentage
Man	3	9,1	6	18,75
Woman	30	90,9	26	81,25
Total	33	100	32	100

Source : Primary data (2024)

Table 2. Normality test results with Shapiro Wilk

Group	pre			post		
	statistic	df	sig	statistic	df	sig
Conventional	0,107	33	0,061	0,093	33	0,200
Flipped Classroom	0,108	32	0,540	0,800	32	0,200

Source : Primary data (2024)

Table 3. Pre-post mean value of flipped classroom and conventional test

Group	Pre test			Post test			*P value*
	N	Mean	SD	N	Mean	SD	
Conventional	32	52,40	8,065	32	69,40	4,875	0,0001
Flipped clasroom	33	55,22	8,112	33	81,07	5,153	0,0001

Source : Primary data (2024)

On the implementation of the conventional method, students are given a pre-test before the lecture and a post-test at the end of the lecture. Lecturers teach according to lecture topics using conventional methods or providing lecture material through lectures. It can be seen that during the lecturer's explanation, students tend to be passive and look bored during the lecture.

The role of lecturers is very active in providing lecture material so that learning is dominated by lecturers compared to students. The time required in the lecture method tends to be longer so that sometimes a discussion cannot be held at the end of the explanation of the material.

3.2 Discussion

The findings of this research show that there is a significant influence on improving nursing student learning outcomes after implementing the Android-based flipped leaning model. The results of this research are in line with (Buhari & Sari, 2022) which shows that there is

an influence of the application of flipped learning models based on Android applications on laboratory skills learning outcomes for nursing students and is proven to improve nursing student learning outcomes.

Learning outcomes are an inseparable part of interaction, process and evaluation of learning so that there are changes in terms of knowledge, attitudes and skills. Student learning outcomes cannot be separated from the teacher's role in designing good and creative learning methods (Kusmaryani et al., 2019). In assessing learning outcomes using authentic and non-authentic assessments. Authentic assessment of learning outcomes through written tests, practicums, tests and exams (Awidi & Paynter, 2019). Increasing practicum learning outcomes is the result of non-authentic learning assessments that are complex and integrated in all educational programs that refer to the curriculum, to achieve student competency (Gonzales et al., 2022).

The flipped learning model is the most effective method applied in practical or laboratory learning because the flipped learning model encourages students to further improve their ability to think creatively and hone their skills (Barbour & Schuessler, 2019). In line with research by (Hadi & Hamid, 2020) the results of his research show that the flipped learning method can increase student involvement in the learning process, thereby making the delivery of learning material more effective and efficient.

Laboratory practical learning is a learning method used to hone psychomotor skills, knowledge and attitudes. These three skills will help students develop their competence when carrying out clinical practice in hospital facilities and so that learning is more effective in developing students' skills, one of which is using the flipped learning learning model (Muhajarah & Sulthon, 2020). The flipped learning method in laboratory practicum allows students to produce better learning because it increases the opportunity to practice more in the experimental process in the laboratory (Çelik et al., 2021).

It can be concluded that the Flipped learning model is the best model that can be used in laboratory courses, which can move students' attitudes with videos and various animations to a higher level, and allows them to develop laboratory self-efficacy. Self-efficacy is defined as a person's belief in their ability to achieve a certain level of performance (Kara & Kayacan, 2023). (Heijstra & Sigurðardóttir (2018) in Çelik et al., (2021).reported that in their research flipped learning had its own advantages compared to traditional classes. This advantage allows recordings to be displayed online, and students can view the recording multiple times, pause to take notes, delete again if something is unclear and view the recording at their own pace. The opportunity to take notes more than once can support or motivate students to study a subject more effectively. Apart from that, the flipped learning method has provided benefits for students because it is useful for students who are hesitant to ask questions and has the opportunity to watch videos to understand them.

4. CONCLUSION

The flipped learning method has been proven to encourage students to think more creatively in developing their abilities. The flipped learning method has many advantages in laboratory learning where students can review the recorded results of courses taught by video and also provides benefits to students. If there are students who are hesitant to ask questions, students can watch the video of the learning results again until they understand the lesson.

REFERENCES

Alamri, M. M. (2019). Students' academic achievement performance and satisfaction in a flipped classroom in Saudi Arabia. *International Journal of Technology Enhanced Learning*, *11*(1), 103–119. https://doi.org/10.1504/IJTEL.2019.096786

Awidi, I. T., & Paynter, M. (2019). The impact of a flipped classroom approach on student learning experience. *Computers and Education*, *128*, 269–283. https://doi.org/10.1016/j.compedu.2018.09.013

Barbour, C., & Schuessler, J. B. (2019). A preliminary framework to guide implementation of The Flipped Classroom Method in nursing education. *Nurse Education in Practice*, *34*, 36–42. https://doi.org/10.1016/j.nepr.2018.11.001

Buhari, B., & Sari, R. M. (2022). Efektifitas Penerapan Flipped Learning Model Berbasis Aplikasi Android Terhadap Hasil Belajar Laboratory Skills pada Mahasiswa Keperawatan di Kota Jambi. *Window of Health : Jurnal Kesehatan*, *5*(1), 433–440. https://doi.org/10.33096/woh.vi.134

Çelik, H., Pektaş, H. M., & Karamustafaoğlu, O. (2021). The Effects of the Flipped Classroom Model on the Laboratory Self-Efficacy and Attitude of Higher Education Students. *Electronic Journal for Research in Science & Mathematics Education*, *25*(2), 47–67.

Collins, A., & Halverson, R. (2018). *Rethinking education in the age of technology: The digital revolution and schooling in America*. Teachers College Press.

Du, X., Zhang, M., Shelton, B. E., & Hung, J. L. (2022). Learning anytime, anywhere: a spatio-temporal analysis for online learning. *Interactive Learning Environments*, *30*(1), 34–48. https://doi.org/10.1080/10494820.2019.1633546

González-Gómez, D., Jeong, J.S. (2020). The Flipped Learning Model in General Science: Effects on Students' Learning Outcomes and Affective Dimensions. In: Mintzes, J.J., Walter, E.M. (eds) Active Learning in College Science. Springer, Cham. https://doi.org/10.1007/978-3-030-33600-4_33

Hadi, M. S., & Hamid, A. (2020). Desain Pembelajaran Flipped Learning Pai Sebagai Solusi Model Pembelajaran Abad 21. *Quality*, *8*, 149–164. http://journal.stainkudus.ac.id/index.php/Quality/article/view/7503

Heijstra, T. M., & Sigurðardóttir, M. S. (2018). The flipped classroom: Does viewing the recordings matter? *Active Learning in Higher Education*, *19*(3), 211–223. https://doi.org/10.1177/1469787417723217

Kara, S., & Kayacan, K. (2023). The Effect of Flipped Learning Model on Pre-Service Science Teachers' Laboratory Practices. *Journal of Education in Science, Environment and Health*, 178–193. https://doi.org/10.55549/jeseh.1331278

Kusmaryani, W., Musthafa, B., & Purnawarman, P. (2019). The influence of mobile applications on students' speaking skill and critical thinking in English language learning. *Journal of Physics: Conference Series*, *1193*(1). https://doi.org/10.1088/1742-6596/1193/1/012008

Muhajarah, K., & Sulthon, M. (2020). Pengembangan Laboratorium Virtual sebagai Media Pembelajaran: Peluang dan Tantangan. *Justek : Jurnal Sains Dan Teknologi*, *3*(2), 77. https://doi.org/10.31764/justek.v3i2.3553

Youhasan, P., Chen, Y., Lyndon, M., & Henning, M. A. (2021). Exploring the pedagogical design features of the flipped classroom in undergraduate nursing education: a systematic review. *BMC Nursing*, *20*(1), 1–13. https://doi.org/10.1186/s12912-021-00555-w

Zainuddin, Z., & Perera, C. J. (2018). Supporting students' self-directed learning in the flipped classroom through the LMS TES BlendSpace. *On the Horizon*, *26*(4), 281–290. https://doi.org/10.1108/OTH-04-2017-0016

The Influence of Education on The Level of Knowledge and Behavior about the Antibiotic for Lectureres at Sahid University Surakarta

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ABSTRACT

The problem of drug misapplication is a case that still often encountered in society. Many people buy potent drugs without a doctor's prescription. Lack of knowledge in knowing the side effects of drugs, storing drugs and disposing of unused drug waste to be destroyed first causes many cases of medication errors to occur, thus increasing ineffectiveness in drug administration therapy. The aim of the research was to determine the profile of drug storage and disposal, family members of Sahid University Surakarta lecturers in drug management at home, the quality profile of drug management, and analyze the factors that influence drug management at home and their effects after being given the correct used antibiotics education. This research uses a pre-experimental design method with a pretest/posttest intervention design without control group, sampling for this research uses a purposive sampling technique. The sample for this research were lecturers at Sahid University of Surakarta in accordance with the inclusion and exclusion criteria that had been determined with a total of 20 respondents. The results of the research show that the results of the Wilcoxon Test have a p value = 0.000 ($p<0.05$). This shows that providing antibiotics medicine education influences the level of knowledge and behavior of the lecturers at Sahid University of Surakarta regarding drug use. The conclusion of this research showing that there is a need to disseminate knowledge about used antiobiotics medicine especially regarding antibiotic drugs, so that the public understands better how to use drugs properly and correctly.

KEYWORDS

Antibiotics Medicine, Knowledge, Behavior

1. INTRODUCTION

The problem of antibiotic drug misapplication is a case that is still often encountered in society. Lack of knowledge in knowing the side effects of antibiotic drugs, storing antibiotic drugs and disposing of unused antibiotic drug waste to be destroyed first causes many cases of medication errors to occur (Dwiaini, 2022). Several studies show that the level of public knowledge regarding self-medication is in the sufficient category, however, accuracy in selecting drugs > 50% still indicates the irrationality of therapy. This causes the emergence of medication error cases and increasing cases of resistance to antibiotics (Kumar et al., 2020).

Based on data from the 2018 Basic Health Research (Riskesdas), it was found that in Indonesian society, 35.2% of households stocked antibiotics for self-medication. This requires educating the public regarding knowledge of antibiotic drug management (Noviani et al., 2024). Based on research in China, the factors that influence medication management in the household are age, gender and occupatio (Duan et al., 2021).

The Drug Aware Family Movement (GKSO) program hopes that people will become smarter and wiser in using drugs. The Family Drug Awareness Movement (GKSO) program is a program to improve the proper and correct management of antibiotic drugs (Djuria, 2019). The Drug Aware Family Movement program was previously launched by IAI, however providing this information was only by placing banners or posters in health facilities, especially pharmacies without providing specific and direct drug information to patients and the public (Dewi et al., 2019; Nugraheni et al., 2020).

Based on the survey, information was obtained that many lecturers at Sahid University, Surakarta, still keep medicine at home, both for stock and leftover medicine from doctors. Some members also have regular medications for chronic illnesses.The high level of drug storage at home and the lack of knowledge of lecturers regarding drug use can lead to the possibility of medication errors and increased inaccuracy of therapy. This requires education regarding the good and correct management of antibiotic drugs. Counseling or education about good management of antibiotic drugs It is hoped that lecturers at Sahid University Surakarta will understand the proper and correct use of antibiotic drugs so that treatment goals and quality of life can be achieved and will not cause environmental pollution due to incorrect disposal of drug waste.

This is what prompted researchers to conduct research on the effect of education on the level of knowledge and behavior regarding antibiotic drug management for lecturers at Sahid University, Surakarta. This research was also carried out as an effort to support the government program in implementing GERMAS.

2. METHODOLOGY

2.1 Research Design

This research uses a pre-experimental design research design with a pretest/posttest intervention design without control group. Before being given education, respondents will be given a (pretest) and after being given education about antibiotic management a (posttest) or measurement will be carried out again after being given the education.

2.2 Population and Sample Used

This research was conducted at Sahid University, Surakarta. The research was conducted in May 2023. The population in this study consisted of 20 respondents. The sampling

technique uses purposive sampling. This research variable consists of the independent variable, namely the influence of education on antibiotic management and the dependent variable in this research is knowledge and behavior regarding antibiotic drug management.

2.3 Data Collection Techniques

The sampling technique uses purposive sampling. Sampling in this study was based on inclusion and exclusion criteria. The inclusion criteria in this study were lecturers aged 25 years and over and less than 65 years, not experiencing hearing loss, and willing to be research respondents. Exclusion criteria in this study were lecturers who also worked as health workers or were basically health workers, and were not cooperative in research.

2.4 Tools and Instruments Used

Data were collected using a knowledge questionnaire on antibiotic drug management which contained 10 multiple choice questions and a drug use behavior questionnaire sheet. This questionnaire contained the respondent's behavior in using drugs, which consisted of 10 statements where there were 4 answer choices using a Likert scale. The questionnaire in this research was no longer tested for validity and reliability, because the instrument is standard and reliable which is commonly used and has a Cronbach's Alpha of 0.902 so it is feasible to carry out research.

2.5 Data Analysis

Data analysis was first conduct with a normality test, then a bivariate test Wilcoxon Statistical, after the data was collected, the completeness of the data was re-checked, data entry, tabulation and data analysis were conduct with the SPSS package program.

3. RESULTS AND DISCUSSION

3.1 Result

A. Respondents Characteristics

Based on table 1, it is found that the dominant number of characteristics based on gender is female at 70%, the highest age range is 25 to 30 years old at 55%, the highest level of education is master's level at 85%, for the study program category the number is evenly distributed at 20%.

Table 1. Distribution of Characteristics of FSHS Lecturer Respondents (n=20)

Respondent Characteristics	Frequency (f)	Percentage (%)
1. Gender		
Man	6	30
Woman	14	70
2. Age		
25-30 years	11	55
31- 40 years	9	45
3. Education		
S1	0	0
S2	17	85
S3	3	15
4. Study Program		
BusinessAdministration	4	20
Psychology	4	20
DKV	4	20
Design interior	4	20

Respondent Characteristics	Frequency (f)	Percentage (%)
Total	20	100

Source : Primary data (2023)

B. Level of Knowledge and Behaviour

Assessment of the level of knowledge and behavior of respondents is categorized into 3 categories. The level of knowledge is said to be good if the value is 76-100%, sufficient with a value of 56-75%, less with a value of 0-55%.

Table 2 shows the characteristics of the respondents based on the level of knowledge when the pre-test was carried out, as many as 10 respondents had knowledge in the poor category. At the time of the post-test there was an increase in the level of knowledge in the sufficient and good categories. This is because respondents looked for answers after taking the pre-test so that during the post-test the respondents changed their answers to the questionnaire so that the pre-test and post-test scores increased.

The behavior during the pre-test showed that the level of behavior was less than 12 respondents. After being given education on antibiotic drug management, behavior in the fair and good categories increased.Data normality using the Kolmogorov-Smirnov method resulted in the data not being normally distributed and continued with statistical tests using the Wilcoxon test. The results obtained were p value = 0.000 ($p<0.05$), so it can be said that there is a significant difference between the knowledge and behavior of respondents before and after providing education regarding the use of antibiotics.

Table 2. Level of Knowledge and Behaviour

Category	Knowledge				Behaviour			
	Pre		Post		Pre		Post	
	Freq	%	Freq	%	Freq	%	Freq	%
Good	2	10	9	45	1	5	6	30
Enough	8	40	9	45	7	35	8	40
Not Enough	10	50	2	10	12	60	6	30
Total	20	100	20	100	20	100	20	100

Source: Primary Data (2023)

C. The Wilcoxon Statistical Test

Table 3 shows the results that the Z score = 5.58 and 5.59 for knowledge and behavior while the p value = 0.001. With a p value = 0.001 < 0.05, H0 is rejected, which means that there is an influence of antibiotic drug management education on the level of knowledge and behavior of FSHS lecturers at Sahid University, Surakarta.

Table 3. Wilcoxon Test Analysis Knowledge and Behavior Levels

Item	Mean	SD	Z	P
Before Knowledge Education	26.99	2.47	5.58	0.001
After Knowledge Education	17.50	3.00		
Behavior before education	27.66	1.47	5.59	0.001
Behavior after education	15.34	4.01		

Source: Primary Data (2023)

3.2 Discussion

A. Respondents Characteristics

The characteristics of respondents based on gender showed that the results of the 20 respondents taken in the research were 14 female respondents who took part in this research, because at the time of data collection female respondents tended to be more enthusiastic about participating in this research. This is because women tend to care more about their own health, especially and the health of their families, compared to men who are more passive about their own health(Lestari, 2020).

Based on the characteristics of the respondents in terms of age, the ages in this study were respondents aged 25-64 years and were divided into 2 age groups, namely early adulthood (24-30 years), late adulthood (31-40 years). Data obtained from the control group for ages 25-35 years was 11 respondents (55%). From the results of these percentages, it can be seen that the majority of people who are willing to be respondents in this research are people in the early adulthood/young lecturer category, because a person's age influences a person's ability to understand.

This is in line with Tagum-Briones et al., (2023) research, the results of the research show that age influences a person's memory, and influences a person's responsibility to make decisions regarding treatment for themselves, so that on average, young people are more likely to be active.

At the level of education in this study, the results showed that the majority of respondents who took part in the research were at Master's level, namely 17 respondents (85%). The research conducted by Herawati et al., (2021) also showed that the level of education influences a person's knowledge. Lack of education causes a person's knowledge about the use of antibiotics to be inappropriate, where someone with low education tends to have low knowledge, whereas the higher the level of education, the better the knowledge they have (Novelni et al., 2020).

Based on the results of measuring the level of knowledge and behavior before and after being given education, the results showed that 10 respondents were still in the poor category and 12 respondents showed poor behavior during the pre-test. After being given education about antibiotic drug management, the level of knowledge of respondents increased. and the respondent's behavior was in the sufficient category when the post test was conduct. Research conducted by Abubakar et al., (2020) on undergraduate pharmacy students in their final year in Asia also showed that their knowledge about antibiotic drug resistance was sufficient, but knowledge about the use of antibiotic therapy was still poor, so there was a need for training on appropriate antibiotic therapy, and correct antibiotic management to increase their knowledge. This is in line with research by Meinitasari et al.,(2021) that providing education or training can increase a person's knowledge in managing the use of antibiotic drugs. The education delivered by lecture or seminar method with the aim of providing knowledge to the general public about antibiotic drug management (Pratiwi & Anggiani, 2020 ;Hajrin et al., 2020).

B. Bivariate Analysis

The effect of education on antibiotic management on the level of knowledge and behavior of FSHS lecturers at Sahid University, Surakarta, was that the Z score = 5.58 and 5.59 for knowledge and behavior, while the p value = 0.001. With a p value = 0.001 < 0.05, H0 is rejected, which means that there is an influence of DAGUSIBU education on the level of knowledge and behavior of FSHS lecturers at Sahid University, Surakarta. The results of this study are in line with research conducted by Saftia et al., (2024) which also shows that providing education about the use of antibiotics has an influence on people's knowledge and

behavior in using antibiotics. Research conducted by (Pratiwi & Anggiani, 2020) also concluded that providing education can increase knowledge about antibiotics. Previous research also showed that there was a significant relationship between knowledge and behavior of using antibiotics (Kondoj et al., 2020).

Research by Karuniawati et al., (2021) on the relationship between knowledge and attitudes towards the rationality of antibiotic use behavior at Sandi Karsa Hospital also shows the results of a significant relationship between knowledge and behavior of using antibiotics, the higher the knowledge, the higher the respondents use antibiotics rationally. Knowledge is an effort to develop personality and abilities inside or outside the home that lasts a lifetime. Education influences the learning process, the higher a person's education, the easier it is for a person to obtain information and if a person's education is low, it is difficult for a person to receive information and this can affect their attitudes and behavior (Hajrin et al., 2020).

4. CONCLUSION

It is necessary to disseminate knowledge regarding the management of antibiotic drugs so that the public better understands how to use drugs properly and correctly. Factors that influence a person's knowledge and behavior in managing antibiotics, apart from providing education or training, are also influenced by age, occupation and educational background.

REFERENCES

Abubakar, U., Muhammad, H. T., Sulaiman, S. A. S., Ramatillah, D. L., & Amir, O. (2020). Knowledge and self-confidence of antibiotic resistance, appropriate antibiotic therapy, and antibiotic stewardship among pharmacy undergraduate students in three Asian countries. *Currents in Pharmacy Teaching and Learning*, *12*(3), 265–273. https://doi.org/10.1016/j.cptl.2019.12.002

Dewi, A. P., Wardaniati, I., Pratiwi, D., & Valzon, M. (2019). Sosiologi Gerakan Masyarakat Cerdas Menggunakan Obat Di Desa Kumain Kecamatan Tsndun Kabupaten Rokan HuluHulu, Sosiologi Gerakan Masyarakat Cerdas Menggunakan Obat Di Desa Kumain Kecamatan Tsndun Kabupaten Rokan. *Psikologi Perkembangan*, *2*(2), 135.

Djuria, R. F. (2019). Peningkatan Pengetahuan Tentang Dagusibu Terhadap Kader Gerakan Keluarga Sadar Obat (Gkso) Desa Tanjung Gunung Bangka Tengah. *Jurnal Kesehatan Poltekkes Kemenkes Ri Pangkalpinang*, *6*(1), 33. https://doi.org/10.32922/jkp.v6i1.43

Duan, L., Liu, C., & Wang, D. (2021). The general population's inappropriate behaviors and misunderstanding of antibiotic use in China: A systematic review and meta-analysis. *Antibiotics*, *10*(5). https://doi.org/10.3390/antibiotics10050497

Dwiaini, I. (2022). The Effect Of Education On The Level Of Community Knowledge and Behavior About Antibiotic Dagusibu In Kurnia Selatan Sungai R. *Nusantara Hasana Journal*, *2*(5), 184–189.

Hajrin, W., Hamdin, C. D., Wirasisya, D. G., Erwinayanti, G. A. P. S., & Hasina, R. (2020). Edukasi Pengelolaan Obat Melalui DAGUSIBU untuk Mencapai Keluarga Sadar Obat. *INDRA: Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 5–7. https://doi.org/10.29303/indra.v1i1.3

Herawati, F., Jaelani, A. K., Wijono, H., Rahem, A., Setiasih, Yulia, R., Andrajati, R., & Soemantri, D. (2021). Antibiotic stewardship knowledge and belief differences among

healthcare professionals in hospitals: A survey study. *Heliyon*, *7*(6), e07377. https://doi.org/10.1016/j.heliyon.2021.e07377

Karuniawati, H., Hassali, M. A. A., Suryawati, S., Ismail, W. I., Taufik, T., & Hossain, M. S. (2021). Assessment of knowledge, attitude, and practice of antibiotic use among the population of boyolali, indonesia: A cross-sectional study. *International Journal of Environmental Research and Public Health*, *18*(16). https://doi.org/10.3390/ijerph18168258

Kumar, S. B., Arnipalli, S. R., & Ziouzenkova, O. (2020). Antibiotics in food chain: The consequences for antibiotic resistance. *Antibiotics*, *9*(10), 1–26. https://doi.org/10.3390/antibiotics9100688

Lestari, M. A. (2020). Pengaruh Edukasi Terhadap Tingkat Pengetahuan dan Perilaku Masyarakat Tentang Dagusibu (Dapatkan, Gunakan, Simpan, Buang) Antibiotik di Empat Lawang Sumatera Selatan. *Skripsi*, 23. http://hdl.handle.net/123456789/29437

Meinitasari, E., Yuliastuti, F., & Santoso, S. B. (2021). Hubungan tingkat pengetahuan terhadap perilaku penggunaan antibiotik masyarakat. *Borobudur Pharmacy Review*, *1*(1), 7–14. https://doi.org/10.31603/bphr.v1i1.4869

Novelni, R., Azyenela, L., & Septiana, Y. (2020). *Antibiotik Oral Di Apotek Kecamatan Koto*. *9*(2).

Noviani, L., Rachmawati, P., & Febrinella, C. (2024). The effects of DAGUSIBU education on the level of community knowledge in obtaining, using, storing, and disposing of drugs in West Java, Indonesia. *Pharmacy Education*, *24*(2), 93–98. https://doi.org/10.46542/pe.2024.242.9398

Nugraheni, A. Y., Ganurmala, A., & Pamungkas, K. P. (2020). Sosialisasi Gerakan Keluarga Sadar Obat: DAGUSIBU Pada Anggota Aisyiyah Kota Surakarta. *Abdi Geomedisains*, *1*(1), 15–21. https://doi.org/10.23917/abdigeomedisains.v1i1.92

Pratiwi, Y., & Anggiani, F. (2020). Hubungan Edukasi terhadap Peningkatan Pengetahuan Masyarakat pada Penggunaan Antibiotik di Kecamatan Jekulo Kabupaten Kudus. *Cendekia Journal of Pharmacy*, *4*(2), 149–155. https://doi.org/10.31596/cjp.v4i2.108

Tagum-Briones, J. M., Romero, C. B., De Villa, L. V., & Hisan, U. K. (2023). Knowledge, Attitudes, and Practices on Antibiotic Use. *Journal of Public Health Sciences*, *2*(01), 1–19. https://doi.org/10.56741/jphs.v2i01.212

The Successful Implementation of Kotter's 8-Step Change and PPM Transformation Model: Bluebird's Digital Transformation

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ABSTRACT

Bluebird is a well-known transportation company in Indonesia known for its quality service and reliable drivers. Bluebird has a vision that changes with the times. The realization of the potential owned by the company is the key to the successful transformation carried out by Bluebird when faced with digital ride-hailing and also the COVID pandemic. Bluebird's transformation capability is reflected in its soaring performance results until now. This research concludes, analysis of the organizational transformation model and the stages of transformation that have been carried out by Bluebird in realizing its success in digital transformation. Data from the company's financial statements, official news, and company interviews in trusted electronic media are used in this research. The results of this study prove that the company has fulfilled the transformation aspects and is ready and successful in carrying out digital transformation. From the transformation carried out by Bluebird, public awareness of Bluebird's existence has also increased.

KEYWORDS

kotter's 8 step change; PPM transformation model; digital transformation; bluebird

1. INTRODUCTION

In the past few decades, digital technology has brought profound changes and continues to evolve, affecting almost every aspect of human life such as communication, education and business. To adapt to current digital conditions, awareness of change, increased digital skills and literacy, equitable internet access, cyber security, digital transformation in organizations and businesses, digital education, and active participation in digital society are needed. (Herlambang & Fathoni, 2023) states that digitalization transforms conventional media into a process that allows data to be processed, created, sent, and received without time and space limits, and increases efficiency and effectiveness (Claretta & Riduwan, 2022)

Digital transformation involves the integration of digital technologies into every aspect and operation of an organization, which changes the way the organization operates and delivers value to its customers (McGrath & Maiye, 2010). Examples of digital transformation include digital solutions, migration to cloud computing, and the use of smart sensors to reduce operating costs. Changes in people's consumption patterns in the age of computers and the internet have led to an increase in activity in online markets and a decrease in conventional markets. Most online shoppers are young families with a monthly expenditure of at least 4 million rupiah.

Digital transformation strategies help companies increase productivity and adapt quickly to change. In Indonesia, digital change is also very important for the ride-hailing industry, such as the use of mobile phone-based applications to book rides and manage driver networks, which improves operational efficiency and customer satisfaction.

Bluebird, the oldest ride-hailing company in Indonesia with 23,000 drivers, has faced two major challenges: digital disruption and COVID-19. This research will explain that Bluebird has fulfilled the transformation aspects and is ready and successful in carrying out digital transformation using Kotter's 8-step change and PPM model transformation. From the transformation carried out by Bluebird, public awareness of Bluebird's existence has also increased.

2. METHODOLOGY

This research is descriptive qualitative in approach. Qualitative research, according to (Anggito & Setiawan, 2018), is defined as data collection in a natural setting with the interpretation of phenomena that occur, where the researcher serves as the main tool, and the analysis carried out is qualitative in nature to produce meanings that are different from generalizations. Descriptive research focuses on phenomena, their nature, and how and why things happen. The results of this research are written in descriptive form. Researchers used secondary data for this study. Secondary data is obtained indirectly through intermediary media, so that the researcher acts as a second party, not obtaining data directly. Secondary data can be obtained through various sources, such as books, websites, or government documents. This data is then used by researchers to understand the problems and analyze the problems in this study. Researchers ensure that the secondary data sources obtained come from trusted and credible sources in accordance with the facts. Data was obtained from electronic newspapers, company financial reports, official company websites, and formal company interviews on news sites.

3. RESULTS AND DISCUSSION

Online-based transportation began to appear in Indonesia in 2010, but only became popular among the public in 2015 with the launch of Android and iOS-based smartphone applications. Indonesia's largest taxi company, Bluebird, has been significantly impacted by the presence of online travel agencies such as Gojek and Grab. To address this challenge, Bluebird implemented various digitalization strategies, including the launch of a smartphone app for taxi booking that improved convenience and efficiency for customers.

Bluebird also introduced innovative programs such as Bluebird Pijakan, which uses motorcycles to reach locations that are difficult to reach by car. In addition, Bluebird works with other businesses, such as its collaboration with Gojek, to expand its reach and improve customer experience. Despite facing major disruptions, including protests from drivers due to the entry of online transportation, Bluebird continues to adapt. Bluebird management realizes that the company's mindset must change to face new competition. Despite having ANDAL values (Aman-Safe , Nyaman-Convenient, muDAh-easy, personaLized), the slogan was not strong enough to maintain their position. The company's focus then shifted to developing and promoting the MyBlueBird app, although it was not maximized at first.

During this period of change, Bluebird emphasized three main advantages: EZpay, on-off integration, and street presence. EZpay makes it easy to pay taxi fares by various methods, working with many banks and digital wallets in Indonesia. On-off integration allows drivers to manage passenger status, while Bluebird's street presence allows passengers to stop the taxi directly, something that online transportation cannot do. Despite facing threats from competitors who are innovative in promotions and discounts, Bluebird management still believes that by maintaining good service and innovation, they are able to compete and grow. They are committed to continue pursuing innovation for the betterment of the company.

With a focus on innovation, digitalization, and strategic alliances, Bluebird is implementing a multidimensional strategy to accelerate its digital transformation. One important step was the creation of a smartphone app for booking taxis, which helped modernize and expand the company's reach. Bluebird also continues to innovate in products and services. During the COVID-19 pandemic, Bluebird saw opportunities in logistics services by carrying goods instead of passengers. They launched a COD (Chat-Order-Delivery) program that allows ordering products and documents via WhatsApp. This service helped the company adapt to social distancing rules and remote work, which proved successful in several major cities in Indonesia.

Bluebird's management emphasizes that service quality is key to the company. They believe that the ability to adapt during PPKM (Pemberlakuan Pembatasan Kegiatan Masyarakat) is a critical success factor. The company's ANDAL values, which consist of one point of safety and three points of service, form the basis of their approach during the pandemic. To strengthen its position, Bluebird collaborated with other businesses, including a partnership with Gojek, to offer wider transportation options and improve customer experience. In addition, Bluebird provides extensive training to its drivers to maintain a competitive edge in an increasingly tight market.

Bluebird's transformation strategy is based on three main pillars: digitalization, innovation, and strategic alliances. By adopting these components, Bluebird is ready to overcome the challenges posed by COVID-19 and continue to offer high-quality services to its customers.

3.1. Transformation Model

3. 1. 1. PPM Transformation Model

The Organizational Transformation approach can be carried out using the PPM transformation model method. The following is an analysis and explanation of the 9 PPM Transformation Models carried out by Bluebird:

Table 1. PPM Transformation Model of Bluebird

No	Elements of PPM Transformation Model	Bluebird
1	Visionary Business Direction	Yes. The statement of business direction is clearly stated in the vision, namely "To be a company that is able to survive and prioritize quality to ensure sustainable prosperity for stakeholders". In addition, Bluebird clearly conveys and communicates the company's values to all stakeholders.
2	Readiness to Change	Yes. In managing changes for individual groups, Bluebird has employees who are willing to participate in change, with this changing mindset making Bluebird's strength to be able to transform. Within the scope of the organization, this change is also always conveyed by the Board of Directors from Bluebird to all its stakeholders. Active provision of information related to changes is carried out at every meeting with stakeholders. Not only that, Bluebird is able to provide training for employees related to services and the use of technology within the company.
3	Market Oriented	Yes. Because in Bluebird's vision, all efforts made by Bluebird in order to fulfill quality and in its mission are also conveyed that customer satisfaction is the main thing with all types of services and efficient resources, aimed at meeting market needs.
4	Responsive to External Environment	Yes. Bluebird already has a sustainability and innovation strategy to face challenges from the external environment. This is also evidenced by winning The Digital Transformer Appreciation at the IDC Digital Transformation Awards in 2020.
5	Operation Excellence	Yes. Good planning, control, operational and quality assurance processes have been carried out by Bluebird.

No	Elements of PPM Transformation Model	Bluebird
6	Strong Leadership	Yes. With the growth mindset brought by the Board of Directors, Bluebird is able to rise and change. There are even Top-Down and Bottom-Up principles in the journey of change. The Board of Directors has strong knowledge, confidence to move forward, and great energy to encourage stakeholders to grow and change.
7	Competent Personnel	Yes. Bluebird encourages an EAL attitude and a family culture. This is the source of change for Bluebird people. With skillful motives, dispositions, and abilities, Bluebird can get through difficult times and rise to make changes.
8	Risk Management	Yes. Bluebird did panic when facing competitors and the pandemic case that hit. However, on its way, Bluebird was able to anticipate existing risks and see future market developments by making innovations and integrating with other businesses.
9	Organizational Culture	Yes. Bluebird's organizational culture is known to be strong. There is no distance between the board of directors and other stakeholders. 95% of complaints from labor unions are known by the Board of Directors and become feedback and solutions. This certainly characterizes Bluebird with its culture.

Source: Prepared by Author's

3. 1. 2. Kotter's 8-Step Change

In carrying out the transformation, Bluebird carried out various activities and processes. These activities and processes are then analyzed in accordance with Kotter's stages of change. To provide an analysis of Kotter's eight stages of transformation that have been carried out by Bluebird, it is necessary to see how this company has responded to challenges in the transportation industry, especially with the emergence of application-based transportation services. The following is an analysis based on publicly available information. The following is an analysis of Kotter's stages of change for Bluebird:

Table 2. Kotter's 8-Step Change of Bluebird

No	Kotter's 8-Step Change	Bluebird
1	Establishing a Sense of Urgency	Bluebird realizes that the emergence of app-based transportation services such as Gojek and Grab pose a

No	Kotter's 8-Step Change	Bluebird
		serious threat to the company. Management understood that without change, the company would lose significant market share. Bluebird (even the CEO) communicated this threat to all levels of management and employees through regular meetings, and utilized market data to show the potential decline in conventional taxi services.
2	Creating a Guiding Coalition	Bluebird established a change team consisting of senior leaders and key managers who are committed to implementing change. This team is responsible for developing the transformation strategy and ensuring buy-in from all parts of the organization. The company also worked with external organizations to gain additional insights.
3	Developing a Vision and Strategy	Bluebird's original vision was to be a sustainable, quality-oriented company that ensures the sustainable well-being of all stakeholders. The company then developed a vision to be a leading and resilient transportation service provider that leverages technology to improve customer experience and stakeholder sustainability. This vision included the development of a mobile app for booking taxis, integration with digital services, working with payment and banking systems, and improved customer service. This strategy is widely communicated within the organization.
4	Communicating the Change Vision	Bluebird recognizes the importance of effective communication to gain support from all employees. It used various communication channels, including regular meetings, internal newsletters, and corporate social media, to explain the vision and change strategy. Bluebird also held training sessions to ensure all employees understood and supported the new vision.
5	Empowering Employees for Broad-Based Action	Bluebird identified key barriers to the adoption of new technology and more flexible business processes. The company changed the organizational structure to better support innovation, provided technology training to drivers and staff, and updated the incentive system to encourage performance in line with the new vision.
6	Generating Short-Term Wins	To demonstrate the benefits of change, Bluebird set short-term targets that could be achieved in a short period of time. Launching the Bluebird app that allows customers to book a taxi via smartphone. Conducted a promotional campaign highlighting the ease and advantages of using the app. The successful launch of the app provided a

No	Kotter's 8-Step Change	Bluebird
		morale boost for employees and increased customer confidence.
7	Consolidating Gains and Producing More Change	Bluebird ensures that the changes it has made do not stop at initial success. Continuing to develop new features in the application, such as digital payment options and integration with other services. Bluebird also continues to collect feedback from customers and employees to improve services.
8	Anchoring New Approaches in the Culture	Bluebird strives to make these changes a permanent part of the company culture. Incorporating the values of innovation and customer orientation into new employee training, updating SOPs (Standard Operational Procedures) to reflect the new way of working, and recognizing and rewarding employees who contribute to the success of the transformation.

Source: Prepared by Author's

4. CONCLUSION

To face the challenges posed by the disruption of application-based transportation services and the COVID-19 pandemic, Bluebird has taken strategic steps. The journey is not easy, various efforts are made to face these two big challenges. In running its business, Bluebird continues to stagnate and close its eyes to the triggers of change. Adaptation and changes made have succeeded in delivering Bluebird to become a company with a large number of fleets and spread everywhere. The main changes made are developing and launching mobile applications that make it easier for customers to order taxis, pay digitally, and access additional services. Not only that, Bluebird expanded its service portfolio, including delivery of goods and collaboration with various digital platforms to improve their offerings. This move helps Bluebird compete with more modern and technological app-based services. The change process carried out by Bluebird has also been in accordance with the PPM organizational change model and Kotter's 8 stages of change. This is what makes Bluebird stronger and able to face changes and survive in the current era in accordance with its vision of becoming a company that is able to survive and provide sustainability.

REFERENCES

Alvian, D. (2023). *Spire Insights: Mengungkap Industri Ride-Hailing di Indonesia.* Technobusiness.Id.

Amriadi, A., Fatma, F., & Suldani, M. R. Y. (2023). *Strategi Komunikasi Pemasaran PT Blue Bird Dalam Menghadapi Persaingan Dengan Taksi Online Di Makassar*. *1*(1), 11–19.

Anggito, A., & Setiawan, J. (2018). *Metodologi penelitian kualitatif*.

Bluebird. (2022). *Annual report 2022*.

Bluebird. (2023). *Annual Report 2023*.

Claretta, & Riduwan. (2022). Strategi Humas SSC Kacapiring Surabaya Dalam Era Digitalisasi Pada Pandemi Covid-19. *Jurnal Ilmu Komunikasi Dan Media Sosial*.

Fernandez-Vidal, J., Antonio Perotti, F., Gonzalez, R., & Gasco, J. (2022). Managing digital transformation: The view from the top. *Journal of Business Research*, *152*, 29–41. https://doi.org/10.1016/J.JBUSRES.2022.07.020

Gong, C., & Ribiere, V. (2021). Developing a unified definition of digital transformation. *Technovation*, *102*, 102217. https://doi.org/10.1016/J.TECHNOVATION.2020.102217

Gregory, V. (2021). Understanding Digital Transformation. In *Managing Digital Transformation* (1st ed.).

Herlambang, S., & Fathoni, M. S. (2023). Pengaruh Penggunaan Teknologi Digital Terhadap Efektivitas Pelayanan Kenaikan Pangkat Di Badan Kepegawaian Daerah (BKD) Propinsi Daerah Istimewa Yogyakarta. *JURNAL EKONOMI, MANAJEMEN PARIWISATA DAN PERHOTELAN*, *2*(2).

Iivari, N., Sharma, S., & Ventä-Olkkonen, L. (2020). Digital transformation of everyday life – How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care? *International Journal of Information Management*, *55*, 102183. https://doi.org/10.1016/J.IJINFOMGT.2020.102183

Kang, S. P., Chen, Y., Svihla, V., Gallup, A., Ferris, K., & Datye, A. K. (2020). Guiding change in higher education: an emergent, iterative application of Kotter's change model. *Studies in Higher Education*, *47*(2), 270–289.

Kraus, S., Durst, S., Ferreira, J. J., Veiga, P., Kailer, N., & Weinmann, A. (2022). Digital transformation in business and management research: An overview of the current status quo. *International Journal of Information Management*, *63*, 102466. https://doi.org/10.1016/J.IJINFOMGT.2021.102466

Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research*, *123*, 642–656. https://doi.org/10.1016/J.JBUSRES.2020.10.033

McGrath, K., & Maiye, A. (2010). The role of institutions in ICT innovation: Learningfrom interventions in a Nigerian e-government initiative. *Information Technology for Development*, *16*(4), 260–278.

Putri et al. (2019). Driving Digital Business Transformation on Coopetition Business Model in the Revolutionary Era 4.0 in Indonesia:Case Study Blue Bird and GO-JEK. *International Conference on Science and Technology*.

Qonita et al. (2022). Porter's Generic Strategies: A Case Study of The Transition of Indonesian Conventional Taxi Company to An Online. *The 5th European International Conference on Industrial Engineering and Operations Management*.

Sibanda, M., Moyo, E., Dzinamarira, T., & Murewanhema, G. (2024). Application of Kotter's 8-steps model to reduce maternal mortality due to third delay in sub-Saharan Africa. *International Journal of Africa Nursing Sciences*, *20*, 100651. https://doi.org/10.1016/J.IJANS.2023.100651

Sukawati, N. K. S. A., Wirasutama, C. P., Oktarianingtyas, D., & Intan. (2021). Analisis Minat Masyarakat Terhadap Pemilihan Moda Transportasi (Studi Kasus : Taksi Online (Grab) Dan Taksi Konvensional (Blue Bird)). *Jurnal Ilmiah Vastuwidya* , *4*(2), 08–13.

Tim Penulis PPM. (2017). *Model Transformasi Indonesia*. Penerbit PPM.

Wang, Z., & Li, S. (2024). Competition between autonomous and traditional ride-hailing platforms: Market equilibrium and technology transfer. *Transportation Research Part C: Emerging Technologies*, *165*, 104728. https://doi.org/10.1016/J.TRC.2024.104728

Zaoui, F., & Souissi, N. (2020). Roadmap for digital transformation: A literature review. *Procedia Computer Science*, *175*, 621–628.

Multiple Representations in The Context of Education in The 21st Century

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ABSTRACT

Multiple representation is an important part of practically any human experience. Literature is being extensively used to study how important multiple representations are for pupils' in understanding a concept. Moreover, we explored whether particular traits in this group were related to participants, the physics concepts, or multiple representation. The eligibility requirements have been encountered in 47 articles studies from Scopus and WoS indexed articles. The review examined the Springer, Sage, Elsevier, Willey, relevant journals using a qualitative research technique. We conducted a search to find papers published from 2019 to 2024. Then, we use descriptive statistics and content analysis to analyse the data. Our qualitative content analysis revealed five key themes: multiple representations, external representations, and multiple representations in physics. The categories and frequencies have each been examined separately. We have been assessed the research's inadequacies in order to direct future efforts toward a deeper comprehension of physics phenomena. In the current reformation of physics education, multiple representation has been highlighted as a new trend in understanding a concept. As a result, the findings of this study may be used as a starting point for all stakeholders involved in physics education in the future, notably educators, professors, and researchers.

KEYWORDS

education; multiple representations; physics; research

1. INTRODUCTION

This paper employed a systematic literature review technique. A total of 47 articles were discovered from various sources such as Sage, Elsevier, Springer, Eric, etc. Nonetheless, several papers were directly searched from particular the journal since they could not be found in such database. All study was eligible since it was written in English, had Scopus/WoS indexed, and was published after 2019. Articles that accomplish the requirements have been implemented in mechanics, kinemathics, fluids, energy, and optics.

To assist understudies procure, get it, and apply arithmetic and characteristic science concepts, teachers regularly utilize and combine outside information representations. Outside representaions come in different designs, such as writings, manipulatives, activitys, sounds, pictures, charts, or equations. Distinctive outside representations may serve distinctive points (Ainsworth, 2006)they may too evoke distinctive learning forms and in this way influence what is learned (Belenky & Schalk, 2014; Lampinen & McClelland, 2018). Educational and mental analysts have broadly examined how to display, combine, and grouping numerous outside representations (MERs) to optimize learning.

This research presents a systematic literature review analysis of 47 publications published during 2019 and indexed by Scopus and WoS. The results of articles that satisfy the criteria of four keywords: multiple representation, multiple external representation, MR, and MER. An additional criterion that is the primary consideration is multiple representation in physics learning. All of the articles analysed positively influenced student learning outcomes, especially in learning physics.

This investigation aimed to map the research landscape on physics problem-solving from kindergarten to higher education after 2019. This study addresses the following research problems:

a) What is the current publishing trend in MR findings in physics?
b) What is the geographical distribution of articles published and the pattern of partnership among countries in findings related to MR in the context of physics?
c) What are the participants in MR in physics?
d) What are the research areas in MR in physics?

2. METHODOLOGY

Research Design A systematic literature review was employed as the research strategy in this study (Petticrew & Roberts, 2006). We selected 49 articles from prestigious journals published after 2019. Scopus and Web of Science index all the journals chosen (WoS). Since Scopus and Web of Science (WoS) are recognized journal indexers. The papers published on Scopus and the Web of Science (WoS) are likewise of high quality and may be accounted for. This study's purpose is to review 47 papers on problem-solving skills in physics education.

Research Procedure The review process for this study included seven steps: (1) defining the research issues (issue: multiple-representation); (2) defining the eligibility requirements (table 1); (3) generating the review protocol; (4) searching, screening, and selecting (figure 1); (5) evaluating and interpreting; (6) producing the article; and (7) publication (Bennett; et al., 2005; Borrego et al., 2014). The steps of the review process are explained in Figure 3. Inclusion criteria: The paper has been published in a peer-reviewed journal in English, the paper reports empirical and original study, the paper is in the area of

problem-solving on physics education research, and the papers have been published in Scopus indexed journals or WoS.

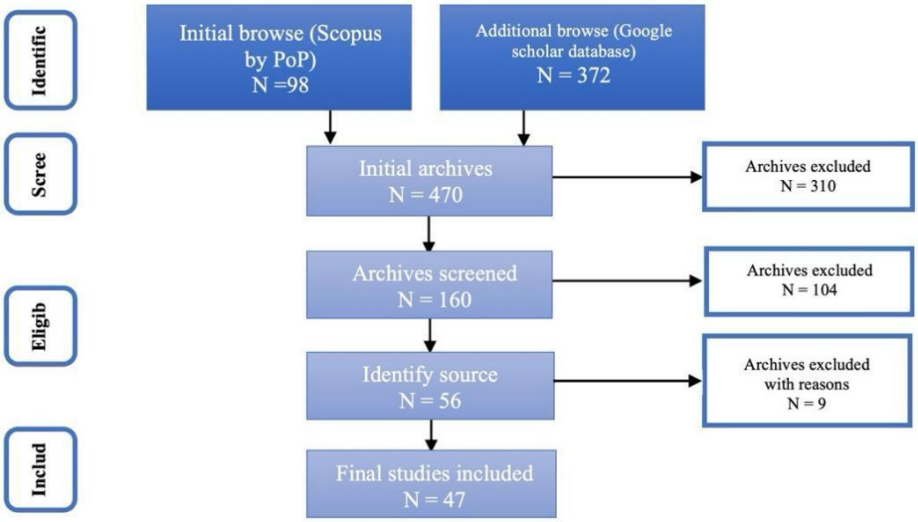

Figure 1 Flowchart of the review process

Data Collection The articles selected for review were issued from March 2019 to April 2024. The highly-regarded publishers chosen are Springer, ERIC, Taylor & Francis, Wiley, Elsevier, Emerald, Sage, etc. We likewise searched for papers on the websites of international journals. The keywords utilized were: "multiple representations," "external representation," "multiple representations on physics learning," and "Physics multiple representations" in physics education. There were about 591 articles found. However, only 47 articles met our research criteria. The shortlisted journals for review are to be found in Table 2. From Table 2, it shows that out of 24 international journals indexed by both Scopus and WoS, 8 are indexed by Scopus only, and the remaining one is indexed by WoS only. Therefore, it can be concluded that the articles chosen for this study are of good quality.

Table 1 The distribution of research based on the database

No	Journal Name	Σ	Indexed by	H-Index 2024	Country
1	Physical Review Physics Education Research (Q1)	5	Scopus & WoS	42	United States
2	International Journal of Science Education (Q1)	3	Scopus & WoS	126	United Kingdom
3	Learning and Instruction (Q1)	2	Scopus & WoS	144	United Kingdom
4	Journal of Educational Computing Research (Q1)	2	Scopus & WoS	76	United States
5	Frontiers in Psychology (Q2)	2	Scopus & WoS	184	Switzerland
6	Eurasia Journal of Mathematics, Science and Technology Education (Q2)	2	Scopus	56	Turkey

7	Research in Science Education (Q1)	2	Scopus & WoS	67	Netherlands
8	Education sciences (Q2)	2	Scopus & WoS	53	Switzerland
9	International Journal of Information and Education Technology (Q3)	2	Scopus	17	Singapore
10	European Journal of Physics (Q2)	2	Scopus & WoS	57	United Kingdom
11	International Journal of Instruction	1	WoS	-	Switzerland
12	Journal of Science Education and Technology (Q1)	1	Scopus & WoS	80	Netherlands
13	International Journal of Educational Research (Q1)	1	Scopus & WoS	80	United Kingdom
14	Educational Psychology Review (Q1)	1	Scopus & WoS	142	United States
15	International Journal of Evaluation and Research in Education (Q3)	1	Scopus & WoS	21	Indonesia
16	School Science and Mathematics (Q2)	1	Scopus & WoS	54	United States
17	European Journal of Science and Mathematics Education (Q3)	1	Scopus	7	Cyprus
18	Journal of Turkish Science Education (Q2)	1	Scopus	25	Turkey
19	Mathematics Education Research Journal (Q1)	1	Scopus & WoS	41	Netherlands
20	European Journal of Educational Research (Q2)	1	Scopus	24	Netherlands
21	Computers & Education (Q1)	1	Scopus & WoS	232	United Kingdom
22	Information (Q2)	1	Scopus & WoS	59	Switzerland
23	Frontiers in Education (Q2)	1	Scopus & WoS	40	Switzerland
24	Applied Intelligence (Q2)	1	Scopus & WoS	95	Netherlands
25	Symmetry (Q2)	1	Scopus	90	Switzerland
26	Journal of Computer Assisted Learning (Q1)	1	Scopus & WoS	114	United Kingdom
27	Teaching Exceptional Children (Q2)	1	Scopus & WoS	19	United Kingdom
28	Kasetsart Journal of Social Sciences (Q3)	1	Scopus	28	Thailand
29	Mathematical Thinking and Learning (Q1)	1	Scopus & WoS	33	United States
30	Policy Futures in Education (Q2)	1	Scopus & WoS	30	United Kingdom

31	Journal of Mathematical Behavior (Q1)	1	Scopus & WoS	58	United States
32	International Journal of Learning, Teaching, and Educational Research (Q3)	1	Scopus	18	Mauritius
33	CBE Life Sciences Education (Q1)	1	Scopus & WoS	90	United States

According to Table 2, the 47 articles we examined, came from 33 different journals, with details: 5 articles came from Physical Review Physics Education Research; 3 articles came from International Journal of Science Education; 2 articles each came from 8 journals namely (1) Learning and Instruction, (2) Journal of Educational Computing Research, (3) Frontiers in Psychology, (4) Eurasia Journal of Mathematics, Science and Technology Education, (5) Research in Science Education, (6) Education sciences, (7) International Journal of Information and Education Technology, (8) European Journal of Physics; and the last 1 article each came from the remaining 23 journals. These journals are published in various nations including United States, United Kingdom, Switzerland, Netherlands, Turkey, Singapore, Indonesia, Cyprus, Thailand, and Mauritius. All journals selected may be viewed in Scimago Journal & Country Rank (scimagojr.com). Based on Scimago Journal & Country Rank, the journals have a high H-index.

Data Analysis The data gathered in this research were evaluated descriptively. Using the predefined research framework, we categorized the data into tables and figures. The data was then thoroughly examined and synthesized with past studies. This investigation aims to look at the allocation of research based on content characteristics, projects, and discussed subjects, as well as the benefits of multiple representation in education especially physics.

3. RESULTS AND DISCUSSION

3.1. Results

The distribution of research based on research trends Figure 2 is a bar graph depicting the distribution of year publications from 2019 to 2024. During this period, most records were released in 2020 (34%), followed by 2023 (21%) and 2022 (19%). The number of multiple representation studies conducted in 2021 and 2024 is the same (11%). The last 4% of articles published in 2019.

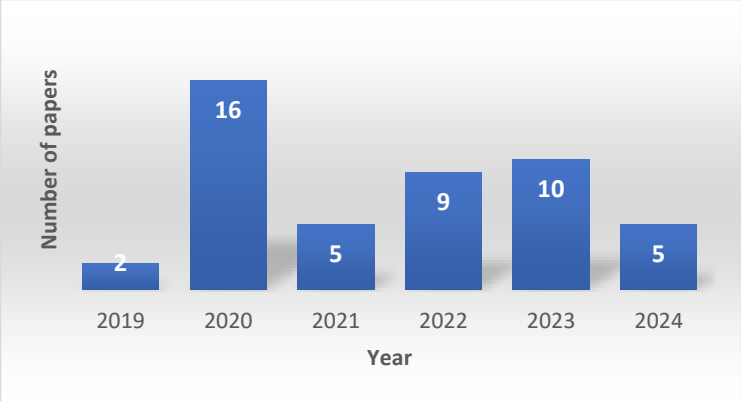

Figure 2 The distribution of research based on research trends

The number of published papers increased dramatically in 2020. The number of publications in 2020 (n = 16) increased eightfold from the previous year, namely 2019 (n =

2). A cumulative frequency graph was created to represent the growth trend of publications. This curve decreased quite drastically in 2021 (n = 5) but increased gradually in 2022 (n = 2022) and 2023 (n = 10). In 2024, it can be seen that the curve has decreased again (n = 5). However, because we only examined articles up to April 2024, we estimate that articles related to multiple representation will be widely studied and published by researchers, so that the trend in the number of publications related to this study will appear to increase at the end of 2024 compared to 2023. This shows that the expansion of research on multiple representations in physics education was quite moderate between 2018 and 2021. Nonetheless, there was a remarkable increase in research after 2022.

The distribution of research based on Geographical Data Figure 3 depicts the geographical distribution of the publications. The author's affiliations were used to identify the nations. The map's color coding indicates the distribution by the number of publications in each country. The darkest shade represents the most publications, and as the number of articles diminishes, the color lightens. The publications were spread across many regions.

Figure 3 The distribution of research based on Geographical Data

Figure 3 depicts a map with 22 nations from the Americas (n=5 countries), Asia (n=4 countries), Europe (n=11 countries), Africa (n=1), and Australia (n=1), colored with varying intensities. The countries with the highest number of authors are Germany (n = 35), which has the darkest color, Indonesia (n = 26), and the United States (n = 22). Australia is the following country with the most significant number of authors (n = 7). This number is quite far from the United States, the third country with the most significant number of authors. Meanwhile, the remaining 18 countries have several authors that vary from 5 to 1 author, such as Mexico.

The distribution of research based on the educational stage The distribution of research based on education level can be seen in Table 3. Multiple representation in physics education research starts from kindergarten, elementary school, high school, university, and even teachers. Multi-representational research has been conducted at all levels of education. Most of the research was conducted at the university level, with 17 articles. Meanwhile, ten articles with middle school participants, 7 with high school participants, 5 with elementary school participants, 4 with teacher participants, and 1 with kindergarteners participants.

Meanwhile, the remaining three articles had elementary, middle, and high school participants. Table 2 shows fewer studies regarding dual representation at the primary and secondary school levels in the last five years. Although there has been research at the elementary school level, there has been no research at all grade levels. Therefore, multiple representations in physics learning must be explored further in elementary and middle schools.

The distribution of research based on content Almost all content in physics is related to human life. Table 3 reveals the data that earlier researchers have investigated. In addition, Table 3 presents the level of education and the number of participants seen in the articles analyzed.

Table 2 The distribution of research based on the content

No	First Author, year	Content	Education stage (n)
1	Chusni, 2022	Global warming	60 Junior high school students
2	Hochberg, 2020	Pendulum movements	52 Senior high school students
3	Becker, 2020	Uniform motion	286 Senior high school students
4	Jiang, 2021	Heat and temperature	70 Junior high school students
5	Hahn, 2023	Vector field	113 College students
6	Leisen, 2023	Force	867 6^{th}, 8^{th}, and 10^{th} grade students
7	Yinka, 2020	Projectiles and equilibrium of forces	324 Senior high school
8	Munfaridah, 2020	Electricity	College students
9	Kokkonen, 2020	Direct current (DC) circuit	4th, 5th, and 6th grade students
10	Erlina, 2023	Intermolekular forces	82 College students
11	Munfaridah, 2021	Thermodynamics	61 First-year preservice teachers
12	Conceição, 2021	Kinetic Energy	15 preservice teachers
13	Kohnle, 2020	Quantum mechanics	163 College students
14	Lucas, 2019	Mechanics	43 High school Students
15	Campos, 2020	Electric field	146 College students
16	Tomkelski, 2023	Ohm's law	4 Physics teachers
17	Abdurrahman, 2019	Energy	74 Junior high school students
18	Post, 2022	Quantum mechanics	Senior high school students
19	Mansyur, 2022	Static Fluid	6 Primary school students, 16 junior high school students, 19 senior high school students, and 16 college students

20	Nielsen, 2022	Optics	Preservice primary teacher
21	Xu, 2021	Optics	70 Primary school students
22	Liaw, 2020	Kinematics	145 College students
23	Flegr, 2023	Optics	202 Junior high school
24	Burgin, 2022	Energy	College students
25	Kokkonen, 2022	Magnetic flux	70 Senior high school students
26	Guentulle, 2024	Motion and force	49 Senior high school students
27	Geller, 2022	Diffusion	64 College students
28	Hahn, 2023	Vector field	138 College students
29	Rahmayani, 2024	Renewable energy	Senior high school students
30	Zheng, 2020	Latent specific characteristic	College students
31	Hahn, 2024	Vector field	190 College studentes
32	Koerfer, 2024	Entropy and temperature	25 College students
33	Bley, 2023	Quantum mechanics	College students
34	Alfianti, 2023	Direct current (DC) circuit	20 Senior high school students
35	Susac, 2023	Free fall, Newton's law, conservation of energy, oscillation, photoelectric effect	38 Senior high school students
36	Åhman, 2020	Heat and temperature	45 Primary school students
37	Jokić, 2020	Absolute value	226 College students
38	Malone, 2020	Linear systems of equation	63 Junior high school students
39	Jitendra, 2022	Multiplication and division	Primary school students
40	Wilson, 2021	Science	744 Primary school students
41	Chusni, 2023	Environmental change	60 Junior high school students
42	Johnson, 2020	Motion and force	College students
43	Matthews, 2022	Universal design for learning	Junior high school students
44	Zentgraf, 2024	Shape	14 Second language students
45	Vogt, 2020	Signaling principle	124 College students
46	Bakar, 2020	Concept of addition	2 pre-school students
47	Hansen, 2020	Cell division	89 Pre-service teachers, 211 adult non-educator,

	and 385 middle school students

Table 3 depicts the different forms of physics topics researched in prior research. Most of these studies concentrate on mechanical issues such as Newton's law, collision, energy, work, moment of inertia, force, simple harmonic motion, and kinematics. Furthermore, several studies are in the study of thermodynamics and electric magnets. Based on the 47 articles we examined, 38 were in the field of physics while 9 were in other fields such as computer science, mathematics, biology, and chemistry.

3.2. Discussion

This study focuses on 47 articles from internationally renowned journals on problem-solving in physics education. This study aims to take a peek at the distribution of research based on research trends, geographical data, educational stage, and content. A literature review study that analyses the distribution of research based on content parameters is consistent with past research (Winarno et al., 2020). One of the most crucial components of conducting a literature review study is analyzing the distribution of research based on the predominant characteristics of the content (Mohammadi et al., 2019; Torregrosa et al., 2023; Winarno et al., 2020).

Research on multiple representations in physics education found 47 articles since 2019. Most of the research was studied in 2020 by previous research. Research from 2021-2023 has increased. The number of articles published by Physical Review Physics Education Research since 2020, 2021, and 2022 are 124, 119, and 115 articles. This may be due to the spread of Covid-19, which limits research activities. In 2021, only eight articles were found in Scopus and WoS-indexed journals. In 2021, it is estimated that the cause is the spread of COVID-19, which makes it difficult for researchers to conduct research. Another reason is that research funds are diverted to procuring public health facilities and infrastructure (Harper et al., 2020; Pokhrel & Chhetri, 2021). However, it is evident that as time develops after COVID-19, the number of studies is increasing. It is estimated that even 2024 will experience an increase from previous years. The main criteria in searching for articles are that they come from Scopus-indexed journals and WoS-indexed Journals. Therefore, the articles reviewed were of good quality.

The distribution of authors came from 22 countries, namely Germany, Indonesia, the United States, Nigeria, Netherlands, Finland, Switzerland, Portugal, Malaysia, Nebraska, Mexico, Chile, Spain, Brazil, Australia, Taiwan, Sweden, Denmark, Croatia, Serbia, United Kingdom, and China. Of the 147 authors, 45% were from Europe, 27% were from Asia, 21% were from America, 5% were from Australia, and the remaining 2% were from Africa. Research on multiple representations is mostly studied by researchers from Europe, with the largest number of authors coming from Germany, namely 35. Physical Review Physics Education Research journal that accepts the scope of research related to multiple representations and is indexed by Scopus Q1. This is in line with the distribution of journals in Table 2 as many as five articles come from these journals. Research on multiple representations in physics education has been minimal in Australia and Africa over the past 5 years. Due to national lockdown laws, several research projects were stopped or abandoned in African higher education (Sonn et al., 2021). In addition, researchers from the African continent do not seem to be interested in problem-solving topics, especially in physics learning. This is evident from the search results on Google Scholar with the keyword multiple

representations in physics in Africa. The search results show no more than ten articles that discuss the topic.

This study used students from 4 levels of education, namely elementary school, middle school, high school, and college, as well as teachers. Participants from elementary school had an age range of 10-12 years, junior high school had an age range of 12-16 years, senior high school had an age range of 16-18 years, and college had an age range of 18-35 years. 36% of the submitted articles examined multiple representations of physics at the college level. Since the participants came from all levels of education, the physics context discussed ranged from basic to complex. In the presentation of problems by physics teachers, the material should have been learned and understood by students (Docktor et al., 2016; Sormunen et al., 2020). Most of the research presented examines how successful multiple representations are in achieving success in learning; of course, the forty-seven articles mostly use different methods—ranging from multiple representations in the form of images, symbols, and videos to applications. Students need to apply multiple representations to what they learn in high school and college to overcome the problems they face in the learning process. The higher the level of education, the more complex the material studied. Perhaps this is why the context of multiple representations is widely researched at the university level. Therefore, further research is recommended to examine students' multiple representations' success at the middle and elementary school levels.

The physics materials covered are mechanical topics such as Newton's law, collision, energy, work, moment of inertia, force, simple harmonic motion, and kinematics. Furthermore, there are several studies in the study of thermodynamics and electric magnets. Based on the 47 articles we examined, 38 were in the field of physics while nine were in the other fields such as computer science, mathematics, biology, and chemistry. This is in line with the survey results of (Heller et al., 1992), who said that most of the goals of students enrolling in physics majors are to learn the basic principles of physics and reduce misconceptions about physical phenomena. Some materials go beyond physics, such as computer science, biology, chemistry, and mathematical applications.

4. CONCLUSION

One aspect that is an essential factor in realizing success in learning is the material presented. Along with the times, each student's acceptance of material is increasingly complex, starting from being based on learning speed to the most common one, which is based on learning style. In this case, the implementation of multiple representations is needed. Therefore, it is imperative to conduct a systematic literature review. This study examined the quality of materials using trend research, geographic data, education level, and content. Based on the study findings, 47 publications published between 2019 and 2024 were selected for review. As Scopus and WoS indexed them, all the selected papers were of high quality. Multiple representation has been widely applied in various countries and continues to grow every time due to its success. In addition, multiple representation is also used in learning in various subjects and even different levels of education. This research examines the spread of research topics while applying multiple representations in education, especially in physics lessons. Multiple representation has been identified as a new trend in education reform.

Moreover, multiple representation is also one of the foundations of the emerging learning philosophy of differentiated instruction. Therefore, the findings of this study can be used as a starting point for all stakeholders involved in education, especially educators, lecturers,

and researchers in the future. In addition, in physics education, multiple representations can be used as one of the alternative learning strategies for understanding various formulas, graphs, and symbols in each material. Therefore, we recommend applying multiple representations in understanding physics materials with issues that previous researchers have not discussed. Further research can clarify research related to the ability to understand multiple representations in physics education.

REFERENCES

Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. Learning and Instruction, 16(3), 183–198. https://doi.org/10.1016/j.learninstruc.2006.03.001

Belenky, D. M., & Schalk, L. (2014). The Effects of Idealized and Grounded Materials on Learning, Transfer, and Interest: An Organizing Framework for Categorizing External Knowledge Representations. Educational Psychology Review, 26(1), 27–50. https://doi.org/10.1007/s10648-014-9251-9

Bennett;, J., Lubben, F., Hogarth, S., & Campbell, B. (2005). Systematic reviews of research in science education: rigor or rigidity? International Journal of Science Education, 27(4), 387–406. https://doi.org/10.1080/0950069042000323719

Borrego, M., Foster, M. J., & Froyd, J. E. (2014). Systematic Literature Reviews in Engineering Education and Other Developing Interdisciplinary Fields. Journal of Engineering Education, 103(1), 45–76. https://doi.org/https://doi.org/10.1002/jee.20038

Docktor, J. L., Dornfeld, J., Frodermann, E., Heller, K., Hsu, L., Jackson, K. A., Mason, A., Ryan, Q. X., & Yang, J. (2016). Assessing student written problem solutions: A problem-solving rubric with application to introductory physics. Physical Review Physics Education Research, 12(1), 10130. https://doi.org/10.1103/PhysRevPhysEducRes.12.010130

Harper, L., Kalfa, N., Beckers, G. M. A., Kaefer, M., Nieuwhof-Leppink, A. J., Fossum, M., Herbst, K. W., & Bagli, D. (2020). The impact of COVID-19 on research. Journal of Pediatric Urology, 16(5), 715–716. https://doi.org/10.1016/j.jpurol.2020.07.002

Heller, P., Keith, R., & Anderson, S. (1992). Teaching problem-solving through cooperative grouping. Part 1: Group versus individual problem solving. American Journal of Physics, 60(7), 627–636. https://doi.org/10.1119/1.17117

Lampinen, A. K., & McClelland, J. L. (2018). Different presentations of a mathematical concept can support learning in complementary ways. Journal of Educational Psychology, 110(5), 664–682. https://doi.org/10.1037/edu0000235

Mohammadi, V., Rahmani, A. M., Darwesh, A. M., & Sahafi, A. (2019). Trust-based recommendation systems in Internet of Things: a systematic literature review. Human-Centric Computing and Information Sciences, 9(1), 21. https://doi.org/10.1186/s13673-019-0183-8

Petticrew, M., & Roberts, H. (2006). How to Find the Studies: The Literature Search. In Systematic Reviews in the Social Sciences (pp. 79–124). https://doi.org/https://doi.org/10.1002/9780470754887.ch4

Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. Higher Education for the Future, 8(1), 133–141. https://doi.org/10.1177/2347631120983481

Sonn, I. K., Du Plessis, M., Jansen Van Vuuren, C. D., Marais, J., Wagener, E., & Roman, N. V. (2021). Achievements and challenges for higher education during the covid-19 pandemic: A rapid review of media in africa. International Journal of Environmental Research and Public Health, 18(24). https://doi.org/10.3390/ijerph182412888

Sormunen, K., Juuti, K., & Lavonen, J. (2020). Maker-Centered Project-Based Learning in Inclusive Classes: Supporting Students' Active Participation with Teacher-Directed Reflective Discussions. International Journal of Science and Mathematics Education, 18(4), 691–712. https://doi.org/10.1007/s10763-019-09998-9

Torregrosa, J., Bello-Orgaz, G., Martínez-Cámara, E., Ser, J. Del, & Camacho, D. (2023). A survey on extremism analysis using natural language processing: definitions, literature review, trends, and challenges. Journal of Ambient Intelligence and Humanized Computing, 14(8), 9869–9905. https://doi.org/10.1007/s12652-021-03658-z

Winarno, N., Rusdiana, D., Samsudin, A., Susilowati, E., Ahmad, N. J., & Afifah, R. M. A. (2020). Synthesizing Results from Empirical Research on Engineering Design Process in Science Education: A Systematic Literature Review. Eurasia Journal of Mathematics, Science and Technology Education, 16(12), 1–18. https://doi.org/10.29333/ejmste/9129

Removal Of Turbidity Using Papaya Seed As A Natural Coagulant

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ABSTRACT

This research aims to use papaya seeds to make a Natural Coagulant. Natural coagulants are compounds that can cause coagulation in liquids, particularly in water treatment procedures, and can be derived from plant, animal, or microbiological sources. This particular substance was selected based on research showing it to be an effective coagulant in the water treatment process. The objectives of this project are to create non-chemical coagulants using natural resources like papaya seeds, create ecologically friendly coagulants from these materials, and measure the turbidity of water samples after utilizing these plant materials. Papaya seeds should then be dried, ground into smaller bits, and extracted. Filtering should be completed following extraction. Papaya seeds were used in three separate ratio tests. When the three papaya seed amounts are ready, they will be measured in quantities varied to approximate six beakers full of sample water from Lake Sultan Idris Shah Polytechnic for the jar test procedure. The papaya seeds will be extracted using 50 ml of distilled water. Of the three papaya seed ratios, the lowest turbidity value is 3.45 NTU for 10 grams, 1.77 NTU for 12 grams, and 4.97 NTU for 14 grams. The primary finding of this experiment is that papaya has qualities that can reduce the amount of turbidity in water. In conclusion, papaya seeds have demonstrated their ability to function as a natural coagulant and to lessen water turbidity.

KEYWORDS

natural coagulant; turbidity

1. INTRODUCTION

Water that is suitable for drinking or use in food preparation is referred to as drinking water. Furthermore, tap water in developed nations satisfies water quality criteria, even when only a small amount is utilized for drinking and food preparation. In less developed and developing nations, treating drinking water with recommended treatment techniques is highly costly and unsuitable. This can also be because of the hazardous chemicals employed in the treatment, which is caused by a lack of appropriate infrastructure and accessories.

The next applications for this water are drinking, irrigation, industrial water supply, maintaining river flow, recreational, and other uses. Human health benefits from drinking and using irrigation are made possible by this treatment (Singh et al., 2018). Furthermore, the consequences of contaminated water and inadequate sanitation are associated with the spread of illnesses like cholera, dysentery, diarrhoea, hepatitis A, typhoid, and polio.

1.1. Water treatment process

The water treatment process, coagulation-flocculation is known to be a successful and important physicochemical process for treating various types of wastewater. In these processes, the coagulant used can be either chemical or derived from natural sources (Nurul et al.,2023). A primary water treatment method called coagulation is used to get rid of tiny, suspended solids from all kinds of water. Sludge disposal is currently a big issue, and garbage management is one of the biggest environmental problems municipalities confront globally. The purpose of this research is to treat water with natural coagulants. Watermelon seeds, fennel seeds, okra seeds, papaya seeds(Carica papaya)and other seeds are natural coagulants. Alum, sodium aluminate, and ferric sulfate are examples of chemical coagulants. Chemical testing, including turbidity and pH measurements, will be performed on both treated and untreated water samples.

Substances that lessen the medium's acidity or alkalinity are used to neutralize pH as part of the treatment process. The coagulation process starts with the addition of coagulants, which can be chemical (lime, sodium aluminate, ferric sulphate, and plant-based) or natural (plant- and animal-based) coagulants. The next step is the sedimentation of the particles and sludge separation before the residual solution is transferred for filtration in the pressure filter, which is composed of a sand-and-rock filtration layer that filters the wet sludge to extract the remaining water. Verifying the final effluent load in the water before its release into the environment is the last step in the effluent treatment process.

1.2. Plant-based coagulant (natural)

Nonetheless, the majority of papaya seeds' composition contains potentially useful by-products, such as protein (21.88%), lipids (21.88%), and fiber (18.03%), on a wet basis (Marfo et al., 1986; Ávila et al., 2020). Monounsaturated fatty acids, which include useful chemicals, are abundant in papaya seed oil (Samaram et al., 2015). The most prevalent fatty acids in papaya seed oil are palmitic, stearic, oleic, and linoleic, coupled with tocopherols and carotenoids with beneficial and functional qualities.

Plant-based coagulants and non-plant-based coagulants are the two categories of natural coagulants. Tree bark, leaves, seeds, and fruit scraps can all be used to make plant-based coagulants. Because they are more affordable than nonplant-based coagulants, research on plant-based coagulants has been conducted more extensively.

Carica papaya seeds can be used as a coagulant since it is a tropical tree comprised of water-soluble and positively charged protein known as cystine protease which emerged as a putative coagulant in both water and wastewater treatments. Carica papaya is widely used as a herbal cure in traditional medicine to treat, protect against, and prevent a wide range of ailments.

2. METHODOLOGY

It is necessary to know the location of the water sample collection and experiment conduct area to carry out this experiment. This is because it will significantly affect the outcomes. The Sultan Idris Shah Polytechnic's lake area is the chosen venue for this experiment. Next, we utilize untreated raw water as our sample of water.

Papaya seeds are a well-known ingredient in this coagulant experiment, and since they are inexpensive when purchased in bulk, it is also advantageous to get them from the market to expedite the next step. It will also begin supplying ingredients right away.

Cleaning the seeds is the first step in the other phases that make up the preparation process. Wash the material with clean water to remove the mucus from the seeds. For this reason, it won't use seeds that contain mucus. the seed is subsequently dried to eliminate any remaining moisture.

After that, the seeds need to be dried for an hour at 100°C. However, first, they need to be pressed using a tissue to absorb any remaining water from the washing procedure. The goal of this drying session is to make the seeds sufficiently dry so that they powder to the ideal consistency. After that, grind the seeds into a finer powder with a mortar or blender. The seed powder will next be sieved to get a fine texture that will make it easy to dissolve in water for the experiment.

The next step is crucial which is to extract the seed to get liquid. Combine with purified water. Papaya seed powder should be combined in three different amounts (10 grams, 12 grams, and 14 grams). Then, to obtain a liquid, dissolve in 50 millilitres of distilled water. Next, use a laboratory magnetic stirrer to stir for 30 minutes to ensure that the powder dissolves completely. To obtain just water, also separate the water from the essence. After being made into a liquid, it will be filtered first to get a clean liquid from the solution and to remove impurities.

The removal of turbidity by using natural coagulant is the water treatment process in this study. Coagulation is to balance the negative charges on non-settlable solids (such clay and organic materials that provide colour), coagulants which have charges opposite to those of the suspended solids are introduced to the water. The little suspended particles can cling to one another once the charge is neutralized. These somewhat bigger particles are not visible to the unaided eye and are referred to as microflocs. The newly created microflocs should be surrounded by clear water.

Sample water that has been added to a beaker and given a minute of 200 rpm stirring. The next step is to pour the liquidized substance into a container and add six different dilution quantities (2, 4, 6, 8, and 10 milliliters), and stir at 100 revolutions per minute for five minutes. This process takes place after one minute. Following a five-minute delay, the jar test procedure will be repeated, this time agitating at 20 rpm for fifteen minutes. This prolonged stirring will induce coagulation and cause the water to somewhat turn clear after the sedimentation process.

Using the data from the jar test procedure for both the turbidity and pH parameters to see the reading after adding the substance that has diluted to check how well the material works

with the natural coagulant process and to see the reduction in the lake water's turbidity measurement.

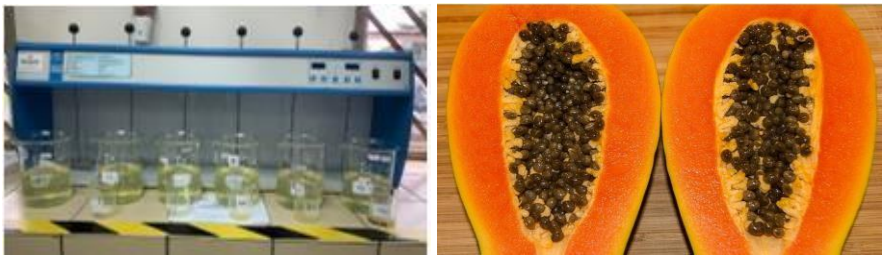


Figure 1. Coagulants used in coagulation-flocculation process

3. RESULTS AND DISCUSSION

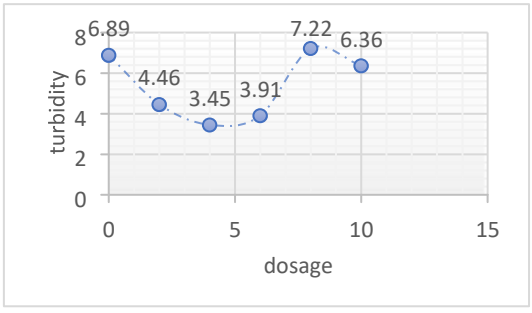
This chapter compiles the experimental data obtained from the coagulation technique used. For further information and a fundamental comprehension of the consequences that are crucial to this coagulant process, analysis is carried out appropriately. The primary objective of the coagulation/flocculation process is to remove turbidity As a result, information regarding the pH and turbidity of papaya seed natural coagulants is also covered in more detail. Consideration is given to variables that impact the coagulants' natural process, like removal effectiveness, as well as operational variables like pH and turbidity. Following that, data tables, line charts, and bar charts are used to illustrate the results. The different coagulation-flocculation tests are performed using the Jar Test consisting of a series of 6 jars (VELP Scientifica JLT 6 Flocculator). The turbid water had an initial turbidity of 24.5 NTU when it was prepared in the lab 20,000 mg/L of coagulant was found to be the ideal dosage, and a final turbidity of 3.45 NTU was achieved.

The turbidity removal rate (TRR) is defined by Eq. (1).

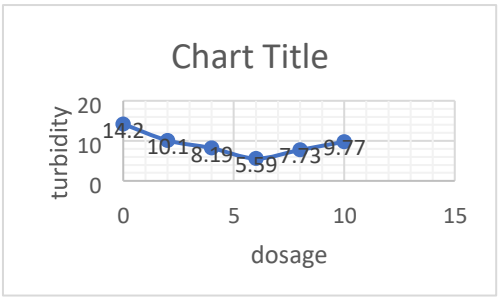
$$(TRR)\% = \frac{Initial\ turbidity - final\ turbidity}{Initial\ turbidity}\ x\ 100$$

Table 1. The data or turbidity reduction by using Carica Papaya Seeds

	Volume of coagulant (mL)	0	2	4	6	8	10
Turbidity (NTU)	10(g)	6.89	4.46	3.45	3.91	7.22	6.36
	12(g)	14.2	10.1	8.19	5.59	7.73	9.77
	14(g)	14.7	14.5	14.5	4.97	10.4	10.6



(a)



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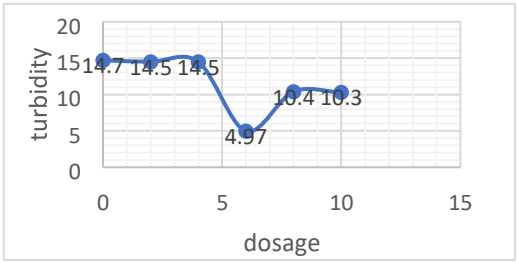

(c)

Figure 2. Optimum dosage from different weights of coagulant (a)10g (b)12g (c) 14g

Table 2. The optimum turbidity reduction by using Carica Papaya Seeds

Optimum Volume (mL)		4.8	6.0	9	Removal Efficiency
Turbidity (NTU)	10(g)	3.2	NA	NA	87
	12(g)	NA	5.2	NA	79
	14(g)	NA	NA	4.9	80

Polymer bridging or charge neutralization are two ways that naturally occurring plant-based coagulants can function. Colloids are usually negatively charged in water. Ionizable polymer coagulants are used in charge neutralization to stabilize the particles (Aminaet al.,2021). Thus, from the initial turbidity 24.5 NTU can be reduced up to 87% from the optimum dosage of coagulant and volume of Carica papaya seeds.

Design components like pH, coagulant dosage, stirring rate, and time have an impact on the coagulation and flocculation process. Changes in one parameter relative to the other showed the strongest effects on coagulant efficiency, each response, and each other (Moltot et al.,2024). As a result, they could influence removal effectiveness favourably or unfavourably. Therefore, the input components utilized during the coagulation and flocculation process determined how much the chosen natural coagulants were able to remove the colour and turbidity %.

From Table 3.0, the highest turbidity removal rate was when using the lowest amount of Caprica seeds with a volume of only 4 ml, where the removal rate increased to 86% with PH2.

Table 3. The PH reading during the coagulation process

Volume of *0 2 4 6 8 10 coagulant (mL)*							
PH	10(g)	2.00	2.00	2.00	2.00	2.00	2.00
	12(g)	2.16	2.15	2.14	2.12	2.14	2.11
	14(g)	2.06	2.10	2.03	2.04	2.04	2.04

4. CONCLUSION

Plant-based coagulants, such as polymer bridging and charge neutralisation, can stabilize negatively charged colloids in water. Carica papaya seeds' optimal dosage and volume can reduce turbidity by up to 87%. Design components like pH, coagulant dosage, stirring rate, and time affect the coagulation and flocculation process, influencing removal effectiveness. Turbidity removal efficiencies higher than 80% can be achieved using natural coagulants. However, there is a challenge of lower efficiencies with water of lower turbidity if the amount of coagulant increased.

REFERENCES

Moltot Getahun , Adisu Befekadu , Esayas Alemayehu .(2024). Coagulation process for removing colour and turbidity from wet coffee processing industry wastewater using bio-coagulant: Optimization through central composite design. Heliyon ScienceDirect Volume 10, Issue 7, 15 April 2024, e27584

Singh, N. B., Nagpal, G., Agrawal, S., & Rachna. (2018). Water purification by using Adsorbents: A Review. In Environmental Technology and Innovation. Vol. 11, pp. 187–240.

Nurul Muna Daud a, Siti Rozaimah Sheikh Abdullah a, Hassimi Abu Hasan a b, Ahmad Razi Othman a, Nur 'Izzati Ismail a b. (2023) Coagulation-flocculation treatment for batik effluent as a baseline study for the upcoming application of green coagulants/flocculants towards the sustainable batik industry. Heliyon ScienceDirect Volume 9, Issue 6, June 2023, e17284

Finney, J. L., Rand, R. P., Franks, F., Pettersson, L., Bowron, D. T., Engberts, J. B. F. N., Ball, P., &Zaccai, G. (2004). Water? What's so special about it? Philosophical Transactions of the Royal Society B: Biological Sciences, 359(1448), 1145–1165.

Kumar Assistant Professor, N. S., Devi, S. P., & Kumar, N. S. (2017). The surprising health benefits of papaya seeds: A review. Journal of Pharmacognosy and Phytochemistry, 6(1), 424–429.

Pakharuddin, N. H., Fazly, M. N., Ahmad Sukari, S. H., Tho, K., & Zamri, W. F. H. (2021) Water treatment process using conventional and advanced methods: A comparative study of Malaysia and selected countries. Conference Series: Earth and Environmental Science, 880(1)

Izabela D.z a, Jesús-D. Q.-Arias b. (2024). Coagulation-Flocculation - Fenton-Neutralization sequential process for the treatment of industrial effluent polluted with AB194 dye. Case Studies in Chemical and Environmental Engineering. Volume 9, June 2024, 100720

Oussama Hartal. (2024). Optimization of coagulation-flocculation process for wastewater treatment from vegetable oil refineries using chitosan as a natural flocculant. Environmental Nanotechnology, Monitoring & Management Volume 22, December 2024, 100957

S. Ávila, M. Kugo, P. Silveira Hornung, F.B. Apea-Bah, E.M. Songok, T. Beta Carica papaya seed enhances phytochemicals and functional properties in cornmeal porridges Food Chemistry, 323 (April) (2020), p. 126808, 10.1016/j.foodchem.2020.126808

E.K. Marfo, O.L. Oke, O.A. Afolabi Chemical composition of papaya (Carica papaya) seeds Food Chemistry, 22 (4) (1986), pp. 259-266, 10.1016/0308-8146(86)90084-1

S. Samaram, H. Mirhosseini, C.P. Tan, H.M. Ghazali, S. Bordbar, A. Serjouie Optimisation of ultrasound-assisted extraction of oil from papaya seed by response surface methodology: Oil recovery, radical scavenging antioxidant activity, and oxidation stability Food Chemistry, 172 (2015), pp. 7-17, 10.1016/j.foodchem.2014.08.068

Natural Bleach Using Lemon Peel

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ABSTRACT

Commercial bleach, as indicated by Yosi Santika Silitonga et al. in 2020, contains chemicals designed to eliminate dirt and stains. In light of this, a solution involving natural bleach derived from lemon peel has been suggested for cleaning purposes. This natural bleach can be produced by synthesizing lemon peel as the primary ingredient and combining it with ethanol and vinegar. The blend of lemon peel, ethanol, and vinegar forms an effective natural bleach agent. Experimental tests were carried out to assess the bleaching efficiancy of lemon peel extract on cotton fabric by varying the amounts of lemon peel in each mixture. Seven different doses of natural agents were tested for each bleach mixture. The findings demonstrated that lemon peel extract is proficient in lightening fabric color and removing stains while preserving fabric integrity, owing to the presence of citric acid in lemon peel which acts as a natural cleaning agent. Citric acid aids in dirt and grime removal, as well as providing a bleaching effect on fabrics, while ethanol functions as an additional cleaning agent and solvent. Additionally, vinegar with its acidic properties contributes to the bleaching process. The study also examined various parameters such as pH levels, the duration needed for lemon peel to eliminate stains on cotton fabric, and the toxicity of the bleach. Time measurements were taken during cotton cloth stain removal tests using natural bleach, based on the quantity of doses applied. Consequently, the bleach testing revealed that the most effective dose for dirt removal is a hundred grams of lemon peel, achieving stain removal within two minutes. It was observed that increasing the amount of lemon peel led to faster dirt removal, showcasing accelerated stain elimination on fabric and delivering a notably clean outcome. In summary, lemon peel extract presents a sustainable alternative with potent bleaching properties. The advantages of natural bleach encompass efficient cleaning without residual harmful chemicals, promoting environmentally conscious practices.

KEYWORDS

Bleach; lemon peel

1. INTRODUCTION

The traditional textile industry has faced significant criticism for its negative impact on the environment, primarily due to excessive water and energy consumption, as well as the release of environmentally harmful wastewater. To address these concerns and promote sustainable practices, there is an urgent need to transform and upgrade the conventional textile industry towards more advanced and environmentally friendly approaches (Ahmad et al.,2015). According to a report in 2018, cotton is a prominent textile substrate known for its moisture absorption and comfortable wearability. It accounts for more than 80% of the total production of natural fibers, totaling 32 million (Ahmed and Mondal 2021).

Bleaching is an indispensable step that aims to achieving required whiteness by removing the intrinsic colored impurities from cotton fibres available for the following processes such as coloration, printing and functionalization. Commercial bleach contains chlorine which can harm aquatic ecosystems and human health. (Dessie et al., 2019).No matter how dangerous the chemical or chlorine pollution is to the environment or public health, it can contaminate water. The use of chemical bleaching agents, particularly chlorine bleach, raises significant health and environmental concerns. Despite its effectiveness in whitening and cleaning, chlorine poses risks due to its strong oxidizing chemicals. Inhaling chlorine fumes may lead to chronic respiratory issues like asthma and bronchitis. (ATSDR, 2004) The release of toxic fumes during bleach is a concern. Besides that, chlorine bleach also produce harmful by-product including dioxins and repeated exposure to dioxins increases cancer and reproductive risks. (EPA, 2018) Due that, by using natural ingredient as an alternative to produce natural bleach like citrus peel extract for cleaning. These alternative are eco-friendly and pose fewer health risks. The natural bleach from lemon peel is one of the eco-friendly product.

Since that, natural bleach from lemon peel was proposed to evalute the effectiveness as a bleach. The main component of this study is lemon peel as organic material. The objective of the study are to evaluate the potential of lemon pees as a suitable material in the production of natural bleach and determine the effectiveness of dirt removal based on the optimal dose of lemon peel.

Natural bleach from lemon peel is a product eco-friendly which containing natural egent , ethanol and vinegar. Jamuna and Kumaravel, 2019 highlighted that lemon peel contain citric acid, limonene, flavonoids and antioxidants that's help as natural bleach. Its may help in breaking down the stains and safe for fabrics and skin. From all this, its shown that natural bleach from lemon peel can classified as environmental flriendly to be use.

The purpose of this study is to evaluate the effectiveness of the natural bleach, which involves the manufacture of natural bleach from lemon peel and another component, namely ethanol . The main component of this study, lemon peel, is a good material for the production of natural bleach. This study will examine its quality and shows how natural bleach works well to remove stains from fabric. The scope of study also want evaluate the influence of pH on the bleaching effect of natural bleach between commercial bleach

In addition, this study will be as a awareness of the harmful in use of chemcial or commercial bleach that contain a high chemical content. Due that, it will show by using natural bleaching will be effective as commercial bleach.

2. METHODOLOGY

In making natural bleach was conducted with the combination of lemon peel, vinegar and ethanol. Smith et. al. (2016) explained that citric acid from lemon peel functions through

chelation, where metal ions causing stains on fabrics are bound and neutralized. Acetic acid in vinegar dissolves dirt by breaking down ionic and hydrogen bonds in dirt, while its acidic nature also kills microorganisms that may cause odors and discoloration.Furthermore, ethanol plays a crucial role in the bleaching process by speeding up the extraction of active components from lemon peel and aiding in fabric drying. Koh, Chia and Goh (2015) demonstrated that ethanol can accelerate water evaporation from fabrics, reducing drying time and minimizing the risk of damage to fabric fibers. Due all the function of the material, its combined all the material in production of natural bleach by using lemon peel. **Figure 1** shown that the parameter study involve in production of natural bleach.

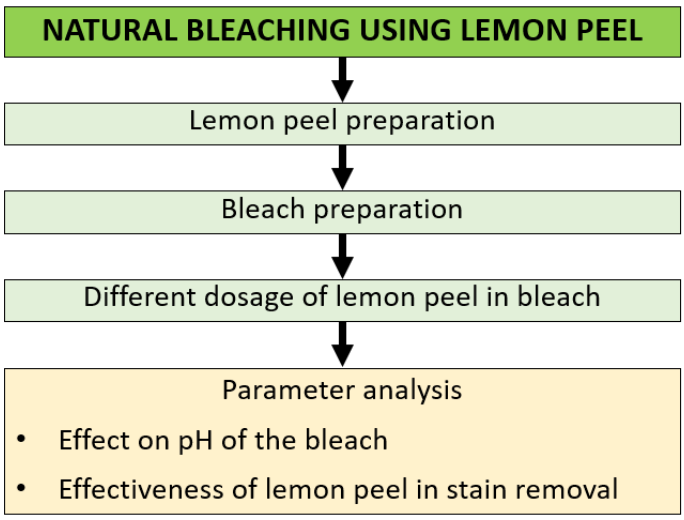

Figure 1. The parameter study of the natural bleach by using lemon peel

Lemon peel is obtained from food waste and separated from the fruit. Lemon peel must cleaned and washed in sterile distilled water and dried in the dry oven for 12hours in 60°C of temperature to remove most of the moisture. After that, it is packed in a steel envelope to be dried in hot air oven at 200°C for 120 minutes. Once it dried, the lemon peel was ground into a fine powder using a grinder.

Next, the natural bleaching preparation involved combining lemon peel powder with ethanol and vinegar as additional ingredients. The dosage of lemon peel varied in different amounts (40 grams, 50 grams, 60 grams, 70 grams, 80 grams, 90 grams, and 100 grams) to examined for its specific effect on the initial pH of the bleach and stain removal from fabrics.

The initial pH of the natural bleach was measure to analyze the optimal or suitable dosage of lemon peel in remove the dirt and stain. By adjusting the amount of peel, its can identify the ideal concentration for achieving the desired pH range in bleach production. Besides that, the optimal contact time of natural bleaching process using lemon peel was measured to achive maximum bleaching results. This analysis is not only to enhance the effectiveness of the bleaching process but also to minimize unnecessary exposure, providing a deeper understanding of the kinetics of the bleaching process with lemon peel (Dessie et al.,2019).

3. RESULTS AND DISCUSSION

This study aimed to identify the optimal pH for effective natural bleaching and to evaluate the effectiveness of lemon peel in removing stains from fabric. Various quantities of lemon peel, namely 40 grams, 50 grams, 60 grams, 70 grams, 80 grams, 90 grams, and 100 grams, were used to investigate this matter, each with different pH levels. This variety in dosage allowed for an in-depth exploration of the potential of lemon peel as a bleach, capable of meeting various cleaning needs and preferences (Kamli et al., 2021).

The effectiveness of lemon peel in removing stains was assessed by measuring the time required to remove stains from fabric samples. This analysis provided insights not only into the efficiency of lemon peel as a cleaning agent but also helped determine the most suitable dosage for optimal performance. This multidimensional approach allowed for a comprehensive understanding of the bleaching capabilities of lemon peel and its potential as a safer alternative to conventional chemical bleaches.

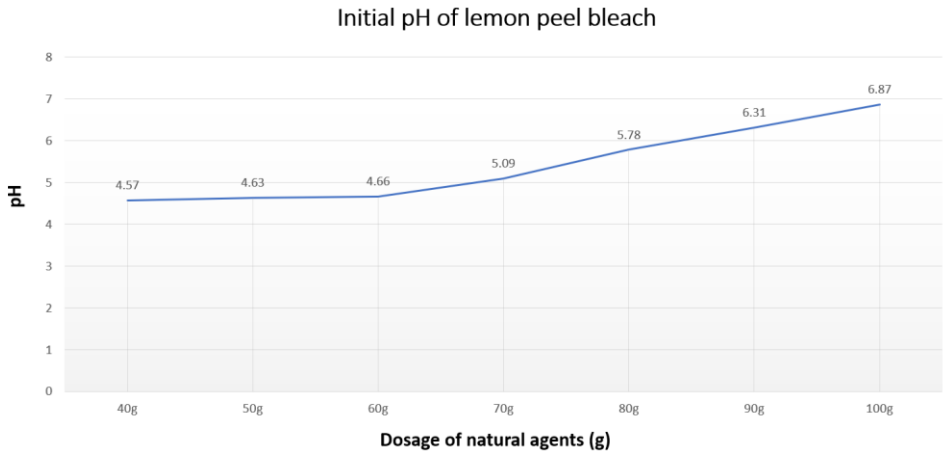

Figure 2. The intital pH of bleach with different dosage of lemon peel

The analysis in Figure 2 show the initial pH data from natural bleaches derived from lemon peel and other organic sources reveals varying values ranging approximately from 4.5 to 7. The acidic nature of lemon peel contributes to lower pH values due to its abundance in citric acid. On the other hand, commercial bleaches have higher alkaline levels with pH ranges often spanning from 10 to 13 (Chandra et al., 2017). These differences reflect variations between natural substances and synthetic chemicals used in commercial bleaches. In the case of natural bleaches, such as those derived from lemon peel, the acidity levels are primarily determined by the concentration of organic acids present. As more lemon peel is added, the overall acidity may increase slightly due to higher concentrations of citric acid, but the pH values generally remain within a relatively narrow range.In contrast, commercial bleaches rely on synthetic chemicals with predetermined alkalinity levels to achieve desired stain removal and whitening effects. The addition of these alkaline chemicals leads to higher pH values in the bleach solution, which correlates with increased effectiveness in stain removal.

Lemon peel contains natural bleaching agents, including citric acid, which can remove and remove dirt through oxidation or other chemical reactions. With a dose of 40 grams, the initial pH may experience a mild increase as the compounds in the lemon peel interact with the solution. However, the lemon peel is providing an acidic environment effect that can start the natural bleaching process, especially effective in removing dirt. When the dose of lemon peel increases to 100 grams, the concentration natural bleaching agents are intensified. This enhanced organic content can cause even more a significant reduction in the initial pH, increasing the bleaching effect on the solution.

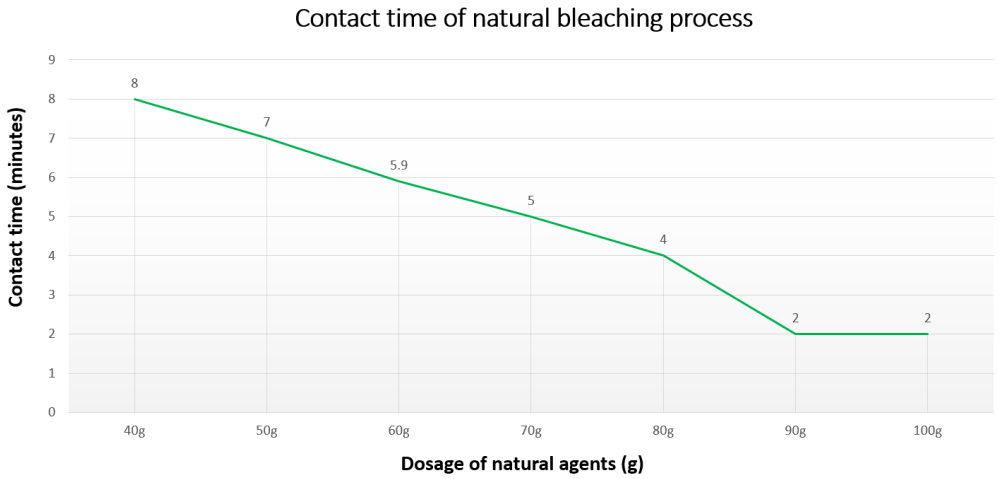

Figure 3. The contact time of bleach with different dosage of lemon peel

The graph in Figure 3 provides an overview of the time comparison of the effectiveness of bleach in removing stains from cotton fabric using various doses of lemon in the cleaning process. The data clearly indicate that as the dose of lemon increases, the time required for the bleach to effectively remove stains decreases. This observed trend can be attributed to the presence of citric acid in lemon peel, which possesses stain-breaking properties. Citric acid initiates a chemical reaction that produces chlorine gas and other compounds, enhancing the bleach's ability to break down stains on fabric. Consequently, higher doses of lemon peel result in increased concentrations of citric acid, leading to more efficient stain removal.

The findings of this study underscore the positive correlation between the dosage of lemon peel and the effectiveness of stain removal from cotton fabric. The results suggest that higher doses of lemon peel yield quicker and more efficient stain removal, emphasizing the potential utility of lemon peel as a natural and effective alternative to conventional chemical bleaches.

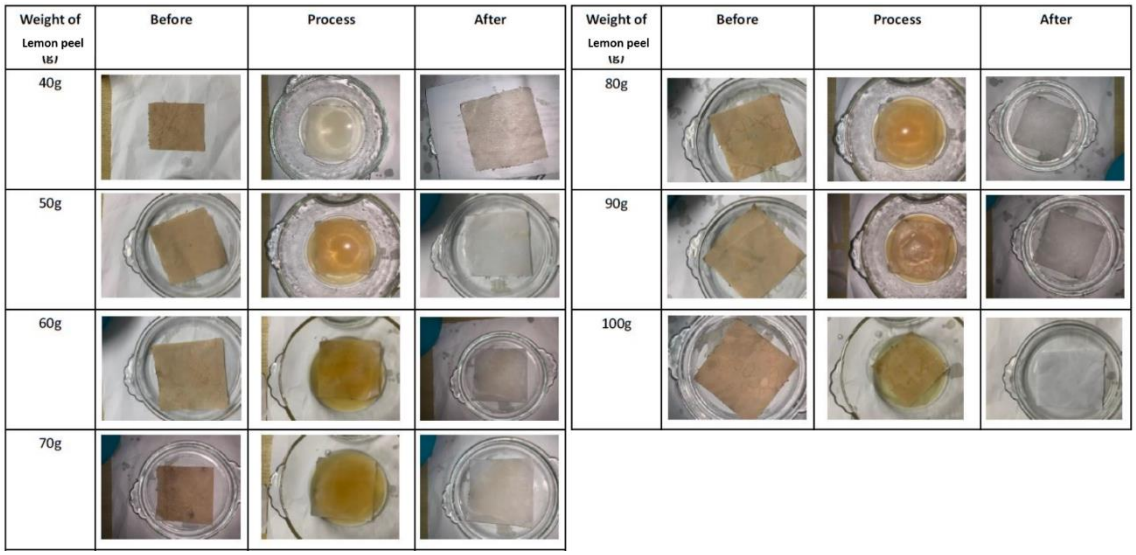

Figure 3. The effectiveness of natural bleach in removal dirt and stain on cotton fabric

The figure 4show the effectiveness of natural bleach in removal dirt and stain on cotton fabric. The findings of the study showed that a higher dose of lemon peel resulted in a more

suitable pH value for bleaching, while the time required to remove stains from the fabric also decreased significantly with higher doses, directly affecting the effectiveness of the bleaching product. An in-depth discussion of the dose-effect relationship on the efficacy and reliability of bleaching products reaffirms the conclusion that lemon peel has great potential as a substitute for conventional chemical bleaches, emphasizing safety, efficacy and positive environmental impact.

Based on a comprehensive analysis of the data and results presented in this study, it can be conclusively concluded that the use of lemon peel as a natural bleaching agent promises an effective and sustainable approach to address cleaning needs safely and efficiently.

REFERENCES

Ahmad, A., Mohd-Setapar, S.H., Chuong, C.S., et al., 2015. Recent advances in new generation dye removal technologies: novel search for approaches to reprocess wastewater. RSC Adv. 5, 30801–30818. https://doi.org/10.1039/c4ra16959j.

Ahmed, F., & Mondal, M. I. H. (2021). Introduction to natural fibres and textiles. In J. Hu, S. Wang, X. Yu, & //M.I.H Mondal (Eds.), Fundamentals of Natural Fibres and Textiles (pp. 1-32). Elsevier.

Dessie, A., Wolela1, A. D., & Govindan2, N. (2019). Ecofriendly Antimicrobial Finishing of Cotton with Extract of Lemon Peels. International Journal of Modern Science and Technology, 4(10), 252–259. www.ijmst.co

Naidenko OV, Jain RB, Brown D. Health Risks of Chemicals in Consumer Products: Chlorinated Tris and Other Flame Retardants. Environmental Science & Technology. 2012;46(11):6287-95

Jamuna P., & Kumaravel S. (2019). Extraction and Characterization of Essential Oil from Lemon Peels (Citrus Limetta) by Using Steam Distillation Method. International Journal of Scientific Research in Science Engineering and Technology, 5(3),1054-1059

Kamli, S., Mir, S. A., Sultan, P., Dar, B. N., Mir, M. M., & Magray, A. R. (2021). An ecofriendly approach towards the green synthesis of ZnO nanoparticles using lemon peel extract and their photocatalytic activity. Journal of Environmental Chemical Engineering, 9(2), 104821. https://doi.org/10.1016/j.jece.2020.104821

Koh, S. L., Chia, L. H., & Goh, J. C. (2015). Effect of Ethanol on Water Evaporation from Fabrics in Garment Drying Process. Journal of Textile Science and Engineering, 5(4), 1-4.

Leadership Role in Implementation of Mutations on Employees' Performance, Department of Education and Culture, Jeneponto

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ABSTRACT

Leaders as an aspect of human resources have an important role in various activities of an institution. Leadership is a manifestation of a person's ability to influence members or subordinates to be willing to work to achieve agreed goals. Often during certain periods, employees are transferred. Transfers are caused by several reasons, such as filling employee vacancies in other offices, filling executive level positions and transferring executive duties, career development and position promotions, and *the spoil system* , namely mutations carried out on the basis of kinship and considerations of likes or dislikes so that employees are hired. mutation is not based on performance considerations. These various reasons clearly have an impact on the work rhythm which was previously well organized and organized. This research aims to find out: (1) Implementation of Mutations at the Jeneponto Regency Education and Culture Office; (2) Employee Performance at the Jeneponto Regency Education and Culture Service; (3) Implementation of Mutations on Employee Performance at the Jeneponto Regency Education and Culture Office. This research is a qualitative descriptive research with a phenomenological and sociological approach. The data source was obtained from employees of the Jeneponto Regency Education and Culture Office. Data collection techniques were carried out through observation, interviews and documentation. The research instrument is an interview guide. Data analysis was carried out using data reduction techniques , data presentation and drawing conclusions or verification. Data validity testing uses source triangulation. The results of the research show that implementing mutations is not the authority or decision of the leadership of the Jeneponto Regency Education and Culture Service as a whole. Mutations are carried out because of a messenger letter from BKD for reasons of *career* development , filling vacant positions, filling executive level positions, promotions and *spoiled systems ; not the decision of the leadership of the agency concerned.* The performance of transferred employees varies according to their respective fields so that the tasks given can be completed and achieve the desired goals. In short, the implementation of communication for employees of the Jeneponto Regency Education and Culture Office was not carried out immediately , but was based on a decision letter from the BKD. The performance of Jeneponto Regency Education and Culture Service employees varies according to their duties and procedures as well as their commitment to achieving targets.

KEYWORDS

Leadership **,** *Transfer, Performance*

1. INTRODUCTION

Human resource management (HRM) is a way of maximally managing the relationships and roles of resources owned by individuals so that the joint goals of institutions/agencies and employees in society can be achieved optimally. Hasibuan, (2017)believes that humans are the most important resource in an organization. Sola, (2020) said that leadership is interpreted as an individual's ability to guide, mobilize and direct members or subordinates regarding the implementation of the process education and teaching in order to realize the stated goals set. With the gift of reason, leadership can achieve success through developing talent, work, motivation, creativity, and innovation. Mutation can be understood as the activity of transferring employees from their current job to another job within the organization (Priansa, 2014). In a narrower sense, (Thoha, 2016) stated that transfers are transfers of civil servants between districts/cities within a province determined by the governor after obtaining consideration from the Head of the State Civil Service Agency. Mutualization functions as employee development to increase work efficiency and effectiveness in organizations/institutions (government/ private). Through communication, leaders can assess the extent of an employee's abilities, which will have an influence on the development of the organization/institution. According to Law no. 43 of 1999, the basis used to determine employee transfers includes; length of work period in a field of work, refreshment, institutional/agency/organizational needs, knowledge and skills and special reasons (for example joining your husband). Mutations are carried out at least once every 2 years and a maximum of every 4 years, carried out based on work unit. The objectives of transfers according to Syukur, (2015) include: 1) To increase employee productivity; 2) To create a balance between workforce and job composition or position; 3) To expand or increase employee knowledge; 4) To provide incentives so that employees want to strive for higher career advancement.

Implementation of mutations in an institution/agency should be carried out purely without any other elements so that employees can develop their careers with the abilities they have. A good mutation is a mutation that is carried out according to the procedures that apply to an organization, there is no discrimination, every employee is equal in the eyes of the leader (Rushananto, 2014). Implementation of employee transfers is carried out based on *the seniority system, spoiled system* and *m erit system. The seniority system* is mutation based or the basis of the length of service, age and work experience of the employee concerned. This mutation system is not objective because the skills of people who are transferred based on seniority are not necessarily capable of occupying new positions. *Spoil* e *d system* is a mutation that is based on kinship. This mutation system is not good because it is based on considerations of likes or dislikes. *A merit system* is an employee transfer that is based on a scientific, objective basis based on work performance results. This *merit system* is a good basis for transfers because work output and productivity increases, work morale increases, the number of errors decreases, employee discipline improves, and the number of work accidents will decrease (Sjafri, 2014).

Performance is the result of work in terms of quality and quantity achieved by an employee in carrying out his duties in accordance with the responsibilities given to him (Mangkunegara, 2013). Some basic criteria for measuring performance are: 1) Quality of work (*quatity*) is a value in the form of a process or result of thoroughness in carrying out work, perfection of the work itself; 2) Quantity of work (*quantity*) is the amount of work done, produced and eliminated, such as the value of money, the number of goods or the number of activities that have been done or carried out; 3) Timeliness is the value of a job that can be carried out in accordance with the specified time so that the desired goal is

achieved; 4) Cost effectiveness (*cost-effectiveness*) is the relationship with organizational resources in obtaining or obtaining wasteful results in using organizational resources; 5) The need for supervision *,* namely that employees can complete work or job functions without the assistance of a leader or supervisory intervention from the leader , and 6) Self-efficacy (*Interpersonal Impact*) ; the ability possessed by individuals to increase feelings of self-esteem, goodwill and cooperation among fellow employees and subordinates . In short, it can be concluded that whether an employee is successful or not in carrying out their activities his task can assessed from 6 indicator, ie 1) *quality* ; 2) *quantity;* 3) *timeliness;* 4) *cost-effectiveness;* 5) *need for supervision* ; And 6) *interpersonal impact* (Sola, 2022).

2. METHODOLOGY

Research is classified as qualitative descriptive research which reveals the circumstances or situations studied in accordance with the facts at the time the research was conducted relating to the Implementation of Mutations on Employee Performance at the Jeneponto Regency Education and Culture Office. The data sources in this research are employees of the Jeneponto Regency Education and Culture Office. Data collection techniques *were* carried *out* through *participant observation , in - depth interviews ,* and *documents .* The research instrument uses an interview guide. Data analysis using reduction techniques data (Data *Reduction) ,* data presentation *(Data Display) , and* drawing conclusions (*Verification*). Testing the validity of the data was carried out by source triangulation.

3. RESULTS AND DISCUSSION

Mutation is a change in position, title, place, work carried out both horizontally and vertically in an organization. Mutation is an activity carried out based on policy to implement the principle "*the right man on the right place and the right man on the right job*". It means; placement of the right people in the right places and positions (Syukur, 2015). Each members of the organization have equal opportunity to achieve a higher position. Job performance is the contribution and output given by employees in carrying out their duties, responsibilities, and functions as employees in the organization. The competition in improving job performance will arise if there is a guarantee that employee mutation is actually done objectively. The implementation of transfers at the Jeneponto Regency Education and Culture Service was carried out due to a decision letter from the Regional Personnel Agency (BKD) , not a decision by the agency leadership. Transfers at the Jeneponto Regency Education and Culture Office are more due to career advancement, superior assessment, filling employee vacancies in a field or institution, promotions and transfer of executive duties. This is in line with the objectives of mutation as stated by Syukur, (2015), namely 1) To increase employee productivity, 2) To create a balance between workforce and work composition or position, 3) To expand or increase employee knowledge, 4) To provide incentives to Employees are willing to strive for higher career advancement.

Apart from that , there are also mutations in this agency which are carried out using *a spoiled system* , that is, mutations are carried out on the basis of family ties and considerations of likes and dislikes. Basically, dealing with *a spoiled system* is not good because it doesn't look at the capacity of employees. In Sjafri, (2014) opinion, *a spoiled system* is a mutation that is based on family grounds , not the ability or skills of the employee being transferred. Furthermore, the length of service of employees who are transferred cannot be determined because transfers in that office depend on regional government (BKD) policy. Mutations can be carried out when the BKD issues a decision to carry out mutations. At the end of every year, the Jeneponto Regency Education and Culture Office carries out performance

evaluations so that employees know their performance capabilities and there could be transfers if there is a policy from the BKD.

Apart from the research findings for several of the reasons mentioned above, mutations also have positive effects, such as refreshing *the* work atmosphere in the institution, giving *rewards* to employees so that other employees are motivated, and eliminating employees' feelings of boredom towards their work, position or position. workplace. Zaidan et al., (2021) that promotion and mutation simultaneously affects employee performance . Apart from that, employee exchange will provide new ideas with new people, making it possible to create new things in a new atmosphere . All of this cannot be separated from the work performance of the employees. According to Hasibuan, (2017)there are several benefits of mutation, namely 1) Increasing employee work productivity , 2) Creating a balance between workforce and job composition or position , 3) Expanding or increasing employee knowledge , 4) Eliminating feelings of boredom/saturation with work , 5) Providing incentives so that employees want to strive for higher career advancement . Employee mutation will open up opportunities for competition in improving job performance (Mahendra, 2014). Thus, the more significant effect of mutation will be followed by the increase o n jobs performance (Zaidan et al., 2021).

4. CONCLUSION

Based on the research results, it can be concluded that:

1) The leadership of the Jeneponto Regency Education and Culture Service does not have the authority to transfer employees of this agency. Transfer of employees based on SK B and Regional Civil Service Agency (BKD).

2) Implementation of transfers for employees of the Jeneponto Regency Education and Culture Office is not carried out suddenly , but based on a decree BKD. Mutualization is carried out with various considerations, including filling vacancies , filling executive level positions, obtaining higher positions, career advancement and *spoiling the system*.

3) Performance of Jeneponto Regency Education and Culture Service employees has different performance according to their respective main duties and functions. Measuring employee performance is seen from tasks/work based on timeliness in completing tasks/work, thoroughness in work and cooperation between groups .

4) The application of mutations to the performance of Jeneponto Regency Education and Culture Service employees can refresh " reasoning power", and add new ideas with creative employees and increase experience and develop employees' careers in the new institutions/agencies they occupy.

Among the important points that agencies must pay attention to are:

1) It is important for the Jeneponto Regency Education and Culture Service to pay attention to employees who have good performance to provide opportunities for promotion .

2) It is important for the Regional Personnel Agency (BKD) to consider and analyze positions before transferring employees either from field to field or from institution to institution.

3) It is important for employees to develop their abilities, so that when there is an employee transfer, it is not just a transfer from institution to institution with the same position but what is expected is a mutation with a change in position both in terms of position and job.

REFERENCES

Hasibuan, M. (2017). *Manajemen Sumber Daya Manusia*. Bumi Aksara.

Mangkunegara, A. P. (2013). *Manajemen Sumber Daya Manusia*. PT. Remaja Rosdakarya.

Priansa. (2014). *Perencanaan dan pengembangan SDM*. Alfabeta.

Rushananto. (2014). *Kebijakan Publik*. Kebijakan Publik.

Sjafri, M. . (2014). *Manajemen Sumber Daya Manusia Strategik*.

Sola, E. (2020). *Kepemimpinan pendidikan dan essential traits* (4th ed.). Idaarah.

Syukur, F. (2015). Reorientasi Manajemen Pembelajaran Pendidikan Agama Islam (Pai) Dan Deradikalisasi Agama. *Walisongo: Jurnal Penelitian Sosial Keagamaan*, *23*(1), 113. https://doi.org/10.21580/ws.2015.23.1.226

Thoha, M. (2016). Manajemen Pendidikan Islam Konseptuual dan Operasional. In *Pustaka Radja* (pp. 1–171).

Zaidan, Melita Andriani, K., Maysela Azzahra, I., & Satria Wiranata, R. R. (2021). Upaya Kepala Sekolah dalam Meningkatkan Kinerja Guru Melalui Supervisi Akademik di SD Negeri 1 Kangkung OKU Timur. *AL-FAHIM: Jurnal Manajemen Pendidikan Islam*, *3*(1), 104–116. https://doi.org/10.54396/alfahim.v3i1.140

Competitive Strategies of Building Material Stores in Facing Retail Industry Competition: A Case Study of XYZ Building Material Store

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ABSTRACT

The retail industry in Indonesia has experienced rapid growth, especially in the building materials sector. This research aims to analyze the competitive strategies implemented by XYZ Building Store in the face of increasing competition in this sector. This research uses a case study approach, collecting qualitative data through in-depth interviews, direct observation, and analysis of company documents. The findings show that there is an adoption of a combination of cost advantage, differentiation, and focus strategies to maintain its position in the market. External factors such as fluctuating raw material prices, government policies, and technological advancements also have a significant impact on competitive dynamics. In addition, this study highlights inter-store or retail competition, the existence of supplier monopolies, and the procurement of development plans that are often won by certain stores. Digital transformation and innovation are proving crucial in improving operational efficiency and market reach. The insights gained from this research make a valuable contribution to academic literature and practical business strategy development, offering guidance for building materials retailers to improve their competitiveness in an ever-evolving market.

KEYWORDS

competitive strategy, building stores, innovation, retail competition

1. INTRODUCTION

The retail industry in Indonesia has been rapidly growing, including in the building materials sector. This sector has shown significant growth in recent years, driven by economic growth and aggressive infrastructure development. The construction and building sector in Indonesia reflects a continuous increase in demand for building materials, fueling the growth of building material stores across various regions. In 2022, the construction sector grew by 6.1%, largely driven by major infrastructure projects (BPS, 2022).

Despite this significant growth, competition in the retail building materials market is becoming increasingly fierce. This poses a challenge for building material stores to continuously innovate and develop effective competitive strategies to maintain and increase their market share. While many studies have been conducted on competitive strategies in the retail industry in general, there is still a research gap regarding the application of these strategies in specific local contexts, particularly in the building materials sector in Indonesia (Rahman & Dewi, 2020; Setiawan, 2021). Previous research often underemphasizes the impact of external factors such as fluctuating raw material prices and government policies on competitive strategies in this sector (Wibowo, 2019).

This research aims to analyze the competitive strategies implemented by XYZ Building Store in facing the increasingly fierce competition in the retail industry. Through this case study, it is expected to gain deeper insights into the competitive dynamics and effective strategies to enhance the competitiveness of building material stores in the local market. Additionally, this study also examines external factors such as fluctuating raw material prices, government policies related to the construction sector, and technological advancements impacting business operations (Porter, 1985).

This study offers new contributions by exploring how a combination of cost advantage, differentiation, and focus strategies can be effectively applied in the local Indonesian market context. Furthermore, it highlights the crucial role of digitalization in competitive strategies, which is rarely discussed in the context of building material stores in Indonesia (McKinsey, 2021). These findings are expected to fill the research gap by providing new and practical perspectives on how building material stores can survive and thrive amid fierce competition (Johnson et al., 2020).

This research has several important significances. From a scientific perspective, it adds to the literature on competitive strategies in the retail building materials industry, particularly in the unique context of the Indonesian market (Rahman & Dewi, 2020). From a practical perspective, the results of this study provide guidance for other building material stores in developing effective and adaptive competitive strategies to external environmental changes (Setiawan, 2021). From a social perspective, this research can help policymakers understand the competitive dynamics in this sector and formulate policies that support the sustainability of the building materials retail business (Wibowo, 2019).

Data from BPS shows that the price of construction raw materials has increased by an average of 3.5% per year over the last five years (BPS, 2023). The trend of digitalization is also beginning to penetrate the building materials retail industry, with around 45% of building material stores in Indonesia adopting digital technology in various aspects of their operations, including inventory management and online marketing (McKinsey, 2021).

Thus, this research not only focuses on internal competitive strategies but also on external factors affecting competition in the building materials retail industry. The results of this research are expected to provide significant contributions to academic literature and

business practitioners in understanding and developing effective competitive strategies in this industry.

2. METHODOLOGY

This research uses a case study approach with qualitative methods to gather in-depth insights into the competitive strategy of XYZ Building Store. Qualitative data was obtained from various sources, including company documents, internal reports, sales data, and marketing materials that provided insights into the store's competitive strategy. In addition, external data such as industry reports, market analysis, and data from the Central Statistics Agency (BPS) were used to contextualize the findings within the broader industry landscape(BPS, 2022).

The instruments used in this study include semi-structured interview guides to obtain in-depth information from key informants, field observation notes to document direct observations, and qualitative data analysis software to assist in coding and analyzing the data (Kvale & Brinkmann, 2015).

Data Analysis, following the qualitative nature of this study, thematic analysis was used to analyse the data collected from interviews, observations, and document analysis. The thematic analysis involved coding the data to identify recurring themes and patterns related to competitive strategies and external challenges. The coding process was iterative, allowing for the refinement of themes as the analysis progressed (Braun & Clarke, 2006). The results were then interpreted to provide a detailed understanding of XYZ Building Store's competitive strategy and its effectiveness in the context of external challenges.

The sample for this study includes key informants selected from XYZ Building Store based on their roles and expertise in the company's strategic decision-making process. These informants include store managers, store owners, and employees who are authorized to manage or act as cashiers as well (Palinkas et al., 2015). With this comprehensive methodology, it is hoped that this research can provide in-depth and practical insights into how XYZ Building Stores can compete effectively in the building materials retail industry in Indonesia.

3. RESULTS AND DISCUSSION

This research found that XYZ Building Store adopts a combination of cost advantage, differentiation, and focus strategies to maintain its position in the increasingly competitive market. Qualitative data collected show that the company focuses on operational efficiency and cost management to offer competitive prices. Additionally, XYZ Building Store offers unique products and superior customer service to differentiate itself from competitors.

The adoption of digital technology, such as e-commerce and advanced inventory management systems, is also an essential part of their competitive strategy. The cost advantage strategy implemented by XYZ Building Store aligns with the concept proposed by Porter (1985), where operational efficiency and cost control are key elements. Additionally, differentiation through unique products and superior customer service is consistent with previous research findings that state that service and product quality can enhance customer loyalty and store competitiveness (Johnson et al., 2020).

Data collected from XYZ Building Store include sales reports, operational observations, and interviews with key informants. Below are some key findings illustrated through tables:

Table 1. Strategy and Description

Strategy	Description
Cost Advantage	Operational efficiency and cost control to offer competitive prices.
Differentiation	Unique products and superior customer service to differentiate from competitors.
Focus	Targeting specific market segments that require specialized products and services.
Digital Technology	Utilizing e-commerce and inventory management systems to enhance efficiency and market reach.

These findings show that the combination of cost advantage, differentiation, and focus strategies implemented by XYZ Building Store is effective in enhancing competitiveness in the local market. The adoption of digital technology also proves crucial in improving operational efficiency and expanding market reach.

This research also identifies several external factors affecting competition in the building materials retail industry. Fluctuating raw material prices, government policies, and technological advancements are key external factors impacting business operations. Data from BPS show that the price of construction raw materials has increased by an average of 3.5% per year over the last five years (BPS, 2023), compelling building material stores to continuously find ways to manage costs and keep prices competitive.

Additionally, interviews with key informants reveal the emergence of new stores as competitors in various regions, as well as supplier monopoly practices that force old stores to stop supply or sales, requiring them to find new suppliers. Findings on fluctuating raw material prices and their impact on competitive strategies align with the study by Lee et al. (2019), which shows that fluctuating raw material prices are a significant challenge for the construction industry. Government policies related to the construction sector also play an important role in determining competitive dynamics. Additionally, technological advancements and digitalization adoption have been identified by McKinsey (2021) as key factors transforming the building materials retail landscape. Supplier monopoly practices and the emergence of new stores as competitors also highlight the complex competitive dynamics and the need for adaptive strategies.

External factors such as fluctuating raw material prices and government policies emphasize the importance of adaptability in competitive strategies. Building material stores that can quickly adapt to external changes have a better chance of surviving and thriving. Additionally, the emergence of new stores as competitors and supplier monopoly practices highlight the need to diversify supply sources to avoid dependency on a single supplier.

Thus, the right combination of competitive strategies and the ability to adapt to external factors are key to success in the building materials retail industry. This research not only provides theoretical contributions to academic literature but also offers practical guidance for building material stores in developing effective competitive strategies. This research also emphasizes the importance of adaptive strategies in facing fierce competition, considering external factors that continuously change and influence market dynamics.

Table 2. Comparison of Strategies with Previous Studies

Study	Key Factors	Main Findings
Porter (1985)	Cost Advantage, Differentiation, Focus	Operational efficiency and cost control are key elements. Differentiation through superior products and services enhances competitiveness.
Johnson et al. (2020)	Service and Product Quality	Service and product quality can enhance customer loyalty and store competitiveness.
Lee et al. (2019)	Fluctuating Raw Material Prices	Fluctuating raw material prices are a significant challenge for the construction industry.
McKinsey (2021)	Digital Technology, Digitalization Adoption	Technological advancements and digitalization adoption transform the building materials retail landscape, enhancing efficiency and market reach.

This research provides valuable insights for other building material stores in developing effective and adaptive competitive strategies in facing fierce competition and continuously changing external factors.

4. CONCLUSION

This study found that XYZ Building Store adopts a combination of cost advantage, differentiation, and focus strategies to maintain its position in the increasingly competitive market. Cost advantage strategies are implemented through operational efficiency and cost control, while differentiation is achieved by offering unique products and superior customer service. These findings indicate that the combination of these strategies effectively enhances XYZ Building Store's competitiveness in the local market.

Additionally, the study identifies external factors such as fluctuating raw material prices, government policies, and technological advancements that affect competition in the building materials retail industry. Data show that fluctuating raw material prices and government policies play a significant role in determining competitive dynamics, while technological advancements and digitalization adoption help building material stores improve their efficiency and market reach.

Supplier monopoly practices and the emergence of new stores as competitors also highlight the complex competitive dynamics and the need for adaptive strategies. XYZ Building Store can leverage supply source diversification to avoid dependence on a single supplier and strengthen its competitiveness.

Practically, the findings of this study guide other building material stores in developing effective competitive strategies. Academically, this research contributes to the literature on competitive strategies in the building materials retail industry, particularly in the unique context of the Indonesian market. The study also emphasizes the importance of adaptive strategies in facing fierce competition, considering continuously changing external factors that influence market dynamics.

Practical implications of these findings include recommendations for building material stores to continuously improve operational efficiency and customer service and to adopt digital technology to remain competitive. Theoretical implications include contributions to the literature on competitive strategies in the building materials retail sector and the importance of adaptability in facing market changes. For future research, it is recommended to further explore the impact of digital technology and supply diversification strategies in a broader context, as well as assess the effectiveness of various competitive strategy approaches in different market conditions.

REFERENCES

Badan Pusat Statistik (BPS). (2022). Statistik Konstruksi Indonesia 2022.

Badan Pusat Statistik (BPS). (2023). Indeks Harga Perdagangan Besar (IHPB) Bahan Konstruksi.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (4th ed.). Sage Publications.

Emerson, R. M., Fretz, R. I., & Shaw, L. L. (2011). *Writing Ethnographic Fieldnotes* (2nd ed.). University of Chicago Press.

Johnson, M., Scholes, K., & Whittington, R. (2020). *Exploring Corporate Strategy*. Pearson Education.

Kvale, S., & Brinkmann, S. (2015). *InterViews: Learning the Craft of Qualitative Research Interviewing (3rd ed.)*. Sage Publications.

Lee, S., Yoo, S., & Kim, D. (2019). The impact of raw material price fluctuations on the construction industry. *Journal of Construction Engineering and Management*, 145(2), 04019011.

Marshall, C., & Rossman, G. B. (2016). *Designing Qualitative Research* (6th ed.). Sage Publications.

McKinsey & Company. (2021). The rise of digital in the building materials sector.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), 533-544

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. Free Press.

Rahman, A., & Dewi, F. (2020). Strategi Bersaing dalam Industri Ritel di Indonesia. *Jurnal Manajemen dan Bisnis*, 10(2), 125-135.

Setiawan, A. (2021). Adaptasi Strategi Pemasaran Toko Bangunan di Era Digital. *Jurnal Ekonomi dan Bisnis*, 15(1), 47-60.

Wibowo, A. (2019). Dampak Kebijakan Pemerintah terhadap Industri Konstruksi di Indonesia. *Jurnal Kebijakan Publik*, 8(3), 223-238.

Development of Balaghoh Badi' Questions based on HOTS using WordWall Media for Madrasah Aliyah Students

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Abstract

High Order Thinking Skill includes three important components in helping to improve the mindset, there are analyzing, evaluating, and creating. However, there is no implementation of HOTS in Balaghoh, because this matter were considered difficult, whereas HOTS can solve this because the student not only understand the matter, but also analyze, evaluate and create the sentences correctly without memorizing it. To help the students understand the useful of these *qowaid,* the researcher developed badi' questions based on HOTS with media word wall, this media can encourage the student to answer and help them to create the sentences like Arabs create it. The type of research used by researchers was R&D as well as data collection techniques used in this research is observation, interview, questionnaire and test. The sample in the study was third grade students of Madrasah Aliyah Raudhatul Ulum Sakatiga with a total of 20 students. The instrument in this study used a High Order Thinking Skill-based test totaling 50 questions that had been placed in WordWall media. The data analysis technique in this study used a question validity test which obtained a valid category on all questions. and the reliability test got a value of 0.974 which is a reliable category, in the item difficulty test there were 14 questions in the easy category, 24 questions in the medium category, and 12 questions in the difficult category. And in the test of discriminating power there are 22 questions

KEYWORDS

Badi', HOTS, Word Wall Media

1. INTRODUCTION

Learning has now entered the era of globalization, various learning innovations continue to be developed, including methods, media and evaluation with the aim that learning remains responsive and needed by students in facing the future challenges they will face(Mukmin et al., 2023).

However, unfortunately the evaluation of the achievement of Arabic language material cannot be said to be optimal, this is because the measurement of Arabic language ability is still focused on the cognitive domain, and cannot be said to be able to measure the affective and psychomotor domains (Hidayah, Mukmin, & Apriyani, 2024). Moreover, Arabic has a variety of Arabic language rules, the meaning and use of which this study never ends, and it seems that memorization still dominates the process of measuring rule mastery in various educational institutions, including Balaghoh rules.

Balagha lessons are subjects that are always categorized as difficult for Arabic language learners(Hidayah, Mukmin, & Sari, 2024). This difficulty is due to the imaginative rules contained in the sentence descriptions that use the Baalghoh rules, and this beauty of course must be mastered by students by increasing the amount of reading that contains these sentences. The problem is, the learning of rules in Indonesia is still dominated by long and lengthy explanations of the rules, so that what students perceive is only the length of the explanation of the rules.(Nuzula & Ammar, 2023)

Research related to the development of learning elements contained in balaghoh material has often been carried out, including trying to teach the material with the help of modules (Abdul Rahman et al., 2021); using methods that can increase students' cognitive abilities (Mukmin et al., 2023) and is able to improve the readability of beautiful, meaningful Arabic text (Ulin Nuha, 2022); relate the material contextually (Mukmin et al., 2024) or explaining problems in the learning process (Aufa & Maknuni, 2022) And to facilitate the delivery of material in learning, there is also the use of media in the form of inspiring lectures, both used as teaching media (Mabruroh & Gustiana, 2020) or used as media as a result of development (Mahliatussikah, 2021).

From several of these studies, researchers assess that one thing that is important to improve mastery of balaghoh is in terms of measurement. As stated by Sulaiman who concluded that one of the weaknesses of balaghoh learning is the weak assessment at the end of the lesson(Sulaiman & Wahid, 2021), even though the Arabic language learning process is vulnerable to intervention by the student's mother tongue(Hidayah, Mukmin, & Cardasyifa, 2024), so that sometimes it is confusing for students when

implementing these rules into sentences, students memorize the rules but stutter when using them.

It is still not possible to measure the achievement of Balaghoh material as a benchmark for assessing whether Balaghoh measurements can measure students' ability to master Balaghoh, or whether it is just material that must be memorized in the learning process(Nuzula & Ammar, 2023). One of the criteria that is being predicted to be able to make students innovate in learning is HOTS Ability, this ability consists of 3 main abilities, namely analyzing, evaluating and creating(Ismayani et al., 2020).

With HOTS, students are expected not only to memorize, understand and then apply, which is a basic ability in the thinking process, but also to be able to relate separate items to the rules being studied, create certain criteria or formulas and then create new patterns obtained from the results of the analysis process. and previous synthesis(Muradi et al., 2020).

To facilitate this, of course it is necessary to change the objectives at the beginning of learning, and this still seems to have to be explained in terms of teaching methods in order to achieve these objectives optimally. However, if this is still difficult to do, then questions wrapped in games are a way that can be chosen as an innovative solution and in accordance with the needs of an era that is very connected to technology(Mukmin et al., 2024).

Among the media that are often used to facilitate educational games are word walls, not only English language materials that often use this media as games(Azizah et al., 2024), social science material for elementary school children(Hartutik & Aprilia, 2024), even computer network engineering cannot escape the use of this media(Reza & Nopiyad, 2022), although in her article Putri questions whether wordwalls can be used in rural areas which in fact rarely uses digital media, but this does not necessarily make balaghoh a material that cannot use this media effectively. although balaghoh material is one of the studies in several schools which may not yet provide digital facilities. For this reason, the researcher tried to develop one of the balaghoh badi materials, namely syaja and jinas material into HOTS-based questions to then be implemented in wordwall media and introduced to Madrasah Aliyah students who were studying this study.

2. METHODOLOGY

This research uses qualitative and quantitative approaches in exploring balaghoh badi learning and the forms of questions that are usually given during classroom learning. For this reason, this research uses the RND method with a borg and gall design as a research step that will be used by researchers(Hidayah, Mukmin, & Sari, 2024), because this research not only creates questions but also wants to create and find out the quality of the questions from the results of the development carried out, the development steps include the following:

1. Potential and Problems

   In this step, the researcher will make observations on the balaghoh learning process that has been carried out from class X and conduct interviews with teachers or Madrasah Aliyah students who follow this material. These two activities will end when the root of the problem in the balaghoh badi material has been described well

2. Data collection

   The researcher will give a questionnaire consisting of 15 questions to students regarding students' needs for questions that can help students understand the balaghoh material that will be studied without having to memorize the burden in class.

3. Product Design

   At this stage, the researcher created the Balaghoh Badi' questions based on High Order Thinking Skill first, after that the researcher entered the questions based on High Order Thinking Skill into WordWall media.

4. Product Validity

   Researchers validated the question products created. The validation carried out was validation of the question form and WordWall media presentation.

5. Product Revision

   After obtaining validation, the researcher then carried out a product revision stage to correct the deficiencies contained in the WordWall media in accordance with the input and suggestions given by experts.

6. Product Trial

   The final step of this development stage is product testing, the researcher must apply the Badi' Science Material Questions based on High Order Thinking Skill using WordWall media into the learning process to find out whether the Badi' Science Material Questions developed using WordWall media are feasible and effective for students or not suitable to be used as a learning resource for students in MA

Research Place

This research was conducted at Madrasah Aliyah Raudatul Ulum which is located in South Sumatra. This school is one of the Islamic boarding schools that focuses on developing its students' abilities in Arabic, so that in everyday life, students are given the opportunity to express sentences in Arabic.

The process of using Arabic in everyday life requires good vocabulary mastery and must be accompanied by appropriate language rules, and balaghoh is one of the rules with the highest degree of difficulty compared to other rules, this is because balaghoh is a standardized rule that is usually used to express something that has beauty.

For this reason, researchers chose Balaghoh Badi to develop the problem with assistance *educational game*, so that students can elaborate on their abilities well without being burdened with rules that must be memorized.

Research Population and Sample

The research population in this research is Madrasah Aliyah students who have studied Balaghoh since they were in class

Data Collection and Research Analysis Methods

The data collection method in this research consists of observation which is used to see the evaluation process carried out by the teacher in the Balaghoh learning process. Second is interviews, researchers conduct interviews with teachers regarding the form of questions and the evaluation process carried out in the learning process. The third is a needs questionnaire for interactive balaghoh questions and a satisfaction questionnaire for the balaghoh questions given.

This research consists of two types of data, the existing qualitative data will be tested for the validity of the data by triangulation and then continued with miles and

Huberman analysis which consists of reduction, explanation and conclusion. Meanwhile, for quantitative data, the researcher carried out validity and reliability tests as a validity test, then continued with an analysis of the quality of the questions being developed, in the form of analyzing the level of difficulty of developing the questions and analyzing the discrimination or differentiating power of the questions being developed.

3. RESULTS AND DISCUSSION

3.1 Potential and Problems

The Badi Science material is the final level of balaghah subject study which discusses the beauty of the Arabic language and is one of the subjects at Madrasah Aliyah, based on an interview with the balaghoh teacher, Mrs. A stated that; "*In teaching I use the Balaghoh book which is a mandatory book in Islamic boarding schools, but in assessing, I have not used the application at all*". This is normal, considering that in most Islamic boarding schools, Balaghoh learning is still based on memorization and written exams regarding the meaning of the rules used(Hidayah, Mukmin, & Marfuah, 2023). However, if the measurement process could be carried out using games, of course the process could be more relaxed and students could express themselves better(Reza & Nopiyad, 2022)

To express well in Arabic, it is important that students are encouraged to think critically and encouraged to continue to create from the many rules taught, so that language rules are not just memorized but are also included in the process of speaking and writing Arabic(Wasilah et al., 2024). That's why it's important for students to be invited to play while learning, of course the games created are not games that don't require thinking, Madrasah Aliyah students' games must be able to be adapted to abilities that can make students think creatively and appliedly.

3.2 **Data collection**

Learning objectives for Badi Science Material at Madrasah Aliyah based on an interview with Mrs. A, " *We teach this material, so that students can understand the Al-Quran through pronunciation and meaning*". Judging from this objective, it is natural that this knowledge is not yet applicable, this is because the orientation of this material is still religiously oriented, so students' tendency to apply rules in the Arabic language process is still low(Mukmin et al., 2024).

This is coupled with the learning process which is still teacher oriented(Hidayah & Muyassaroh, 2023), students are taught using lecture and discussion methods. The

teacher is actively involved in the class as the center of the material and provides very little space for students to be actively involved in expressing sentences using the Balaghoh rules they have learned.

Based on the results of the needs questionnaire given to students, as many as 90% of students stated that balaghoh was very difficult material, 80% of students stated that balaghoh was not applicable, 82% stated that memorization was their way to pass this subject, 85% of students wanted to try a fun game but still fosters Arabic language skill training, and 75% agree that balaghoh is a source of the beauty of the Arabic language which should be well understood by Arabic language learners.

From the results of this questionnaire, it can be seen that students at this school have an awareness that balaghoh is a language rule that is very important to learn but has many obstacles when learning it.

3.3 **Product Design**

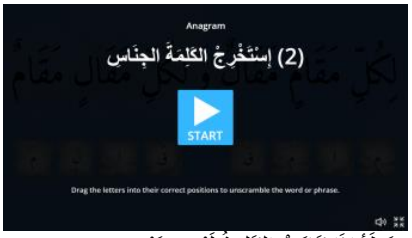
Development of Badi' based Science Material Questions *High Order Thinking Skill* has several steps including; identifying the material that will be developed, sequencing the presentation of the material that will be used as questions, creating question indicators that are in accordance with the HOTS indicators, choosing a wordwall template that can facilitate the questions that have been developed, inserting the questions into the media to then be presented after quality testing, as for the output from the development The questions can be seen in the presentation of the wordwall template below;

إِخْتَارْ الكَلِمَةَ بَيْنَ الجِنَاسَ وَ السَّجَعَ

Picture 1: First Development Question

أَكْمِلْ الكَلِمَةَ بَيْنَ الجِنَاسَ وَ السَّجَعَ

Picture 2: Second Development Question



صَحِيْحُ أَمْ خَطَأْ (صَحِيحُ إِذَا كَانَتْ الكَلِمَةُ الجِنَاسَ أَوَ السَّجَعَ), (خَطَأْ إِذَا كَانَتْ الكَلِمَةُ لَيْسَ غَيْرِ هِمْ)

Picture 3: Third Development Question

صِلْ عِبَارَاتِ القَائِمَةِ (أ) مَعَ يُنَاسِبُهَا عِبَارَاتِ القَائِمَةِ (ب) حَتَّى تَكُوْنُ كَلِمَةَ السَّجَعُ.

Picture 4: Fourth Development Question

إِخْتَارْ الجَوَابَ الصَّحِيْحَ بِوَضْعِ دَائِرَةٍ حَوْلَ الحَرْفِ المَنَاسَبَةِ

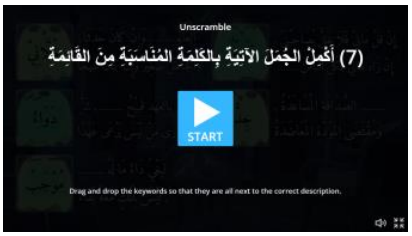
Picture 5 : Fifth Development Question

أُكْتُبْ الكَلِمَةَ الجِنَاسِ التَّامّ

Picture 6 Sixth Development Question

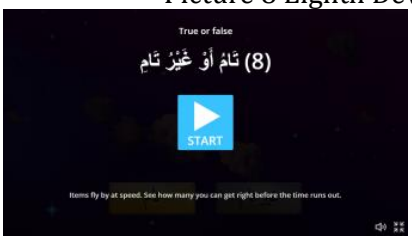
أَكْمِلْ الجُمَلَ الآتِيَةِ بِالكَلِمَةِ المَنَاسَبَةِ مِنَ القَائِمَةِ

Picture 7 Seventh Development Question



تَامٌ أَوْ غَيْرُ تَامٍ

Picture 8 Eighth Development Question



1. أَكْمِلْ الكَلِمَةَ السَّجَعَ الآتِيَةِ!!

Picture 9 Ninth Development Question

From this question the researcher focused only on the material *syaja'* and *and so on*. This question consists of 10 forms of questions that facilitate at least 3 HOTS level classifications. For the analyzing category; The verbs that will be used as question

indicators are checking and testing. The forms of development questions that have been carried out are in the form of questions 4 and 8

As for the evaluating category, the researcher uses the indicator of deciding and choosing, the forms of development questions that have been carried out are in questions 1, 2, 3, and 5. Meanwhile in the creating category, the researcher uses the indicator of formulating, the forms of development questions that have been carried out are in question 6 , 7, 9, and 10. Each question form consists of 5 questions, so the total questions developed in this wordwall media are 50 questions to test students' HOTS ability to understand the material *syaja* and *and so on* .

3.4 **Product Validity and Product Revisions**

The following are the scores for the assessment of the Badi Science Material Questions developed was 92,5, From the results of the validation above, it is known that the material in the Badi' Science Material Questions is based *High Order Thinking Skill* developed by researchers obtained a score with a percentage of 92.5, indicating that the questions were very valid and worth testing with improvements as follows:

Table 1. Results of Material Validation Revision

Revision	Error
1. إِخْتَارْ الجَوَابَ الصَّحِيْحَ بِوَضْعِ دَائِرَة	1. اختر الجواب الصحيح بوضع دائرة حول الحرف المناسبة
2. حَوْلَ الحَرْفِ المَنَاسَبَة	2. إختار الجملة بالقائدة
3. إِخْتَارْ الجُمْلَةُ بِالقَوَاعِدِ	3. تام أم غير تام إستخرج الكلمة بين تام أم غير تام
4. تَامْ أَمْ غَيْرُ تَامْ (إِسْتَخْرِجْ الكَلِمَةَ بَيْنَ تَامْ أَمْ غَيْرُ تَامْ)	4. إختار الكلمة الخطأ
5. إِخْتَارْ الكَلِمَةَ الخَطَأَ	5. صحح الخطاء الكلمات اليت تنها خط
6. صَحِّحْ الكَلِمَاتَ الأَخْطَاءِ الَّتِيْ تَحْتَهَا خَطُّ	إختار الجملة بالقائدة
إِخْتَارْ الجُمْلَةُ بِالقَوَاعِد	1. صحح الخطاء الكلمات اليت تتها خط
1. صَحِّحْ الكَلِمَاتَ الأَخْطَاءِ الَّتِيْ تَحْتَهَا خَطُّ	2. اقْتَبِسْ اللآية القُرْآنِ أَوْ الحَدِيْثُ الآتية
2. إِقْتَبِسْ اللآيَاتَ القُرْآنِيَّةِ أَوْ الأَحَدِيْثَ الآتِيَةِ	

From the table above, the focus of improving the language or material validator is the form of the questions and the use of appropriate words in creating the questions themselves. In terms of media, the following scores and categories of media assessment developed questions were 96

Based on the results of the validation above, it is known that the WordWall media in developing Badi' Science Material Questions is based *High Order Thinking Skill* which was developed by researchers obtained a score with a percentage of 96.66 with an indication of being very valid. So WordWall as a development medium is worth testing based on the following suggestions:

Table 2. Revision Based on Media Validation Results

Error	Revision
1. The distribution of questions is adjusted to make it easy to answer	The questions are divided into 10 questions consisting of 5 questions
2. Accuracy in selecting games based on material.	Adapted the questions to the WordWall game to make it better.

Based on the revised suggestions from the validator, the WordWall media is suitable for use with consideration of the question material so that it is more adapted to the material that will be studied by students at the school.

3.5 Product Trial

After going through the development stages above, the final step is to test the product to determine the effectiveness of question development through validity testing, validity testing, difficulty level testing and question differentiation testing.

Validity Test Results

The validity test in this research was carried out to measure the validity of the question pattern, question form, media features used in developing the questions were truly valid, the results of this validity trial calculation used the SPSS calculation tool. *(statistical package for social scieses)* The following validity results in this first question development session will be shown in the table below:

Table 3. Validity Analysis of Testing Questions

Question No	R Count	R Table	Decision making criteria	Information
1	0,643	0,444	If r count ≥ r table then the question is valid	Valid
2	0,461			Valid
3	0,743			Valid

4	0,773		If r count ≤ r table then the question is Invalid	Valid
5	0,461			Valid
6	0,721			Valid
7	0,743			Valid
8	0,589			Valid
9	0,769			Valid
10	0,680			Valid
11	0,830			Valid
12	0,461			Valid
13	0,461			Valid
14	0,589			Valid
15	0,701			Valid
16	0,527			Valid
17	0,578			Valid
18	0,773			Valid
19	0,830			Valid
20	0,830			Valid
21	0,773			Valid
22	0,589			Valid
23	0,672			Valid
24	0,461			Valid
25	0,773			Valid
26	0,743			Valid
27	0,589			Valid
28	0,830			Valid
29	0,527			Valid
30	0,461			Valid
31	0,773			Valid
32	0,743			Valid
33	0,589			Valid
34	0,830			Valid
35	0,527			Valid
36	0,461			Valid
37	0,461			Valid
38	0,461			Valid
39	0,773			Valid
40	0,830			Valid
41	0,818			Valid
42	0,461			Valid

43	0,461			Valid
44	0,743			Valid
45	0,773			Valid
46	0,527			Valid
47	0,743			Valid
48	0,773			Valid
49	0,680			Valid
50	0,461			Valid

Based on the table above, if r is calculated ≥ r table then the question is declared "Valid" If r is calculated ≤ r table then the questions are "Invalid", and in the table above it is known that the questions that have been developed by researchers are in the valid category for 50 questions.

Reliability Results of Testing Questions

The reliability test in this research was carried out to measure how far the measurement results remain consistent if measurements are carried out repeatedly using the same measuring instrument. The reliability test can be seen from the Cronbach Alpha statistical test, where if the Cronbach Alpha value is > 0.61, it is said to be reliable. The reliability test in this study used SPSS, the following results of the reliability test in this question is 0,974

Results of Analysis of Question Difficulty Levels

Test The level of difficulty of the questions has a level of difficulty or difficulty in the interval 0.00-0.30 for the difficult category, 0.31-0.70 for the medium category and 0.71-1.00 for the easy category. The level of difficulty of the test being developed is also obtained from the results of students in the field test, the results of calculating the level of analysis of this test question using the SPSS calculation tool *(statistical package for social scieses).* The following are the results of the difficulty level:

Table 4. Analysis of the Difficulty Level of Question Development

Question No	Difficulty Level	Category
1	0.60	Medium
2	0,80	Medium
3	0,55	Medium
4	0,50	Medium
5	0,80	Easy

6	0.60	Easy
7	0.55	Easy
8	0,15	Difficult
9	0,55	Difficult
10	0,55	Difficult
11	0,45	Easy
12	0,80	Easy
13	0,80	Easy
14	0,50	Medium
15	0,60	Medium
16	0,60	Medium
17	0,60	Medium
18	0,50	Medium
19	0,45	Medium
20	0,45	Easy
21	0,50	Medium
22	0,50	Medium
23	0,50	Medium
24	0,80	Medium
25	0,28	Difficult
26	0.55	Medium
27	0,50	Medium
28	0,45	Medium
29	0,16	Difficult
30	0,80	Easy
31	0.80	Easy
32	0.17	Difficult
33	0,50	Easy
34	0,45	Medium
35	0,50	Medium
36	0,80	Easy
37	0,80	Easy
38	0,55	Easy
39	0,50	Medium
40	0,60	Medium
41	0,15	Difficult
42	0,15	Difficult
43	0,15	Difficult
44	0,80	Medium

45	0,50	Easy
46	0,50	Medium
47	0,50	Medium
48	0,16	Difficult
49	0,15	Difficult
50	0,11	Difficult
Rate-rate	0,577	Medium

In the table above, it is known that there are 14 questions in the easy category, 24 questions in the medium category and 12 questions in the difficult category.

Results of Differentiating Question Analysis

High-level thinking skills items can be said to be very good if they get a score of 0.70-1.00, good if they get a score of 0.40-0.70, fair if they get a score of 0.20-0.40, and bad if they get a score of 0.00. -0.20. The differentiating power in the development of this question was obtained from the results of field trials *(field test)*. The results of the calculation of the level of differentiation analysis for this question use the SPSS calculation tool *(statistical package for social scieses)* The results of the differentiating power analysis of items regarding instruments can be displayed in the following table:

Table 5. Differentiating Power Instruments for Question Development

Question No	Differentiating Power	Category
1	0.643	Good
2	0,461	Good
3	0,743	Very good
4	0,773	Very good
5	0,461	Good
6	0.721	Very good
7	0.743	Very good
8	0,589	Good
9	0,769	Very good
10	0,680	Good
11	0,830	Very good
12	0,461	Good
13	0,461	Good
14	0,589	Good
15	0,701	Good
16	0,527	Good
17	0,578	Good

18	0,773	Very good
19	0,830	Very good
20	0,830	Very good
21	0,773	Very good
22	0,589	Good
23	0,672	Good
24	0,461	Good
25	0,773	Very good
26	0,743	Very good
27	0,589	Good
28	0,830	Very good
29	0,527	Good
30	0,461	Good
31	0,461	Good
32	0,461	Good
33	0,773	Very good
34	0,830	Very good
35	0,818	Very good
36	0,461	Good
37	0,743	Very good
38	0,773	Very good
39	0,527	Good
40	0,743	Very good
41	0,773	Very good
42	0,680	Good
43	0,461	Good
44	0,773	Very good
45	0,773	Very good
46	0,578	Good
47	0,680	Good
48	0,461	Good
49	0.589	Good
50	0,773	Very good
Rate-rate	0,652	Good

Based on the table above, it is known that in the development of the questions there were 22 questions in the very good category, 28 questions in the good category and there were no questions in the fair and poor categories.

After testing these 4 results, the researcher distributed satisfaction questionnaires to students whose results were as follows:

1. A total of 20 people felt happy, 3 people felt confused and normal, and 2 people felt challenged
2. 22 people answered that the questions made it easier for them to understand the material and 3 people answered that the questions made it difficult for them
3. 20 people answered that they didn't feel confused about the question, 2 people answered that it was quite confusing, and 3 people answered yes because the question was tricky.
4. 25 people answered the question to make them understand the rules of Badi Science Material.
5. 25 people answered that the questions were easy to do and 2 people found it difficult to do
6. 17 people answered that they did not need a relatively long time to answer the questions, and 8 people felt it took a little longer
7. All students thought that the questions helped in improving their thinking patterns
8. All students agreed that they had studied the material in the questions
9. 21 people answered that the use of sentences in the questions was easy to understand. 4 people found the questions quite difficult to understand
10. 24 people answered that the questions were presented well and 1 person answered that the questions were presented simply

From the results of this questionnaire it can be concluded that students are very happy with the development of this question, because language is a habit, if you don't get used to it then success in learning Arabic language rules is still very doubtful. Someone who is said to be able to speak Arabic cannot be measured by their ability to identify the position of words or the form of words expressed in a sentence, but the indicator of being able to speak Arabic must be seen from how someone is able to analyze, assess and then create a language with correct language rules both orally and in writing. .

To achieve all this, Arabic language teachers, especially balaghoh teachers, must have a clear mission in learning objectives, and it would be very good if these objectives were able to reflect the HOTS indicator as a benchmark for material achievement.

Apart from that, the material taught to students must be clear and contextual (Hidayah & Mukmin, 2021)Even though in the end students will be invited to see Arabic poetry, students must first identify where these rules are used in students' daily lives, so that these rules can be applied and not just memorized.

The method used in teaching balaghoh must also be interactive(Hidayah, Mukmin, & Eltika, 2023), as much as possible the teacher does not become the center of learning

when the Balaghoh learning process takes place. Because a student can achieve the learning objectives of course based on the way the teacher delivers it in class, it is time for learning media for Balaghoh material to be maximized, not only visual media, but also visual media. audio and visual, so that what appears to students is Arabic text or Arabic hiwar audio in which there are applicable balaghoh rules

And finally, the process of measuring the achievement of balaghoh material should not only be based on memorization, although it is very good if students memorize it, but understanding the use of the rules must be given more priority(Hidayah et al., 2021). The questions should be more creative and can be included in online or offline media, so that students get used to repeating the material they study through level practice questions. The online media for presenting questions does look more interesting(Hidayah, Mukmin, & Marfuah, 2023), because these questions don't look like questions, but like games that are often popular with today's young people, so this is very appropriate and very useful for teachers to continue to use in maintaining students' motivation in studying the Arabic language material studied in every school.

4. CONCLUSION

Researchers developed questions for the Badi Science subject based on higher thinking skills using WordWall media, and the higher thinking skills used consisted of three skills, namely analytical skills, evaluation skills and creativity skills. Researchers develop analytical skills through the True or False game which consists of ten questions, the Group Sort game which consists of five questions, and the Unscrumble game which consists of five questions. Chase Game which consists of five questions, and Matching Pairs Game which consists of five questions, Unscrumble which consists of five questions, Match Up which consists of five questions, and Quiz which consists of five questions. Researchers develop creativity skills through the Anagram game which consists of five questions, and the Hangman game which consists of five questions. This development is expected to be able to help students not only understand the rules of balaghoh which are often only memorized, but also this game aims to make students think deeply about the use of the material, so that when they are used to it, this understanding will be expressed in the Arabic language process both orally. or written.

REFERENCES

Abdul Rahman, M. S., Daoh, M., Ghazali, A. R., Ismail, M. R., Mohd Pisol, M. I., & Salahuddin, N. (2021). Effectiveness of the Learning Module for the Balaghah Subject At Higher Learning Institutes in Malaysia. *International Journal of*

Humanities, Philosophy and Language, *4*(14), 01–15. https://doi.org/10.35631/ijhpl.414001

Aufa, N., & Maknuni, J. (2022). Penerapan Model Pembelajaran Problem Based Learning (PBL) Upaya Meningkatkan Hasil Belajar Siswa pada Materi Balaghah. *Jurnal Aktual Pendidikan Indonesia (API)*, *1*(2), 41–45.

Azizah, B. S. H., Hidayati, Irwandi, & Edi. (2024). Meta-Analysis: The Effect of Word Search, Wordwall, Crossword, &Scramble Games in Learning English Vocabulary. *Journal of Language and Literature …*, *4*(1), 71–83. https://journal-center.litpam.com/index.php/jolls/article/view/1756

Hartutik, & Aprilia, R. (2024). Pengembangan Wordwall : Inovasi Media Pembelajaran Digital Terintegrasi. *Didaktika: Jurnal Kependidikan*, *13*(2), 1525–1540.

Hidayah, N., Mukmin, & Cardasyifa. (2024). Cefr Pada Materi Bahasa Arab : Inovasi Pembelajaran Ramah Anak Pada. *KIDDO : Jurnal Pendidikan Islam Anak Usia Dini*, *Spesial Edition: Araksa 1*, 117–127. https://doi.org/10.19105/kiddo.v5i1.12742

Hidayah, N., & Mukmin, M. (2021). The Contextualization of the Verse of the Qur'an in Learning Arabic and Its Effect on the Literation Ability of UIN Raden Fatah Students, Palembang. *… of International Geographical Education …*, *11*(7), 1050–1057. https://doi.org/10.48047/rigeo.11.07.99

Hidayah, N., Mukmin, M., & Apriyani, G. (2024). Kemampuan Abad 21 Siswa Pendidikan Menengah di Sumatera Selatan:Sebuah Tinjauan Pembelajaran Menulis Berbahasa Arab di Madrasah. *Al-Muktamar As-Sanawi Li Al-Lughah Al-Arabiyyah (MUSLA)*, 1–10. https://prosiding.iaincurup.ac.id/index.php/musla/article/view/17/21

Hidayah, N., Mukmin, M., & Eltika, L. (2023). Konsep Aritmetika pada Perubahan Kata Bahasa Arab. *Kalamuna: Jurnal Pendidikan Bahasa Arab Dan Kebahasaaraban*, *4*(2), 153–169. https://doi.org/10.52593/klm.04.2.04

Hidayah, N., Mukmin, M., & Marfuah, S. (2023). The Correlation between Arabic Learning Motivation and Arabic Language Competence of Education Study Program Students in PostCOVID-19 Pandemic. *Al Bayan: Jurnal Jurusan Pendidikan Bahasa Arab*, *15*(2), 380–398. https://doi.org/10.24042/albayan.v15i2.17453

Hidayah, N., Mukmin, M., & Rahma, M. (2021). Kecerdasan Dan Kepribadian Siswa di SMP IT Fathona Palembang Dan Pengaruhnya Terhadap Kemampuan Berbicara. *Taqdir*, *7*(1), 115–130. https://doi.org/10.19109/taqdir.v7i1.8455

Hidayah, N., Mukmin, M., & Sari, U. N. (2024). Learning evaluation of arabic morfhoplogy for tsanawiyah students based on 21. *International Conference On Islam And Education*, 222–242.

Hidayah, N., & Muyassaroh, L. (2023). Pembelajaran Bahasa Arab Bagi Non Muslim Berbasis Moderasi Beragama di Sekolah Umum. *Jurnal Ilmiah Wahana Pendidikan*, *9*(3), 103–104. https://doi.org/10.1306/st531003c13

Ismayani, R. M., Aditya, P., & Sary, S. (2020). Pelatihan penyusunan soal berbasis HOTS bagi guru bahasa Indonesia tingkat SMP Se-Kabupaten Subang. *Abdimas Siliwangi*, *3*(1), 173–185.

Mabruroh, & Gustiana, A. (2020). تطوير الوسائل التعليمية في درس البلاغة باستخدام برنامج لكطورا اينسبير. *Arabia: Jurnal Pendidikan Bahasa Arab*, *12*(1), 1–17. https://doi.org/10.21043/arabia.v12i1.6592

Mahliatussikah, H. (2021). Development of Interactive Learning Media "Lectora Inspire" for Balaghah Learning. *Advances in Social Science, Education and Humanities Research*, 128–133. https://doi.org/10.2991/assehr.k.211212.024

Mukmin, M., Hidayah, N., & Amelina, N. (2024). Evaluasi Program Intensif Bahasa Arab pada Kelas Akselerasi di Pondok Pesantren. *NASKHI: Jurnal Kajian Pendidikan Dan Bahasa Arab*, *6*(1), 38–47. https://doi.org/10.47435/naskhi.v6i1.2570

Mukmin, M., Hidayah, N., & Marpuah, S. (2023). Reorientation of The Arabic Language Curriculum for Secondary Education in The Endemic Era. *Arabiyât: Jurnal Pendidikan Bahasa Arab Dan Kebahasaaraban*, *10*(2), 217–229. https://doi.org/http://dx.doi.org/10.15408/a.v10i2.34960

Muradi, A., Mubarak, F., Darmawaty, R., & Hakim, A. R. (2020). Higher Order Thinking Skills Dalam Kompetensi Dasar Bahasa Arab. *Arabi : Journal of Arabic Studies*, *5*(2), 177. https://doi.org/10.24865/ajas.v5i2.293

Nuzula, U. N. S., & Ammar, F. M. (2023). Analisis Pembelajaran Ilmu Balaghah di Madrasah Aliyah Muhammadiyah 08 Takerharjo Solokuro Lamongan. *Emergent Journal of Educational Discoveries and Lifelong Learning (EJEDL)*, *3*(2), 1–7. https://doi.org/10.47134/emergent.v3i2.19

Reza, M. F., & Nopiyad, D. (2022). Pengembangan Media Evaluasi Pembelajaran berbasis Game Edukasi Wordwall pada Mata Kuliah Jarigan Komputer. *Jurnal Pendidikan Dan Konseling*, *4*(4), 5459–5467.

Sulaiman, R. H. R., & Wahid, N. A. (2021). Faktor-faktor Kelemahan Pembelajaran Balaghah [Factors of Weaknesses in Learning Balaghah. *International Journal of Contemporary Education*, *1*(1), 111–120.

Ulin Nuha, M. A. (2022). The Effectiveness of Using the SQ3R Method in Improving Maharah Qira'ah in Balaghah Learning at Al-Muhibbin Islamic Boarding School Tambakberas Jombang. *Al-Tadris: Jurnal Pendidikan Bahasa Arab*, *10*(2), 278–303. https://doi.org/10.21274/tadris.2022.10.2.278-303

Wasilah, Nazarmanto, Utami, S. T., & Hidayah, N. (2024). Cooperative Learning In Arabic Writing Skill with Media Chain Word Flag. *International Conference On Islam And Education*, 120–126.

Building Roof Model Influenced by Environmental Climate

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ABSTRACT

The roof is the main thing in a building that functions to protect the building and occupants. Indonesia has gable and trapezium roof models. Both have advantages and disadvantages. The advantages and disadvantages are managed to become a strength that complements the building. The roof consists of three parts, first the roof frame, second the roof covering frame and the covering material. The roof frame is often called the truss and is made of wood, iron, concrete or mild steel. The covering frame is often called a batten made of bamboo wood or mild steel. The roof is often called tiles made from clay, concrete or metal. Each roof construction has different slope requirements. The slope angle will affect the maintenance, durability and beauty of the building. Determining the angle must be careful and adjusted to the characteristics of the roof covering. The characteristics of the roof angle are influenced by the impermeability of the covering material. The more impermeable it is, the slower the angle will be. The climate also affects the existing roof model. The angle of the roof will be influenced by the environmental climate. The climate affects the use of roof angles.

KEYWORDS

Roof, roof angle, climate affect the roof.

1. INTRODUCTION

Many houses have good designs but have problems during the rainy season. Luxury homes have high walls, high ceilings but still use air conditioners for comfort. This phenomenon is all around us and it is the designer's job to solve it.

Research Gap. Some researchers have taken up the topic of models, the effect of materials on heat, and traditional roofs. This manuscript examines roofs in terms of climate adjustment. It is very interesting to study and few researchers have studied this topic. Choosing the wrong roof model and building height will make the building vulnerable to rainwater. We all know that many residential houses use roof models that do not pay attention to the environmental climate. Designers only pursue the latest house style but do not pay attention to the climate so that residents are less comfortable in the rainy season. Building designs that pay attention to the surrounding climate will result in comfort and ease of cleaning and maintenance.

Objective. Many residential buildings are built to extreme heights. The height of the building does not take into account the climate and the direction of the sun, so there will be problems when the sun shines on the house and when it rains. The house needs cool air. Air conditioning does not have to use high walls but can use proper ventilation according to the air flow in the environment(Badan Standarisasi Nasional, 2020; Zameeruddin & Sangle, 2021; Zięba & Skrzypczak, 2021). Building design needs to consider lighting, airflow, door and window direction(Kałuża, 2020; Kementerian PUPR, 2023),

Novelty. The manuscript has a novelty roof design that pays attention to the surrounding climate will produce a comfortable building, easy to clean and maintain as in table 1. This manuscript shows the things that should be considered when designing a roof. Many residential buildings only pursue the current model but are not climate-friendly. Buildings that do not pay attention to the climate and materials result in difficulties in maintenance and cleaning (Afrina et al., 2023; Ichwan Prastowo, 2023; Kementerian PUPR, 2023).

Significance. This manuscript is useful in guiding the design of residential houses. Homeowners can use this manuscript as a basis for designing houses. In addition, the manuscript has environmental studies that make the house sustainable. Sustainable home design is the dream of all homeowners.

2. METHODOLOGY

This research uses the literature analysis method. Literature analysis is used to process the field data obtained. Whether the roof design used has met the requirements for the angle, distance of the rafter and truss. Whether the use of materials is in accordance with the environmental climate. Validation of the literature with design data in housing and village houses is a guideline in producing conclusions.

Research Design. The study used an action research model. The action research in question is to observe the sample and then analyze it with existing guidelines and then conclude (Kartikawati, 2024; Kementerian PUPR, 2023; Parekh, 2024) Eden, Colin and Huxham, Christine; Clegg, S and Hardy, C and Nord, W, eds. (1996) Action research for the study of organizations. In: Handbook of organization studies. Sage, Beverly Hills, pp. 526-542.

Population and sample used. The population uses two groups, namely the residential roof model group and the roof model in the village. The sample takes several existing designs. Some images can be taken from the internet and analyzed and validated with guidelines summarized by several researchers.

Data Collection Techniques. The research data was collected using observation, analysis and confirmation. These three methods are needed to determine the climate around the house. The climate includes wind direction, rain direction, openings facing where and comfort (Hadi, 2020; Zameeruddin & Sangle, 2021)). This data is used as a parameter in validation and drawing conclusions. Validation uses PUPR regulations (Barkanov, 1978; Kartikawati, 2024; Kementerian PUPR, 2023; Parekh, 2024).

Tools or Instruments Used. The tools used were stationery in launching the question and answer media. Questions include some data on wind direction, rain direction, openings facing where and comfort. This question is equivalent with PUPR regulations.

Data Analysis Methods. The method used is observation and validation between field data and resume from PUPR regulations and journal articles. From the field data then validated with the results of several studies and existing regulations. Then recommendations are written for a building roof design. The above activities resulted in three recommendations, namely: meets; needs alignment; does not meet

3. RESULTS AND DISCUSSION

The results of the validation of regulations and scientific articles are as follows.

Table 1. Requirement Guidelines

No	Units	Indicator
1	Tile roof angle	30^0 -35^0
2	Zinc roof angle	20^0 -35^0
3	Angle of asbestos roof	20^0 -35^0
4	Roof edge height of each floor	175 -300cm
5	Wooden truss	Maximum span 700 cm
6	Iron tuss	Maximum span 1500 cm
7	Light steel truss	Maximum span 1000 cm
8	Facing Openings	According to local wind direction
9	Air flow	diagonal
10	Opening ratio	5-15%
11	Terrace width	200-300 cm
Nb:	Tile roof angle Above indicators require separate calculations	

Source: research Source: penelitian (Badan Standardisasi Indonesia, 2020; Badan Standarisasi Nasional, 2010; Hadi, 2020; Islam et al., 2020; Marwahyudi, 2019, 2020; "Micro- and Macro-Structural Analysis," 1993; Miha Timocevic, 2006; Nurdiah & Hariyanto, 2013; PUPR, 1991, 2021, 2018; Tomaževič, 2009; Ullah et al., 2022; Wibowo, 2021).

Table 1 serves as a guideline in calibrating, validating the data obtained. The roof angle is based on the climate in Indonesia. Indonesia has a tropical climate consisting of dry and rainy seasons. The biggest problem is rainwater, so the angle is expected to be safe and comfortable. The roof height is also influenced by the climate in Indonesia. This height is expected to be safe against tempias. Many buildings with high roof designs cause problems with rainwater. This problem causes discomfort in the activities inside. The span of the truss is based on the strength and length of the material in the field. If made in excess of the existing table then a detailed calculation is required. The facing of the opening is based on the method of wind entry and exit. Buildings produce maximum wind movement must meet

several requirements; openings facing the wind direction; using diagonal opening circulation; opening ratio 5-15%. The effective slag distance is 2-3 m. This distance is adjusted to rainy conditions with normal winds so that it is protected from tempias. If the above provisions are violated, it is likely that the building will get problems during the rainy season (National Standardization Agency, 2010; Gambarotta & Lagomarsino, 1997; Marwahyudi, 2020; M. Marwahyudi, 2019b; Y. galuh and Marwahyudi, 2020; Miha Timocevic, 2006; Nurdiah & Hariyanto, 2013; PUPR, 2018, 1991; Tomaževič, 2009(DL, 2023; Ernawati et al., 2022; Kementerian PUPR, 2023; Rezaie et al., 2022; Ullah et al., 2022)).

Figure 1. House Design

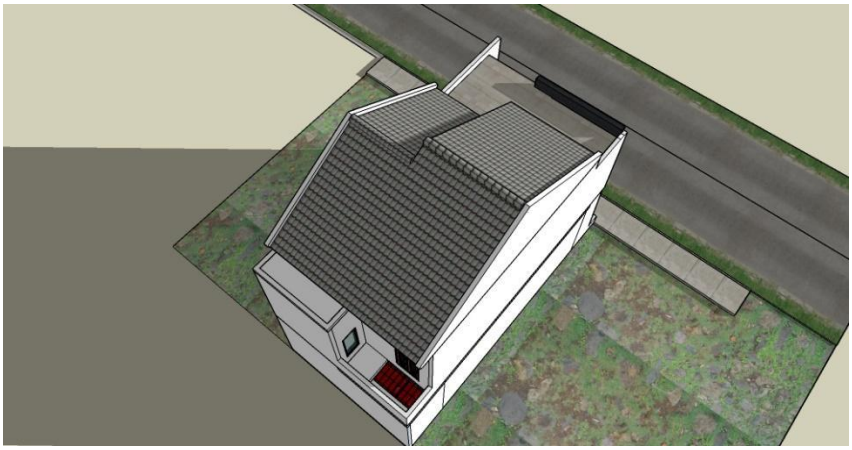

Figure 2. Top View of Window Location

Figure 3. Design Maximizes Wind and Sun Ventilation

The above design in figures 1, 2 and 3 shows a method that meets some of the provisions of table 1. So that in designing it needs some data that must be obtained.

Figure 4. Roof heights and terrace distances are not yet compliant

Figure 4 shows a design that does not meet Table 1 so that to get comfort it needs special treatment, namely additional canopy on the terrace. In addition, the balcony also requires a canopy.

4. CONCLUSION

The conclusion obtained is that the designed building must meet several regulations summarized in table 1. Table 1 describes some building criteria based on the climate in Indonesia. A comfortable building design must consider the climate. The data needed in

designing based on the surrounding climate are 1. Building facing anywhere, 2. Wind flow typology data, 3 wind during rain. In addition to climate-related data, of course, basic data in design must also be considered. Most homeowners don't pay attention to rainwater problems, they consider good, contemporary and cheap models. The results of this research provide guidelines for sizes that are safe for tropical climates. The table above can be used as a guide in designing a house so that the house has a good, contemporary, cheap and safe model for tropical climates.

REFERENCES

Afrina, C., Rasyid, S., Nazira, H., Oktaviani, A., Yoelanda, A. M., Syukrinur, S., & Elvi, E. (2023). Pentingnya Desain Interior terhadap Kenyamanan Pengunjung Perpustakaan. *Jurnal Pustaka Ilmiah*, *9*(1), 35. https://doi.org/10.20961/jpi.v9i1.67849

Badan Standardisasi Indonesia. (2020). SNI 1727:2020 Beban desain minimum dan Kriteria terkait untuk bangunan gedung dan struktur lain. *Jakarta*, *8*, 1–336.

Badan Standarisasi Nasional. (2010). *SNI 03-1726-2010 Standar Perencanaan Ketahanan Gempa untuk Struktur Bangunan Gedung dan Non Gedung*. Kementrian PUPR.

Badan Standarisasi Nasional. (2020). *Tata Cara Perencanaan Ketahanan Gempa untuk Struktur Bangunan Gedung dan Non Gedung*. *8*.

DL, A. M. A. M. G. (2023). The Spirit of The Value of the Diagonal Shear Stress of the Masonry on. *International Journal of Society Development and Engagement*, *7*(1), 68–75.

Ernawati, Tumingan, & Nugroho, B. (2022). Evaluasi Kuat Tekan Beton Menggunakan Hammer Test Dan Ultrasonic Pulse Velocity (Upv) Pada. *Jurnal Ilmiah Teknik Sipil Politeknik Negeri Samarinda*, *14*(1), 16–22.

Hadi, J. C. (2020). *PENERAPAN DESAIN RUANG KEBERANGKATAN DOMESTIK (PELABUHAN TANJUNG EMAS SEMARANG)*. *01*(2), 1–11.

Islam, M. S., Alwashali, H., Sen, D., & Maeda, M. (2020). A proposal of Visual Rating method to set the priority of detailed evaluation for masonry infilled RC building. *Bulletin of Earthquake Engineering*, *18*(4), 1613–1634. https://doi.org/10.1007/s10518-019-00763-5

Kałuża, M. (2020). Effectiveness of shear strengthening of walls made using aac blocks - laboratory test results. *Archives of Civil Engineering*, *66*(2), 33–44. https://doi.org/10.24425/ace.2020.131794

Kartikawati, D. (2024). View of Evaluasi Aspek Penghawaan Alami Terkait Sistem Ventilasi Bangunan Berdasarkan Standar Nasional Indonesia (SNI).pdf. *Gewang*.

Kementerian PUPR. (2023). Bangunan Gedung Cerdas. *Kementerian PUPR*, 1–24.

Marwahyudi, M. (2019). Typologi Kerusakan Masonry Infilled Frame. *MoDuluS: Media Komunikasi Dunia Ilmu Sipil*, *1*(1), 11. https://doi.org/10.32585/modulus.v1i1.376

Marwahyudi, M. (2020). Stiffness Dinding Batu Bata Meningkatkan Kekuatan Struktur. *Astonjadro*, *9*(1), 30. https://doi.org/10.32832/astonjadro.v9i1.2840

Micro- and Macro-Structural Analysis. (1993). *Developments in Geotechnical Engineering*, *66*, 279–348. https://doi.org/10.1016/B978-0-444-88911-9.50014-0

Miha Timocevic. (2006). *Earthquake Resistant Design of Masonry Building*. Emparial Collage Press.

Nurdiah, E. A., & Hariyanto, A. D. (2013). Struktur Rangka Atap Rumah Tradisional Sumba (Roof Structure of a Traditional Sumba House). *Semnas Reinterpretasi Identitas Arsitektur Nusantara*, 117–124.

Parekh, R. (2024). Automating the design process for smart building technologies. *World Journal of Advanced Reasearch and Reviews*, *23*(August), 1213–1234.

PUPR. (2018). Peraturan Menteri Pekerjaan Umum Dan Perumahan Rakyat Republik Indonesia Nomor 22/PRT/M/2018 Tentang Pembangunan Bangunan Gedung Negara. *JDIH Kementerian PUPR*, 1–20. https://jdih.pu.go.id/detail-dokumen/2594/1

PUPR, K. (1991). *SNI 03-2447-1991 Spesifikasi Rumah Tumbuh Rangka Beratap Dng Komponen Beton Pracetak.pdf*.

PUPR, K. (2021). Bangunan Gedung Hijau. *Sekretariat Negara Republik Indonesia*, *1*(078487A), 483. http://www.jdih.setjen.kemendagri.go.id/

Rezaie, A., Godio, M., Achanta, R., & Beyer, K. (2022). Machine-learning for damage assessment of rubble stone masonry piers based on crack patterns. *Automation in Construction*, *140*(June), 104313. https://doi.org/10.1016/j.autcon.2022.104313

Tomaževič, M. (2009). Shear resistance of masonry walls and Eurocode 6: Shear versus tensile strength of masonry. *Materials and Structures/Materiaux et Constructions*, *42*(7), 889–907. https://doi.org/10.1617/s11527-008-9430-6

Ullah, S., Farooq, S. H., Usman, M., Ullah, B., Hussain, M., & Hanif, A. (2022). In-Plane Seismic Strengthening of Brick Masonry Using Steel and Plastic Meshes. *Materials*, *15*(11). https://doi.org/10.3390/ma15114013

Wibowo, A. P. (2021). Pemodernan Atap Rumah Tradisional Jawa sebagai Upaya Pelestarian Kearifan Lokal. *Sinektika: Jurnal Arsitektur*, *18*(2), 141–147. https://doi.org/10.23917/sinektika.v18i2.15337

Zameeruddin, M., & Sangle, K. K. (2021). Performance-based Seismic Assessment of Reinforced Concrete Moment Resisting Frame. *Journal of King Saud University - Engineering Sciences*, *33*(3), 153–165. https://doi.org/10.1016/j.jksues.2020.04.005

Zięba, J., & Skrzypczak, I. (2021). *Multi-stage analysis of reliability of an example masonry construction*. https://doi.org/10.24425/ace.2021.137168

The Role of Technology to Sustainability in Building Maintenance for Infrastructure

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ABSTRACT

Based on the law No. 28 of 2002, The building is the outcome of construction activities that are either partially or entirely integrated into its location, whether on land or in water. In accordance with the definition of a building, the building must be able to be used for its intended function. In addition, all buildings have a service life. To achieve the planned service life, buildings must be maintained.

Building Information Modeling (BIM) is a building modeling process that was primarily based on 3D models and has been developed to 8D that provides information and tools that help the planning process to maintain assets more efficiently and effectively. BIM in its early days served to assist in the design, construction and operation of buildings. Although it has not been widely done, it is currently starting to develop BIM functions to assist building asset management. This article uses descriptive methods to describe the relationship between BIM technology and building maintenance for the implementation of sustainable building strategies. With this information, it is hoped that it can increase knowledge related to technology development for infrastructure which is very useful for easier maintenance on building assets and all data can be well organized. As well as the importance of the sustainable development strategy implementation.

KEYWORDS :

BIM; Building; Maintenance; Sustainable

1. INTRODUCTION

According to Indonesian Building, The building is the outcome of construction activities that are either partially or entirely integrated into its location, whether on land or in water. (Republik Indonesia, 2002). In accordance with the definition of a building, the building must be able to be used for its intended function. In addition, all buildings have a service life. To achieve the planned service life, buildings must be maintained.

The operation and maintenance of buildings in service have been ongoing for over 40 years(Jiao et al., 2023). The notions of "operation" and "maintenance" first appeared in 1976(Raouf & Kettunen, 1978). Building maintenance is essential for preserving an asset's value. It ensures that building systems operate efficiently, extends equipment lifespan, and maintains a comfortable environment while managing operations in a cost-effective manner. (Shi et al., 2020) describes a comparable framework that allows grouping preventive maintenance tasks for different systems based on expected reliability and a specified minimum reliability level. Both emphasize minimizing maintenance costs in their respective publications(Meissner et al., 2021).

Maintenance is generally categorized as either preventive or corrective. Preventive maintenance focuses on routine maintenance schedules, while corrective maintenance addresses reactive measures in response to failures or breakdowns. In current practice, information needed for preventive maintenance can be more readily prepared in advance compared to the information needed for corrective maintenance(Motawa & Almarshad, 2013). A major challenge in projects is ensuring that sufficient product information is readily accessible for any maintenance tasks, including specifications, records of previous maintenance, and lists of specialized professionals for the job. Since building maintenance (BM) spans the longest phase of a building's life and involves multiple stakeholders who may change over time, it is essential for authorities and clients to keep detailed records of the products in use (Nummelin et al., 2011) To improve maintenance management performance, the Building Information Modeling (BIM) approach is implemented and developed into 3D information models for overseeing and maintaining facilities in the study. By integrating the BIM model with relevant maintenance information, facility maintainers can enhance the efficiency of both maintenance and management tasks(Su et al., 2011).

The United Nations has established 17 Sustainable Development Goals, which pose significant challenges not only to governments but also to a broad range of stakeholders. The importance of sustainable buildings in achieving the UN's Sustainable Development Goals is emphasized through Goal 11, which focuses on Sustainable Cities and Communities (Marzouk et al., 2018). Sustainable development can be represented by a Venn diagram **(Figure 1),** with its three pillars being economic, social, and environmental. This diagram illustrates all possible logical relationships among these three pillars. Sustainability entails a responsible approach that reduces negative environmental impacts while maintaining a balance between these pillars. From this diagram, four domains of sustainable development are identified: ecological, economic, political, and cultural. Additionally, social and economic factors must be regulated by environmental considerations.

This article will explore how technology, specifically Building Information Modeling (BIM), contributes to sustainable building strategies and facilitates more efficient and effective maintenance.

Figure 1. Three pillars of sustainable development
Source :(Royer, 2019)

2. METHODOLOGY

This research purposes to describe the utilization of technology, specifically BIM, in an effort to implement a sustainable building strategy. In addition, from various related literature studies, it can be explained the role of BIM for sustainable infrastructure, maintenance on building components from the construction design stage to operation and maintenance. he data will be collected through a literature review related to BIM technology and its connection to sustainable building strategies. The study will review journals, scientific articles, reports, and other relevant sources to identify the role of BIM in sustainable infrastructure.

3.1 RESULTS AND DISCUSSION

3.2 BIM (Building Information Modelling)

Building Information Modeling (BIM) is revolutionizing the traditional methods of building delivery. The construction industry is expanding rapidly, and there is a growing demand for sustainable facilities that have minimal environmental impact. Sustainable development is categorized into areas such as water conservation, energy reduction, sustainable material procurement, industrial growth, recycling, waste minimization, climate change, transportation strategies, and biodiversity(Khan & Ghadg, 2019).

A crucial step in the planning process is to clearly define the potential benefits of BIM for the project and its team members by outlining the overall goals for its implementation. These objectives may focus on project outcomes and could include factors such as shortening the schedule, enhancing performance, improving quality, lowering change costs, or acquiring essential operational data for the facility (Videika & Migilinskas, 2020). IM is developed using object-oriented software. The most commonly used software includes REVIT, ARCHICAD, and BENTLEY. These programs operate with smart objects to create building components. These objects, which can be geometric or non-geometric, contain functional, semantic, or topological information (Kalfa, 2018). Through BIM systems, 3D models for architectural, structural, mechanical, electrical, and plumbing designs can be created. Additionally, for time planning, construction simulation, and cost analysis, 4D and 5D models are generated (Hardin & McCool, 2015). The dimensions of BIM are shown in **Figure 2**(Darko et al., 2020).

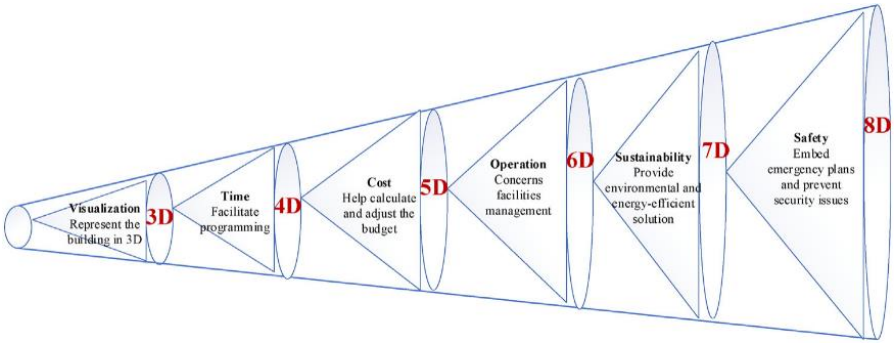

Figure 2. BIM Dimensions
Source : (Darko et al., 2020)

3.3 Process of Sustainable Building Operation and Maintenance Based on BIM

The selection of building techniques, components, and materials is typically based on factors such as functionality, technical performance, architectural aesthetics, cost, durability, and maintenance needs. However, this decision often overlooks the environmental and human health impacts. Sustainable building practices ensure that social, economic, and environmental factors are considered throughout the building's life cycle starting from the extraction of raw materials, through design, construction, usage, maintenance, renovation, and eventual demolition(Krawczyk et al., 2022). The process of sustainable building operation and maintenance is crucial to maximizing the life cycle and environmental benefits of modern buildings. BIM plays a transformative role in achieving sustainability objectives by enhancing efficiency and reducing resource consumption in building operations.

BIM is a collaborative digital model that represents the physical and functional properties of built assets, aiming to streamline design, construction, and operational processes for more informed decision-making. In Facility Management, BIM encompasses a comprehensive information repository, essentially a Big Data database, that serves as a building owner's manual. It offers valuable resources for analysis, supports emergency response, enhances security management, and facilitates scenario planning. As shown in **Figure 3** (Charef, 2022), There are various scenarios, including the application of BIM across the entire lifespan of the building.

Using BIM, facility managers and building operators can track real-time performance data, predict maintenance needs, and implement proactive measures to reduce energy use and minimize waste. This approach promotes a more sustainable building operation by optimizing resource utilization, reducing operational costs, and extending the building's lifespan. Additionally, BIM enables collaborative workflows among stakeholders, making it easier to address issues related to sustainability and compliance with environmental regulations.

Overall, adopting a BIM-based approach in the operation and maintenance of buildings is a step toward more sustainable and resilient infrastructure, aligning with the growing demand for environmentally responsible and energy-efficient practices in the built environment.

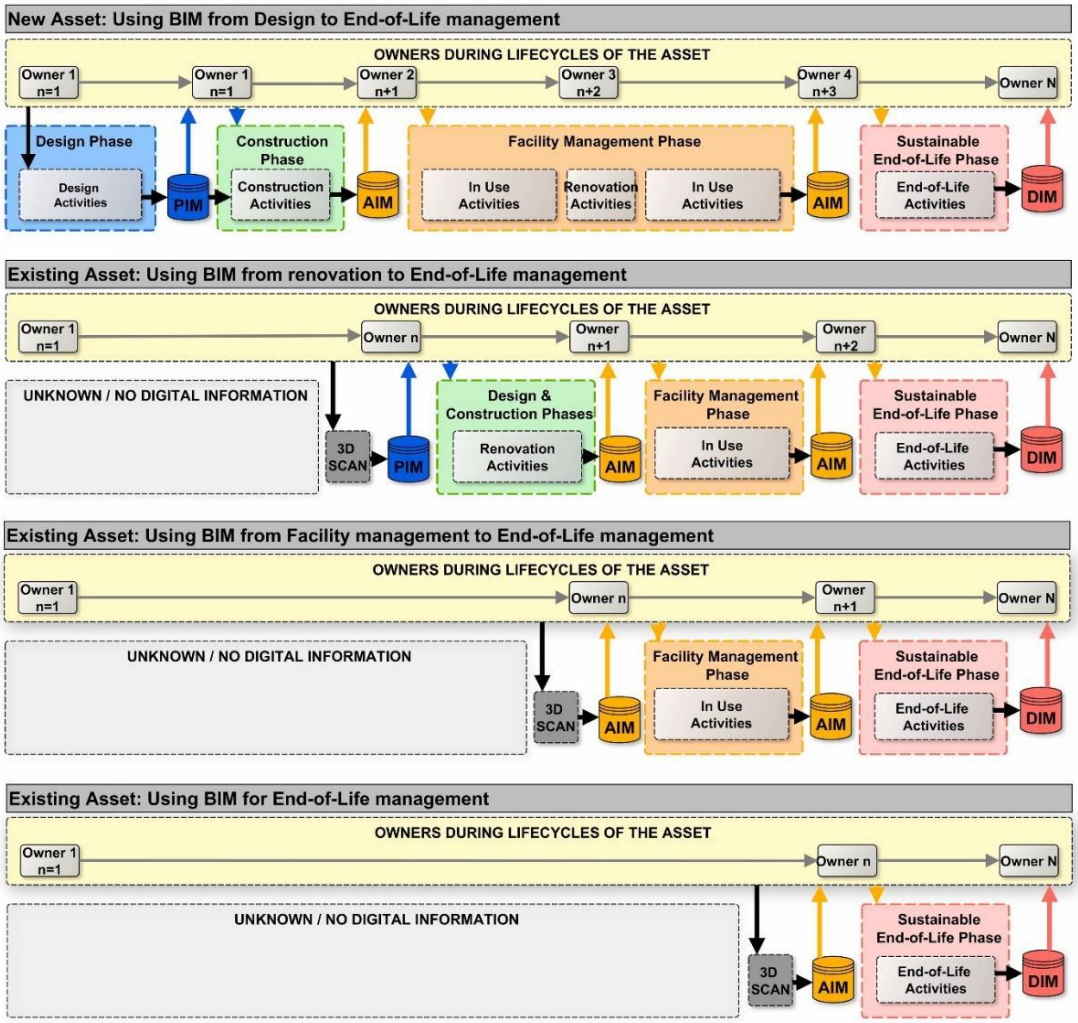

Figure 3. Various scenarios for the use of BIM throughout the asset lifecycle
Source : (Charef, 2022)

Facility personnel only need to connect the facility's maintenance documents to the relevant models once maintenance work is finished. Then, the facility manager or staff can easily access the information and maintenance documents using this external program. With the help of this program, users can gain a more thorough understanding of the facility's details and enhance the completeness of BIM implementation in facility management.

Each facility in a building is considered an individual entity with two types of properties: attributes and portfolios. Six types of basic equipment, such as HVAC, plumbing, and electrical systems, are represented as entities in BIM. Each entity has its own attributes (such as vendor information and location details) and associated documents (such as specifications, warranties, and manuals)(Wang et al., 2013). Product serial numbers specified by vendors will be gathered as unique identifiers for each facility. Model and part numbers serve as reference information during maintenance activities. Location details include the building number, floor, and room number, while the description provides the facility's current status. Attributes encompass weight, power, and energy consumption. This information is compiled into a standardized BIM database for seamless integration, interoperability needs to be assured, the illustration of the proposed structure the proposed BIM database for FM is shown in **Figure 4**(Wang et al., 2013)**.**

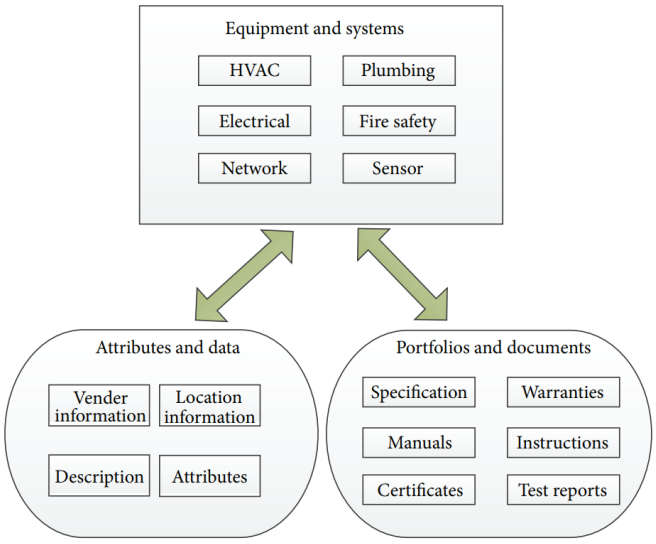

Figure 4. FM based BIM Database
Source : (Wang et al., 2013)

Furthermore, FM personnel can access relevant task data directly from BIM's graphical interface in real-time. For instance, when fixing a printer, they need to review the maintenance history, obtain the maintenance manual, create maintenance reports, and finalize the request. Traditionally, this would require logging into various electronic document management systems (EDMSs) and switching between multiple databases to gather all necessary information(Wang et al., 2013). Moreover, Building Information Modeling (BIM), as a virtual design and construction, is a communication tool for stakeholders. Besides, BIM is an effective strategy to minimize conflicts, misunderstandings and reduce uncertainties in the implementation and maintenance stages, in addition, BIM can visualize delay analysis for problem solving in the implementation and maintenance process in buildings.

Preventive maintenance (PM), also known as planned maintenance, involves preparing to perform maintenance tasks within the scheduled timeframe, which can help reduce the likelihood of accidents and failures to some extent (Dong et al., 2023). A schedule will be created for regular inspections. A detailed work description is recommended to enhance overall productivity, including the work order ID, facility ID, location, description of the preventive tasks, documents needed for maintenance, estimated and actual labor hours, and the frequency of maintenance activities (Wang et al., 2013). All of this data can be integrated into the BIM database as attributes and documents. By assigning a unique ID to each facility, a corresponding barcode can be provided to facilitate easy access to relevant information in real time via mobile devices. Furthermore, after each maintenance session, status updates and work hours will be sent back to the BIM system as feedback and reference for future tasks.

Figure 5. illustrates the workflow of BIM-based preventive maintenance (PM). By pre-designing maintenance details such as location information, relevant maintenance history, and PM schedules within BIM, the integrated data can be accessed efficiently. This ensures that future maintenance is well-planned and helps avoid unnecessary redesign (Wang et al., 2013).

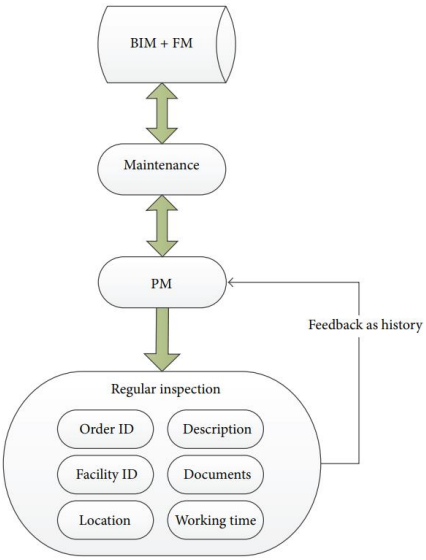

Figure 5. BIM-based Preventive Maintenance workflow
Source : (Wang et al., 2013)

By understanding the asset, the type of damage, and its maintenance requirements, an optimal maintenance interval can be determined. This is the preventive maintenance (PM) interval that minimizes maintenance costs throughout the asset's lifecycle for a specific PM task. A similar cost concept is illustrated in **Figure 6**, which demonstrates that extending the equipment's lifecycle through regular preventive maintenance can lead to substantial savings in operational and maintenance costs. In turn, preserving the building's service life aligns with the implementation of a sustainable building strategy.

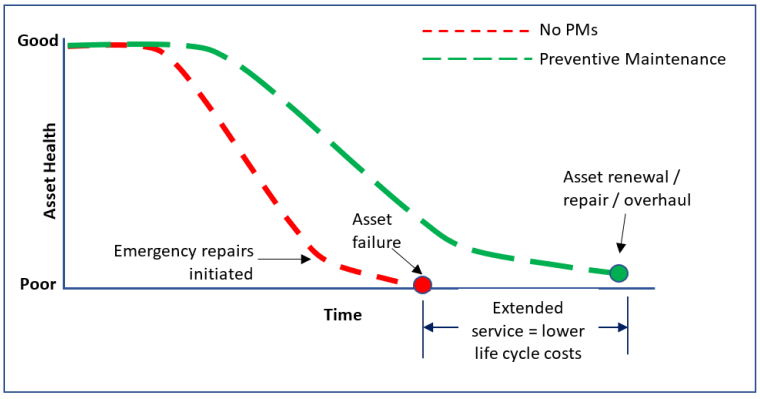

Figure 6. Relationship between Maintenance and Repair Costs
Source : (Borley, 2020)

3. CONCLUSION

BIM, as a repository for building assets and components, helps in managing the upkeep and maintenance of building elements, such as architectural, structural, utility, fire protection, accessibility, and environmental components, as well as building planning. Furthermore, through preventive maintenance, it can reduce associated costs. Continuous maintenance will ensure the building's longevity in line with the planned schedule. Therefore, utilizing BIM technology is an effective strategy for achieving sustainable buildings.

REFERENCES

Borley, J. (2020). *What is Preventive Maintenance?* Https://Www.Dynaway.Com/

Charef, R. (2022). The use of Building Information Modelling in the circular economy context: Several models and a new dimension of BIM (8D). *Cleaner Engineering and Technology*, *7*, 100414. https://doi.org/https://doi.org/10.1016/j.clet.2022.100414

Darko, A., Chan, A. P. C., Yang, Y., & Tetteh, M. O. (2020). Building information modeling (BIM)-based modular integrated construction risk management – Critical survey and future needs. In *Computers in Industry* (Vol. 123). Elsevier B.V. https://doi.org/10.1016/j.compind.2020.103327

Dong, L., Xiao, Q., Jia, Y., & Fang, T. (2023). Review of research on intelligent diagnosis of oil transfer pump malfunction. *Petroleum*, *9*(2), 135–142. https://doi.org/https://doi.org/10.1016/j.petlm.2022.01.002

Hardin, B., & McCool, D. (2015). *BIM and Construction Management : Proven Tools, Methods and Workflows* (Indiana, Ed.; Second Edition). Wiley & Sons.

Jiao, Z., Du, X., Liu, Z., Liu, L., Sun, Z., & Shi, G. (2023). Sustainable Operation and Maintenance Modeling and Application of Building Infrastructures Combined with Digital Twin Framework. *Sensors*, *23*(9). https://doi.org/10.3390/s23094182

Kalfa, S. M. (2018). Building information modeling (BIM) systems and their applications in Turkey. *Journal of Construction Engineering, Management & Innovation*, *1*(1), 55–66. https://doi.org/10.31462/jcemi.2018.01055066

Khan, A., & Ghadg, A. N. (2019). Building Information Modelling (BIM) based Sustainability analysis for a construction project. *Proceedings of Sustainable Infrastructure Development & Management (SIDM)*. https://ssrn.com/abstract=3366799

Krawczyk, D., Ruiz de Adana, M., Moreno-Pérez, M. F., Bullejos Marín, D., Teleszewski, T., & Teilans, A. (2022). *Sustainable buildings. Designing and management of cost-effective and eco-friendly systems*. https://doi.org/10.24427/978-83-67185-29-5

Marzouk, M., Azab, S., & Metawie, M. (2018). BIM-based approach for optimizing life cycle costs of sustainable buildings. *Journal of Cleaner Production*, *188*, 217–226. https://doi.org/10.1016/j.jclepro.2018.03.280

Meissner, R., Rahn, A., & Wicke, K. (2021). Developing prescriptive maintenance strategies in the aviation industry based on a discrete-event simulation framework for post-prognostics decision making. *Reliability Engineering and System Safety*, *214*. https://doi.org/10.1016/j.ress.2021.107812

Motawa, I., & Almarshad, A. (2013). A knowledge-based BIM system for building maintenance. *Automation in Construction*, *29*, 173–182. https://doi.org/10.1016/j.autcon.2012.09.008

Nummelin, J., Sulankivi, K., Kiviniemi, M., & Koppinen, T. (2011). *Managing Building Information And Client Requirements In Construction Supply Chain - Constructor's View*. https://api.semanticscholar.org/CorpusID:55392943

Raouf, A., & Kettunen, O. V. (1978). Developing Apartment Maintenance Systems As Urban Operations. *Kybernetes*, *7*(2), 131–140. https://doi.org/10.1108/eb005477

Royer, P. (2019). *Circular Economy, utopia or promising new business model? An evaluation of Circular Economy efficiency against environmental challenges*.

Shi, Y., Zhu, W., Xiang, Y., & Feng, Q. (2020). Condition-based maintenance optimization for multi-component systems subject to a system reliability requirement. *Reliability Engineering and System Safety*, *202*. https://doi.org/10.1016/j.ress.2020.107042

Su, Y. C., Lee, Y. C., & Lin, Y. C. (2011). Enhancing maintenance management using building information modeling in facilities management. *Proceedings of the 28th*

International Symposium on Automation and Robotics in Construction, ISARC 2011, 752–757. https://doi.org/10.22260/isarc2011/0140

Republik Indonesia. (2002). *Undang-Undang Republik Indonesia Nomor 28 Tahun 2002 tentang Bangunan Gedung*. Lembaran Negara Republik Indonesia Tahun 2002 Nomor 134

Videika, G., & Migilinskas, D. (2020). Evaluation Of The Main Standards For Sustainable Buildings And Evaluation Bim Details In The Commercial Project. *Mokslas - Lietuvos Ateitis*, *12*(0), 1–6. https://doi.org/10.3846/mla.2020.11379

Wang, Y., Wang, X., Wang, J., Yung, P., & Jun, G. (2013). Engagement of Facilities Management in Design Stage through BIM: Framework and a Case Study. *Advances in Civil Engineering*, *2013*(1), 189105. https://doi.org/https://doi.org/10.1155/2013/189105

The Strategic of School Principal Leadership in Dealing with School Management Problems at The Menara Fitrah Integrated Islamic High School

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ABSTRACT

School management plays a very important position in the implementation of education. However, in implementing school management, it cannot be separated from challenges and challenges. As the highest peak in the school's organizational structure, the principal has a significant role in determining direction and policy in the running of management at the school.This research aims to analyze the principal's leadership strategy in dealing with various school management problems at SMA IT Menara Fitrah and identify supporting and inhibiting factors in implementing the principal's leadership strategy. This research is a qualitative descriptive study. carried out at SMA IT Menara Fitrah, Ogan Ilir Regency. The key informant of this research is the school principal and the supporting informants are teachers and students. Research data was collected by interviews, observations and documentation studies. To obtain credible findings and data validity, triangulation techniques were used. The research results show that the principal of SMA IT Menara Fitrah applies transformational leadership strategies in dealing with school management problems. This strategy includes: building a clear and measurable school vision, mission and goals, maintaining a positive and supportive school culture, encouraging participation and empowering all school officials and stakeholders to achieve school goals, and developing an effective evaluation and accountability system. The factors that support the implementation of the principal's leadership strategy include the principal's commitment to realizing the school's vision, mission and goals. Meanwhile, factors that hinder the implementation of the principal's leadership strategy include the lack of communication and commitment of some school officials in supporting the success of school management.

KEYWORDS

Strategy; leadership; school management

1. INTRODUCTION

The development of the world of education is currently running very quickly in line with technological advances and globalization, as well as the demands and needs of society. This often causes various changes in the world of education both in terms of curriculum, systems and so on. In the world of education, there is an institution that is a means or forum to help implement education, namely the school (Julaiha, 2019).

Schools have a central and strategic position in developing all individual potential to be ready to live in the dynamics of life in the future . Schools now face much greater challenges than before, especially with regard to the communication and information era that is unfolding in the 21st century. Schools that are able to adapt to this era are certainly not ordinary schools, but schools that are able to manage their schools well and effectively. (Fathurrochman et al., 2022). Because schools as formal institutions need to have clear and measurable planning, organization, implementation and evaluation. So that the process of providing education in schools can run effectively and efficiently. Quality school management can produce a quality generation and can bring positive change to the country. (Musnaeni et al., 2022).

School management is a series of activities that utilize all components, both human and non-human, of the school in order to achieve efficient goals. School management can also be interpreted as a process or series of activities that have been prepared previously to achieve predetermined school goals. School management is the most important factor in organizing education and teaching in schools. Therefore, in managing a school, you must use a system in which there are related components such as teachers, TU staff , parents, community, government, and others which must function optimally. So, in schools, effective management is needed so that work can run smoothly (Fathurrochman et al., 2022). The implementation of education is very dependent on good management, including planning, organizing, directing and controlling (Syoviana, 2021). Schools that are not supported by appropriate management processes can result in irregular organizational rhythms that fail to achieve educational goals properly. Through good school management, future opportunities can be expanded and realized risks can be minimized (Musnaeni et al., 2022).

However, the process of implementing management in schools cannot be separated from various challenges and obstacles, according to Musnaeni et al. (2022) there are several challenges and problems found in the implementation of school management, namely, many school programs and activities which sometimes overlap with each other in their implementation; The number and quality of teachers is inadequate and the distribution of educational materials is uneven; The condition of infrastructure such as buildings, study rooms, laboratories, libraries and textbooks is inadequate; The education budget is very limited so that most schools' operational costs are below standard; As well as an ineffective learning process with too much administrative burden; as well as a lack of understanding of teachers and staff regarding strategic management, because teachers' and staff's understanding of strategic management is very important in implementing management in schools. To overcome these various problems , the leadership role of the school principal is needed.

The principal is the highest leader in the school organizational structure. The leadership of the school principal has a strategic role in determining various directions and policies in the school, especially in implementing management in the school (Siregar et al., 2022). So the principal must be able to manage school administration, communication, commitment, integrity, charisma, and think about school progress. The presence of the principal helps motivate all school staff , especially teachers and students. The principal is the key to the success of a school or institution, because the success of achieving school goals and quality

is greatly influenced by the leadership of the principal. Schools with good quality and management definitely have good principal leadership within them , so that the role of the principal determines the success or failure of the quality of education in the school.

SMA IT Menara Fitrah is one of the leading and integrated Islamic-based high schools in Ogan Ilir Regency, which has achieved various academic and non-academic achievements. In organizing its education, SM IT Menara Fitrah uses an integrated curriculum that integrates the national curriculum, namely the independent curriculum and the integrated Islamic curriculum, so that students at SMA IT Menara Fitrah are not only formed to be students who excel academically but also excel in Islamic religion and good morals. . In carrying out school management, the principal of SMA IT Menara Fitrah admitted that of course problems were found as well as supporting and inhibiting factors in overcoming these problems. Based on the research background, the researcher is interested in analyzing the principal's leadership strategy in dealing with various school management problems at SMA IT Menara Fitrah and identifying supporting and inhibiting factors in implementing the principal's leadership strategy.

2. METHODOLOGY

This research uses a qualitative research method with a qualitative descriptive approach. This research was carried out at SMA IT Menara Fitrah, Ogan Ilir Regency. The research subjects consisted of: the head teacher and students, with the principal being the key informant and the teachers and students being the supporting informants. Research data was collected by interviews, observations and documentation studies. To obtain credible findings and data validity, triangulation techniques were used. The data analysis technique used is the interactive model from Miles, Huberman & Saldana including collection, reduction, presentation of data and conclusions.

3. RESULTS AND DISCUSSION

3.1. School Management Problems

In essence, achieving educational goals in a school depends on whether or not all components in the school's management function effectively and efficiently. (Mu'awwanah & Zulela, 2021). Because the quality of managerial activities in schools will be related to the management of intra-curricular, co-curricular and extra-curricular activities which will lead to the quality of education in the school. So the better and more effective the school management, the better the output will be on the quality of education at the school (Dewi & Primayana, 2019). In implementing its educational process SMA IT Menara Fitrah uses the school management model of school-based management (MBS). This management pattern can encourage schools to independently carry out development and strive to increase all their potential in accordance with the conditions of the school. Management functions in schools basically include planning, organizing, implementing and controlling. The planning function includes strategic planning, operations and curriculum development. The organizing function includes grouping tasks, labor, and arranging classrooms and laboratories. Implementation functions include teaching, assessment, and student development. Meanwhile, the supervisory function includes monitoring and control activities to ensure that the stated objectives are achieved effectively and efficiently (Zohriah et al., 2023).

Effective school management is the main key in achieving quality education goals. However, in practice, the implementation of school management in Indonesia still encounters various problems that can hinder the achievement of goals according to research (Mu'awwanah &

Zulela, 2021). In general, the problems that are often found in school management in Indonesia are, first, limited resources such as school operational funds for teacher salaries, facility maintenance and procurement of learning media, limited and inadequate various school facilities. and limited qualified and competent educational staff. Second, there is a lack of an effective management system and understanding of school tools in school management. Third, the curriculum implemented in schools is not in accordance with students' needs and interests, and the management of various activities ranging from intracurricular, co-curricular and extracurricular activities is not optimal. Fourth, lack of cooperation and support from school stakeholders such as parents, community and government. At SMA IT Menara Fitrah, the implementation of school management is also not free from various problems, such as the lack of commitment of all school officials and stakeholders in supporting and realizing optimal school management, the consistency and optimality of several program responsibilities in carrying out various management functions and activities in the school. .

3.2. Principal Leadership Strategies in Facing School Management Problems

Leadership is one of the part most importantly in walking something organization . Without exists leader so A organization will lost direction in run his organization . As well as quality and ability leadership to the leader will role important in determine How quality walking organization the (Sriwahyuni & Kristiawan, 2019). Head school as leader highest in structure organization school own role important in determine direction and purpose school . Head school in institution education as decider A decisions and policies . Leadership head effective school very needed For overcome various problematic management school and achieve objective quality education . For that , chief school need have an internal strategy operate his role as leader school to get it face various problems that occur in implementation of school education , especially in matter management school (Mukhlisin, 2019). According to Head Menara Fitrah IT High School , his leadership strategy implement in face various problems at school , especially in face problematic managerial school including , first , in lead school organize various Educational processes, head Menara Fitrah IT High School uses style leadership transactional .

According to Handayani et al. (2023) Leadership transformational can interpreted Where a leader give motivation and direction to his subordinates For Work in a way maximum in reach objective company , leadership transformational originate from desire For transfiguring something organization going to more changes Good matter the applied by doing motivation , inspire and provide attention to his subordinates. Important for a leader For learn and apply style leadership in lead something organization , p This in accordance with study Nur et al. (2021)which reveals that interest a leader in learn and apply style leadership in company need improved Because can help leader become more wise and responsible answer and also can help leader in develop knowledge , experience and abilities .

According to Handayani et al. (2023) in his research namely , Innovation approach new in leadership become A need organizations that don't can avoided at all times This is one of them is style leadership transformationalf . Leadership style the needed Because in a way innovative can fertilize potency followers , can empowering staff nor organization through pattern thinking , improvement vision , recognition and understanding will objective organization , up to capable bring organization leads to sustainable change through procurement activity capital work ability as well as experience each follower so that himself feel involved and responsible answer in his job . Leadership transformational known as figure open leader with his followers , like leader with like heart accept criticism and suggestions. Through various policy the expected capable advance civilization with method unique .

Second , develop vision and mission clear and measurable school , according to head Menara Fitrah IT High School , vision mission is reference in organize various quality educational processes in schools , so that For minimize various possibility the problems that will arise happen in the future , then must be clear in determine vision and mission school . With exists clear vision and mission will give clear direction for all over school equipment and stakeholders in work The same For reach objective together , apart that also works help school For focus on what is important and avoid activities that are not in line with the goal . So from That vision and mission school must agreed and communicated to all school equipment and stakeholders , because in maintenance education at school need good role and collaboration between all party . According to study Hasan & Anita (2022) For reach repair Sustainable schools are very important For involving teachers, staff education , parents , society , in formulation vision , mission and goals clear and measurable school .

Third , improve quality planning school , planning is stage beginning in managerial management school at a time is important and crucial aspects in determined How quality maintenance management in schools , so planning various programs and activities school need arranged with mature and comprehensive . Deep strategy increase quality planning school at SMA IT Menara Fitrah was held with organize training preparation plans and devices learning For all teachers at SMA IT Menara Fitrah at this time before enter year teachings new . Planning schools at SMA IT Menara Fitrah include Plan Strategic (Renstra), Plan Work Annual (RKT), annual program , semester program, syllabus , lesson plans and plans others more operational . Planning schools at SMA IT Menara Fitrah were arranged with involve all over school equipment and stakeholders and must based on vision and mission school . According to study Anggraini et al. (2021) conclude that training about development device RPP for teachers in Pekanbaru effective in increase teacher's abilities in compile various planning in learning especially lesson plans and affordability minimize the obstacles experienced by teachers in preparing lesson plans at school .

Fourth , strengthening the school's organizational structure, the school's organizational structure must run effectively and efficiently in supporting the achievement of school goals. The principal of SMA IT Menara Fitrah, as the highest leader in the organizational structure at the school, always ensures that the organizational structure and division of tasks and roles in carrying out various educational processes at the school are clear, structured and in accordance with the potential and capacity of each person in charge. answered the program. The principal also needs to ensure that there is good communication and coordination between parts of the school. This is in accordance with research(Subekti, 2022) which concludes that education as an organization must be managed in such a way that educational program implementation activities in schools can run effectively, efficiently and productively to achieve the desired goals.

Fifth, improve the quality of teachers and school staff, teachers and school staff are the main assets for schools. Therefore, the principal of SMA IT Menara Fitrah designs and organizes various training and professional development programs for all teachers and staff in order to improve the quality of teachers and staff at SMA IT Menara Fitrah. School principals also try to create a conducive work environment for teachers and school staff so that they can work optimally. As well as trying to motivate and raise the work enthusiasm of teachers and school staff through various means, such as giving awards for achievements. This also aims to improve the optimization and quality of all activities at school, including intracurricular, co-curricular and extracurricular activities .

3.3. Supporting and Inhibiting Factors

The principal of SMA IT Menara Fitrah in implementing various leadership strategies to deal with various school management problems , is supported by several supporting factors and is also inseparable from inhibiting factors which become challenges in implementing the strategy. The supporting factors for the principal of SMA IT Menara Fitrah in implementing his various leadership strategies are, first , the principal's leadership abilities, such as visionary, communicative and motivational abilities , making it easier for the principal to implement his strategies and overcome various school management problems . Second , support from school stakeholders , who actively participate in various school programs and activities, and actively contribute their thoughts and energy to help the school achieve its goals. Third , adequate resources ; such as funds, facilities and educational personnel, are very important for school principals in implementing their strategies. Adequate resources will enable school principals to implement school programs effectively and efficiently. Fourth , supportive policies, both from the government, education services and foundations It is very important for school principals to implement strategies, because supporting policies will provide freedom for school principals to make decisions and implement school programs according to the needs and conditions of their school.

Apart from several supporting factors, there are also several inhibiting factors for the principal of SMA IT Menara Fitrah in implementing his various leadership strategies, namely, the lack of commitment of several administrators in the school structure who have the responsibility to be one part of the implementation of school management in carrying out their duties, because this will affect the process of implementing school management. Apart from that, the lack of optimal school apparatus in organizing and participating in various school activities and programs also affects the quality of school management implementation. Therefore, in implementing leadership strategies in dealing with various school management problems, school principals cannot do it alone, they need good collaboration and cooperation with all parties and school stakeholders. By understanding the supporting and inhibiting factors, school principals can be more effective in implementing their strategies as leaders in dealing with school management problems and achieving quality education goals.

4. CONCLUSION

School management is a series of activities arranged to achieve school goals. The implementation of education is very dependent on good management. However, in its implementation it is not uncommon to encounter various problems. Therefore, a good leadership strategy is needed from the school principal as the highest leader in the school organizational structure and determines various school policies in implementing school management. In carrying out his role as school principal and in carrying out school management, the principal of SMA IT Menara Fitrah has leadership strategies including , using a transactional leadership style, developing a clear and measurable school vision and mission, improving the quality of school planning, strengthening the school's organizational structure, and improving The quality of teachers and school staff, the supporting factors for the principal of SMA IT Menara Fitrah in implementing various leadership strategies, namely, the principal's leadership ability, which is visionary, communicative and motivating, support from school stakeholders , adequate resources , and appropriate policies . support. Meanwhile, the inhibiting factors, namely, the lack of commitment of some administrators in the school structure and the lack of maximum performance by school officials in organizing and participating in various school activities and programs also affect the quality of school management implementation. Therefore, in implementing leadership strategies in dealing with various school management problems, school

principals cannot do it alone, they need good collaboration and cooperation with all parties and school stakeholders.

REFERENCES

Anggraini, L. M., Wahyuni, P., Wahyuni, A., Dahlia, A., Abdurrahman, & Alzaber. (2021). Pelatihan Pengembangan Perangkat Rencana Pelaksanaan Pembelajaran (RPP) bagi Guru-Guru di Pekanbaru. Community Education Engagement Journal, 2(2), 62–73.

Dewi, P. Y. A., & Primayana, K. H. (2019). Peranan Total Quality Management (TQM) di Sekolah Dasar. Jurnal Penjaminan Mutu, 5(2).

Fathurrochman, I., Adilah, P., Anjriyani, A., & Praseya, A. Y. (2022). Pengelolaan Manajemen Sekolah yang efektif. Jurnal Pengabdian Kepada Masyarakat, 02(02), 1363–1374. https://doi.org/10.2207/jjws.91.328

Handayani, P., Astaivada, T., Aisyah, N., & Anshori, M. I. (2023). Konsep Kepemimpinan Transformasional. Cerdika: Jurnal Ilmiah Indonesia, 1(3), 84–101. https://doi.org/10.59141/cerdika.v1i7.123

Hasan, M., & Anita, A. (2022). . Implementasi Supervisi Akademik dalam Meningkatkan Kompetensi Dan Kinerja Guru di MA Al Ishlah Natar dan MA Mathlaul Anwar Cinta Mulya. At-Tajdid : Jurnal Pendidikan Dan Pemikiran Islam, 6(1), 85–97.

Julaiha, S. (2019). Konsep Kepemimpinan Kepala Sekolah. Tarbiyah Wa Ta'lim: Jurnal Penelitian Pendidikan Dan Pembelajaran, 6(3), 179–190. https://doi.org/10.21093/twt.v6i3.1734

Mu'awwanah, U., & M.S, Z. (2021). Problematika Fungsi Manajemen Sekolah Pada Pendidikan Sekolah Dasar Serandakan Kabupaten Serang School Management Functions in Education Primary School Serandakan Serang District. Jurnal Riset Pendidikan Dasar, 4(1), 1–7. http://journal.unismuh.ac.id/index.php/jrpd

Mukhlisin. (2019). NoKepemimpinan Pendidikan di Era Revolusi Industri 4.0 Title. Jurnal Tawadhu, 3(1), 674–692.

Musnaeni, Abidin, S., & Purnawati. (2022). Pentingnya Manajemen Strategi dalam Meningkatkan Kualitas Pendidikan. CENDEKIA: Jurnal Ilmu Pengetahuan, 2(2), 98–104.

Nur, A., Aprilianda, D., & Budiman, A. P. (2021). Konsep Kepemimpinan Transformasional. Jurnal Illmiah Indonesia, 1(7), 840–846.

Siregar, W., Lubis, M. J., & Darwin, D. (2022). Kepemimpinan Kepala Sekolah dalam Pelaksanaan Manajemen Sekolah. Jurnal Basicedu, 6(3), 3867–3874. https://doi.org/10.31004/basicedu.v6i3.2766

Sriwahyuni, E., & Kristiawan, M. (2019). Strategi Kepala Sekolah Dalam Mengimplementasikan Standar Nasional Pendidikan (SNP) Pada SMK Negeri 2 Bukittinggi. JMKSP (Jurnal Manajemen, Kepemimpinan, Dan Supervisi Pendidikan), 4(1).

Subekti, I. (2022). Pengorganisasian Dalam Pendidikan. TANJAK: Journal of Education and Teaching, 3(1), 19–29. https://doi.org/10.35961/tanjak.v3i1.422

Syoviana, E. (2021). Implementasi Perencanaan Strategis Organisasi dalam Rangka Pencapaian Tujuan Pendidikan. Jurnal STITNU Sadhar, 3(2), 12–17.

Zohriah, A., Farah Diba, I., Sultan Maulana Hasanudin Banten, N., Syekh Moh Nawawi Albantani, J., & Curug, K. (2023). Pelaksanaan Fungsi-Fungsi Manajemen Di Lembaga Pendidikan Dalam Meningkatkan Mutu Pendidikan. Journal on Education, 06(01), 5449–5460.

Optimal Bread Production Operator Placement by Using Hungarian Method

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ABSTRACT

CV Roti Bangkit is a home industry that produces packaged bread with various variations. CV Roti Bangkit is addressed in Kadisono, Tegaltirto, Berbah District, Sleman Regency, Special Region of Yogyakarta. Operator placement is done randomly in the manufacturing of oval cheese so that production targets are often not achieved. Therefore it's necessary to look at the position of operators.The problem of optimal operator placement can be done using the Hungarian method. Time data for each operator is measured for each work element, and the standard time is calculated. After receiving the most optimal operator placement, we can calculate the increased productivity before and after applying the assignment method. Based on this research, the standard operator time before applying the assignment method is 90.96 seconds, and after using the assignment method is 75.41 seconds. The level of productivity based on standard output calculations before and after the application of the assignment method increases productivity by 27.28%

KEYWORDS

hungarian method; optimal operator placement; productivity

1. INTRODUCTION

Human resources need to increase productivity at work. Poor productivity will cause variation in the output produced. To increase the success of a business, a company must be careful in carrying out the strategy or technique used. The problem that often occurs relates to the optimal allocation of labor. This problem is an assignment problem. The assignment problem starts with placing operators in several fields by determining the optimal time for each operator.

The issue of assigning operators can be done in two ways, namely manually or using software programs. This research searches the time for each operator for each work element, and then the operators' assignment will be allocated using the Hungarian method. The difference between before and after Hungarian implementation is tested with a hypothesis and continued with productivity calculations.

2. METHODOLOGY

The Assignment Method is part of a linear program that allocates job to specific subjects to obtain optimal results. Optimal results can be in the form of the most minimal costs, the maximum benefits, the minimum time, and so on. The analysis tool for this method uses the Hungarian method approach. This method is mutually exclusive, meaning that if someone has done a particular job, it is impossible to do another job (one person, one job).

Problems solved through the assignment method include Maximization problems Concerning issues of profit, sales, satisfaction, minimization problems concerning production costs, travel time, wages, etc (Kuru et al., 2019; Rusdiana et al., 2019; Sari et al., 2021; Son & Kim, 2014). There is also a requirement in the assignment method, namely that the number of rows in the assignment table must be the same as the number of columns (number of rows = number of columns). In other words, the number of operators must equal the number of jobs. An additional variable, namely a dummy, is needed if not equal. The dummy is added to the row or column of the assignment table. The dummy variable shows which jobs are not filled by anyone and operators without a job.

The research was conducted at CV Roti Bangkit, located at Kadisono, Tegaltirto, Berbah, Sleman, Yogyakarta. The research began in December 2021. The data needed in this research are as follows: Cheese oval bread production process, number of operators, number of work elements, Data on working time for each work element for each operator, and Data on standard operator time before and after assignment. Data collection was carried out by interviewing operators of the warehouse and marketing department in the company.

The data collected is then tested for adequacy until the data meet the criteria of $N' < N$. The uniformity of the data is based on calculating the Upper Control Limit (UCL) and the Lower Control Limit (LCL)(Panudju et al., 2021).

3. RESULTS AND DISCUSSION

Work measurements were constructed to obtain standard time data (Lukodono & Ulfa, 2018). Eight operators were assigned to perform eight elements of work. The eight work elements of the oval cheese bread production process are presented in Table 1 below:

Table 1. The Eight Elements of Work

Nu.	Element of Work	Nu.	Element of Work
1	dough cutting (P1)	5	Formation of Bread (P5)
2	dough balancing (P2)	6	Check (P6)
3	dough distribution (P3)	7	Giving Toppings (P7)
4	Baking Pan (P4)	8	Packaging (P8)

The observed data obtained for each work element in the cheese oval bread production process is presented in matrix shown in Table 2. The row section offers the operators and the column for the work elements. Furthermore, the assignment of operators using the Hungarian method is carried out by finding the smallest value of each row and column. The complete results are shown in Table 3 to Table 11.

Table 2. Standard Time Matrix (Sec)

Job Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	19.57	11.36	8.62	7.94	7.11	8.62	12.59	8.76
2	20.26	8.21	7.94	8.62	8.62	8.76	12.18	8.62
3	17.75	7.8	8.6	8.07	6.99	11.97	14.66	8.6
4	18.69	7.8	10.08	6.99	8.47	12.24	16.68	11.03
5	21.14	9.91	10.04	8.45	7.92	10.83	18.63	9.77
6	22.26	8.51	9.03	7.59	8.51	9.95	14.66	9.29
7	20.95	9.03	9.82	8.38	6.8	7.59	17.67	9.03
8	20.16	9.03	9.29	8.11	7.59	8.38	16.63	7.59

Look for the smallest value of each row in Table 2, then all values of each row are subtracted to the smallest value. The results of the calculation are presented in Table 3.

Table 3. Reduced Matrix (Sec)

Job Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	12.46	4.25	1.51	0.83	0	1.51	5.48	1.65
2	12.32	0.27	0	0.68	0.68	0.82	4.24	0.68
3	10.76	0.81	1.61	1.08	0	4.98	7.67	1.61
4	11.7	0.81	3.09	0	1.48	5.25	9.69	4.04
5	13.22	1.99	2.12	0.53	0	2.91	10.71	1.85
6	14.67	0.92	1.44	0	0.92	2.36	7.07	1.7
7	14.15	2.23	3.02	1.58	0	0.79	10.87	2.23
8	12.57	1.44	1.7	0.52	0	0.79	9.04	0

From Table 3, each row has a value of 0 (zero), but each column still needs to have a value of 0 (zero) as the same method is carried out for columns. Look for the smallest value from each column and subtract all with the smallest value from each column. The complete results are presented in Table 4.

Table 4. Total Opportunity Time Matrix (Sec)

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1.7	3.98	1.51	0.83	0	0.72	1.24	1.65
2	1.56	0	0	0.68	0.68	0.03	0	0.68
3	0	0.54	1.61	1.08	0	4.19	3.43	1.61
4	0.94	0.54	3.09	0	1.48	4.46	5.45	4.04
5	2.46	1.72	2.12	0.53	0	2.12	6.47	1.85
6	3.91	0.65	1.44	0	0.92	1.57	2.83	1.7
7	3.39	1.96	3.02	1.58	0	0	6.63	2.23
8	1.81	1.17	1.7	0.52	0	0	4.8	0

Table 4 shows a value of 0 (zero) for each row and column. Next, draw lines horizontally and vertically that cover all 0 (zero) values. To get the minimum possible lines, draw a line in the row or column with the highest 0 (zero) value first. The number of lines must equal the number of rows or columns, namely 8. If the number of lines differs from the number of rows or columns, then the table is not optimal. Then the same calculation process is carried out as shown in Table 5 to Table 11 below:

Table 5. Optimality Test **1**

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1.7	3.98	1.51	0.83	0	0.72	1.24	1.65
2	1.56	0	0	0.68	0.68	0.03	0	0.68
3	0	0.54	1.61	1.08	0	4.19	3.43	1.61
4	0.94	0.54	3.09	0	1.48	4.46	5.45	4.04
5	2.46	1.72	2.12	0.53	0	2.12	6.47	1.85
6	3.91	0.65	1.44	0	0.92	1.57	2.83	1.7
7	3.39	1.96	3.02	1.58	0	0	6.63	2.23
8	1.81	1.17	1.7	0.52	0	0	4.8	0

Table 6. Optimality Test **2**

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1.7	3.44	0.97	0.83	0	0.18	0.7	1.11
2	2.1	0	0	1.22	1.22	0.03	0	0.68
3	0	0	1.07	1.08	0	3.65	2.89	1.07
4	0.94	0	2.55	0	1.48	3.92	4.91	3.5
5	2.46	1.18	1.58	0.53	0	1.58	5.93	1.31
6	3.91	0.11	0.9	0	0.92	1.03	2.29	1.16
7	3.93	1.96	3.02	2.12	0.54	0	6.63	2.23
8	2.35	1.17	1.7	1.06	0.54	0	4.8	0

Table 7. Optimality Test **3**

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1.7	3.44	0.97	0.83	0	0.18	0.7	1.11
2	2.1	0	0	1.22	1.22	0.03	0	0.68
3	0	0	1.07	1.08	0	3.65	2.89	1.07
4	0.94	0	2.55	0	1.48	3.92	4.91	3.5
5	2.46	1.18	1.58	0.53	0	1.58	5.93	1.31
6	3.91	0.11	0.9	0	0.92	1.03	2.29	1.16
7	3.93	1.96	3.02	2.12	0.54	0	6.63	2.23
8	2.35	1.17	1.7	1.06	0.54	0	4.8	0

Table 8. Optimality Test **4**

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1.59	3.33	0.86	0.83	0	0.18	0.59	1.11
2	2.1	0	0	1.33	1.33	0.14	0	0.79
3	0	0	1.07	1.19	0.11	3.76	2.89	1.18
4	0.94	0	2.55	0.11	1.59	4.03	4.91	3.61
5	2.35	1.07	1.47	0.53	0	1.58	5.82	1.31
6	3.8	0	0.79	0	0.92	1.03	2.18	1.16
7	3.82	1.85	2.91	2.12	0.54	0	6.52	2.23
8	2.24	1.06	1.59	1.17	0.65	0.11	4.69	0

Table 9. Optimality Test **5**

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1.59	3.33	0.86	0.83	0	0.18	0.59	1.11
2	2.1	0	0	1.33	1.33	0.14	0	0.79
3	0	0	1.07	1.19	0.11	3.76	2.89	1.18
4	0.94	0	2.55	0.11	1.59	4.03	4.91	3.61
5	2.35	1.07	1.47	0.53	0	1.58	5.82	1.31
6	3.8	0	0.79	0	0.92	1.03	2.18	1.16
7	3.82	1.85	2.91	2.12	0.54	0	6.52	2.23
8	2.24	1.06	1.59	1.17	0.65	0.11	4.69	0

Table 10. Optimality Test **6**

Job / Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1	3.33	0.27	0.83	0	0.18	0	0.52
2	2.1	0.59	0	1.92	1.92	0.73	0	0.79
3	0	0.59	1.07	1.78	0.7	4.35	2.89	1.18
4	0.35	0	1.96	0.11	1.59	4.03	4.32	3.02
5	1.76	1.07	0.88	0.53	0	1.58	5.23	0.72
6	3.21	0	0.2	0	0.92	1.03	1.59	1.57
7	3.23	1.85	2.32	2.12	0.54	0	5.93	1.64
8	2.24	1.65	1.11	1.76	1.24	0.7	4.69	0

Table 11. Optimality Test **7**

Job Operator	P1	P2	P3	P4	P5	P6	P7	P8
1	1	3.83	0.27	0.83	0	0.18	0	0.52
2	2.1	0.59	0	1.92	1.92	0.73	0	0.79
3	0	0.59	1.07	1.78	0.7	4.35	2.89	1.18
4	0.35	0	1.96	0.11	1.59	4.03	4.32	3.02
5	1.76	1.07	0.88	0.53	0	1.58	5.23	0.72
6	3.21	0	0.2	0	0.02	1.03	1.59	1.57
7	3.23	1.85	2.32	2.12	0.54	0	5.93	1.64
8	2.24	1.65	1.11	1.76	1.24	0.7	4.69	0

Table 11 has obtained lines whose number equals the number of rows or columns, so the table is optimal. Then determine the assignment of each operator by selecting a row or column with a value of 0 (zero). From the assignment results using the Hungarian method, a trial was carried out by placing the operator back in the appropriate work element. Data adequacy and uniformity tests were then carried out for cycle time, normal time, and standard time. A comparison of the operator standard time before and after the assignment is shown in Table 12.

Table 12. Operator Standard Time Before and After Assignment

Element of Work	Operator	Initial Standard Time (sec)	Operator	Final Standard Time (sec)
dough cutting (P1)	6	14.66	1	11.65
dough balancing (P2)	2	10.08	2	7.8
dough distribution (P3)	4	22.26	3	17.38
Baking Pan (P4)	7	11.36	4	7.94
Formation of Bread (P5)	5	7.92	5	7.66
Check (P6)	3	8.38	6	7.8
Giving Toppings (P7)	1	8.71	7	7.59
Packaging (P8)	8	7.59	8	7.59
Total Waktu Proses		**90.96**		**75.41**

1. DISCUSSION OF FINDING

From the data obtained, a hypothesis test was carried out using the SPSS-21 computer program with the Paired-Samples T Test menu. The results show the significance of the test, namely that the value is 0.016 <0.050, which means H0 is rejected so that the standard time before and after the assignment is different. Increased productivity can be affected by the level of production or production standards. After repairing the assignment, we can calculate the new productivity. The increased productivity level can be calculated by comparing the improved standard output with the initial. For some related data, such as standard time data, operator working hours, and initial standard output, it is essential to calculate the standard production output that the company must achieve to increase productivity, as calculated below:

– ***Standard Output (SO) for Initial***

Calculation of the standard output of all elements of works from Table 5.13(Lukodono & Ulfa, 2018):

a. SO/hours = 1 hrs/90.96 sec = 1/1.51 minute = 1/0.025 hrs = 40 units/hours
b. SO/day = 7 hrs × 40 = 280 units/day
c. SO/week = 6 days × 280 = 1,680 units/week
d. SO/month = 26 days × 1,680 = 43,680 units/month

From the calculation of the initial standard output of the entire production process, the total production output of oval cheese bread is 43,680 units/month.

- ***Standard Output (SO) for Final***

Calculation of the standard output of all elements of works from Table 5.13 (Lukodono & Ulfa, 2018):

a. SO/hours = 1 hrs/75.41sec = 1/1.25 minute = 1/0.020 hrs = 50 units/hours
b. SO/day = 7 hrs × 50 = 350 units/day
c. SO/week = 6 days × 350 = 2,100 units/week
d. SO/month = 26 days × 2,100 = 55,600 units/month

From the calculation of the final standard output of the entire production process, the total production output of oval cheese bread is 55,600 units/month.

- **Calculation of Productivity Index**

Calculating the Productivity Index according to (Muhartono et al., 2020; Ramadhan & Waluyo, 2020)as below:

$$\text{IP} = \frac{\text{OS}_1 - \text{OS}_0}{\text{OS}_0} \times 100\%$$

$$\text{IP} = \frac{55600 - 43680}{43680} \times 100\%$$

$$\text{IP} = \frac{11920}{43680} \times 100\%$$

$$\text{IP} = 27.28\ \%$$

The percentage increase in productivity is 27.28%, equivalent to 11,920 units/month. From the data obtained, the productivity level has improved, and the company's production capacity is increased.

4. CONCLUSION

Based on the discussion from the study, the results obtained that the optimal placement of cheese oval bread production operators for each work element is operator 1 for the topping assignment with a standard time of 12.59 seconds, operator 2 for the dough distribution task with a standard time of 7.59 seconds, operator 3 for the dough cutting with a standard time of 17.75 seconds, operator 4 for the dough distribution with a standard time of 7.80 seconds, operator 5 for the bread forming with a standard time of 7.92 seconds, operator 6 for the task of basting the pan with a standard time of 7.59 seconds, operator 7 for checking with a standard time of 7.59 seconds, and operator 8 for the task of packing with a standard time of 7.59 seconds. The reassignment of operators at CV Roti Bangkit using the Hungarian method has increased productivity by 27.28%, or 11,920 units/month. Production output increased from 43,680 units/month to 55,600 units/month.

REFERENCES

Kuru, K., Ansell, D., Khan, W., & Yetgin, H. (2019). Analysis and Optimization of Unmanned Aerial Vehicle Swarms in Logistics: An Intelligent Delivery Platform. *IEEE Access*, *7*. https://doi.org/10.1109/ACCESS.2019.2892716

Lukodono, R. P., & Ulfa, S. K. (2018). DETERMINATION OF STANDARD TIME IN PACKAGING PROCESSING USING STOPWATCH TIME STUDY TO FIND OUTPUT STANDARD. *Journal of Engineering And Management In Industrial System*, *5*(2). https://doi.org/10.21776/ub.jemis.2017.005.02.5

Muhartono, A., HM, G. B., & Suparto. (2020). Pengukuran Produktivitas di PT. XYZ dengan Metode APC (AMERICAN PRODUCTIVITY CENTER) dan MARVIN E. MUNDEL. *Seminar Nasional Sains Dan Teknologi Terapan VIII 2020*, *53*(9).

Panudju, A. T., Marfuah, U., & Mutmainah. (2021). The Measurement of Standard Time for Analysis of Output Standards in the E-Commerce Process. *International Journal of Research and Innovation in Applied Science*, *06*(05). https://doi.org/10.51584/ijrias.2021.6508

Ramadhan, I. A. P., & Waluyo, M. (2020). Pengaplikasian Metode American Productivity Center (APC) Pada Pengukuran Dan Perencanaan Produktivitas Di PT. XYZ. *Jurnal Manajemen Industri Dan Teknologi*, *01*(05).

Rusdiana, S., Oktavia, R., & Charlie, E. (2019). Application Of Hungarian Method In Optimizing The Scheduling Of Employee Assignment And Profit Of Home Industry Production. *Journal of Research in Mathematics Trends and Technology*, *1*(1). https://doi.org/10.32734/jormtt.v1i1.754

Sari, G. A., Herwanto, D., & Nugraha, B. (2021). Optimalisasi WAKTU KERJA DAN JARINGAN PENDISTRIBUSIAN MAKANAN RINGAN MENGGUNAKAN MODEL ASSIGNMENT DAN HUNGARIAN. *Inaque : Journal of Industrial and Quality Engineering*, *9*(1), 81–95. https://doi.org/10.34010/iqe.v9i1.4364

Son, M. J., & Kim, T. W. (2014). Business process management-based job assignment in ship hull production design. *Ocean Engineering*, *88*. https://doi.org/10.1016/j.oceaneng.2014.05.010

The Effect Of Health Education On Nutrition On Increasing Mothers' Knowledge In Preventing Stunting In Children

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ABSTRACT

Background: Early childhood stunting is a chronic nutritional problem that results in impaired growth due to long-term nutritional deficiencies. Stunting can increase the risk of disease, inhibit brain and mental development, and affect children's motor development. Lack of maternal knowledge can increase the risk of stunting in children. Therefore, maternal education and knowledge are very important in preventing stunting, so it is necessary to increase knowledge through providing health education about nutrition. The purpose of this study was to analyze the effect of providing health education on nutrition on maternal knowledge in preventing stunting in children. Methods: This study used pre-experimental research with one group pre-test post-test design. The number of samples was 36 respondents and the sampling technique used total sampling. Data collection using a questionnaire. Data analysis using the paired sample t test statistical test. Research Results: The mean value of maternal knowledge before being given health education is 61.89 after being given health education is 87.36. The results of the Paired sample t test analysis obtained a p value of 0.001 <0.05. Conclusion: There is an effect of providing health education about nutrition on maternal knowledge in preventing stunting in children. Suggestion: nurses can carry out the role of educator through providing health promotion to mothers and the community as an effort to prevent stunting in children.

KEYWORDS

Health education; knowledge; stunting prevention

1. INTRODUCTION

Stunting is a failure of child growth caused by malnutrition, so that children do not grow like other children of the same age, which occurs from the beginning of pregnancy until after the baby is born. But stunting conditions will begin to appear after the baby is 2 years old. (Julita, Kusumarini dan Aulia, 2023). Stunting occurs as a result of a long period of malnutrition. A stunted child has a height-for-age index (TB/U) of less than minus two standard deviations (<-2 SD) or a toddler's height is shorter than it should be at a certain age. According to the World Health Organization (WHO) in Global Nutrition Targets 2025, stunting is considered an irreversible growth disorder that is largely influenced by inadequate nutritional intake and recurrent infections during the first 1000 days of life (KemenkesRI, 2021). Children can experience stunting due to a lack of maternal knowledge about special child nutrition in the first 1000 days after birth. The adverse effects of stunting in the short term are disruption of brain development, intelligence, impaired physical growth, and metabolic disorders in the body, and the long-term effects of stunting are decreased cognitive abilities and learning achievement, decreased immunity so that they get sick easily, and a high risk of diabetes, obesity, heart and blood vessel disease, cancer, stroke, and disability in old age. (Rini, 2020).

Stunting prevention starts from the preparation of prospective mothers to the period of maintaining the development of babies so that the quality of life of children is better. Pregnancy is a period of early life or commonly called the First 1000 Days of Life. This period is also often called the sensitive period. The development of human brain cells during this period determines the quality of future human resources, so if there is a disturbance during this period it will have a permanent, irreparable impact. Nutrition is one of the determinants of the quality of human resources, nutrition is also a factor that affects the health of the mother (Julita, Kusumarini dan Aulia, 2023).

The level of maternal knowledge is one of the factors that cause stunting in children. Mothers care for and determine the food consumed by children and other family members. Mothers who have poor knowledge about nutrition can make children experience nutritional disorders such as stunting. (Kuswanti dan Azzahra, 2022). Providing nutrition counseling can affect knowledge, and attitudes about stunting where there is an increase in maternal knowledge about stunting and an increase in maternal attitudes. (Mulyani et al., 2022). The role of mothers is very important in fulfilling children's nutrition, so that children can grow and develop optimally according to their age and avoid nutritional problems, one of which is stunting. (Munawaroh et al., 2022).

The results of the preliminary study found that 6 out of 10 mothers in 'Aisyiyah Bustanul Athfal Mandong Kindergarten, Trucuk, Klaten Regency did not know about good nutrition or nutrition for the prevention of stunting in children. The purpose of this study was to analyze the effect of providing health education on nutrition on maternal knowledge in preventing stunting in children.

2. METHODOLOGY

This study uses a one group pre-test and post-test pre experiment design which aims to increase mothers' knowledge in preventing stunting in children. The sampling technique used total sampling, a total of 36 respondents. Data collection using a knowledge questionnaire. Analysis using paired sample t-test.

Before providing education, researchers identified mothers who were willing to become respondents and asked mothers to fill out an agreement sheet to participate in research activities until completion. Researchers then asked respondents to fill out a characteristic questionnaire consisting of age, education, occupation, and asked respondents to fill out a knowledge questionnaire (pretest).

After the pretest, researchers provided nutrition education to mothers to increase their knowledge about nutrition in preventing stunting in children. Researchers and parents also discussed various matters related to child nutrition to prevent stunting. Researchers re-measured the mother's level of knowledge about nutrition (posttest) using the same questionnaire at the time of the pretest.

Data obtained during the research activities were collected and processed using computerization starting from the editing, coding, entry and tabulating stages. The data that has been processed is analyzed using the paired t test to determine whether or not there is an effect of nutrition health education on increasing maternal knowledge in preventing stunting in children and then presented in the form of a table.

3. RESULTS

a. Characteristics of Respondents

The characteristics of respondents in this study include age, education, and occupation. The characteristics of respondents can be seen in table 1 as follows:

Table 1 Frequency Distribution of Respondents Based on Age, Education and Occupation

Characteristics	Frequency (f)	Percentage (%)
Age		
Teenagers (17-25 years old)	5	13,9
Early Adult (26-35 years old)	22	61,1
Late Adult (36-45 years old)	9	25
Education		
Elementary		
Junior High	6	16,7
High School	23	63,9
Higher Education	7	19,4
Occupation		
Housewife (IRT)	23	63,9
Trader / Entrepreneur / Private Employee	8	22,2
Civil Servant	5	13,9

b. Univariate Test

Table 2. Distribution of Respondents' Knowledge Before and After Given Education

Knowledge	Pretest		Posttest	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Good	2	5,5	36	100
Fair	34	94,5	0	0

Less	0	0	0	0

Table 2 shows that there was an increase in maternal knowledge with a good value category in the posttest compared to the pretest. The maternal knowledge with a sufficient category at the time of the pretest was 34 respondents (95.5%) and good knowledge was 2 people (5.5%). After being given an educational intervention, all respondents' knowledge increased to a good category.

The results of this study are in line with the research of Amraini, et al (2024) which showed that before being given stunting education through audiovisual media, out of 45 respondents, there were 40 (88.9%) respondents with a good knowledge category and there were 5 (11.1%) respondents with a poor knowledge category. Meanwhile, after being given stunting education through audiovisual media, out of 45 respondents, 45 (100%) respondents were in the good knowledge category.

c. Bivariate Test

Table 4. Paired T-Test Results of the Effect of Providing Education

Knowledge	Mean	Difference	t	*p value*
Pretest	61,89	25,47	-25,48	0,0001
Posttest	87.36			

The results of the analysis in Table 4 show that the average knowledge of mothers before receiving counseling (pre-test) is 61,89 and after receiving counseling (post-test) is 87,36. These results indicate that there is an increase in maternal knowledge after receiving counseling on nutrition in preventing stunting in children. The T-Test results show that the p value which can be seen in sig (2 tailed) is 0.001 < α 0.05 which means that there is a significant difference in maternal knowledge before and after getting education.

4. DISCUSSION

Increasing one's age will change physical and psychological (mental) aspects. Respondents were mostly aged 26-35 years as much as 61.1%. Physical growth consists of four categories of changes, namely changes in size, changes in proportion, loss of old characteristics, and the emergence of new characteristics. These changes occur due to the maturation of organ functions. In the psychological or mental aspect, a person's level of thinking becomes more mature and mature. (Notoatmodjo, 2014). Age affects a person's capturing power and mindset, the older the age, the more developed the capturing power and mindset so that the knowledge gained will be even better. (Notoatmodjo, 2014). The results of this study are in line with the results of research conducted by Setyaningsih and Dari (2019) in the North Larangan Health Center area of Tangerang City, which found that almost all respondents had an early adult age, namely 67 respondents (90.5%). Maternal age affects knowledge and ability to make decisions. So the older a person gets, the more likely it is that knowledge will increase because of the information and experience gained. (Setyaningsih dan Dari, 2019). Age is a characteristic of a person that relates to his inner nature and nature in determining better behavior. (Mardianti dan Yuli Farida, 2020).

The level of education is an effort or activity to create conducive community behavior. The high formal education of a person can reflect the better knowledge and skills they have about the health they need. A person's high level of knowledge will be followed by better behavior towards a behavior. (Surury et al., 2021). The results showed that the majority of

respondents' education was high school as many as 23 respondents (63.9%). The results of this study are in line with previous research which states that there is a significant difference in the average value of the attitude of mothers of toddlers before and after being given Booklet media with the average pre-post value of knowledge of mothers of toddlers about stunting before being given Booklet media is 0,440 with a standard deviation of 0,501. (Khatimah, Iksan dan Avila, 2024). Education is one of the most important factors in determining parental behavior, because parents with high education will affect the health of their families, because a lot of information is obtained at school, but if someone has a low education, it is hoped that parents can increase their information from other sources outside of formal education or called informal channels such as through electronic media (television, radio, internet), reading newspapers, or magazines. (Teja, Mastryagung dan Diyu, 2021).

The work environment can make a person gain experience and knowledge, both directly and indirectly. The results showed that the majority of respondents' jobs were housewives as many as 23 respondents (63.9%). The results of this study are in line with the results of research conducted by Setyaningsih and Dari (2019) which analyzed that almost all respondents were housewives, namely 65 respondents (87.8%) and a small proportion of respondents were private employees, namely 2 respondents (2.7%). Work does not affect the knowledge of mothers, it can be seen from the results of this study which shows that some mothers who work as housewives have quite good knowledge compared to mothers who work. This is because many mothers are monitored at home by health workers. However, work is not an obstacle for mothers in feeding their children, because mothers who do not work do not always feed their children on time. (Siringoringo et al., 2020).

Stunting is a condition of growth failure in children under five due to chronic malnutrition, especially in the first 1,000 days of life (HPK). Stunting affects brain growth and development. Stunted children also have a higher risk of suffering from chronic diseases in their adult life. The problem of stunting occurs starting from the womb and will only be seen when the child reaches the age of two. UNICEF defines stunting as the percentage of children aged 0 to 59 months, with height below minus (moderate and severe stunting) and minus three (chronic stunting). This is measured using child growth standards issued by WHO. In addition to experiencing stunted growth, stunting is also often associated with the cause of poor brain development (Ginting, Simamora dan Siregar, 2022).

The results showed that the average value of maternal knowledge increased by 25.47, before being given health education amounted to 61.89 after being given health education amounted to 87.36. The results of the Paired sample t test analysis obtained a p value of 0.001 <0.05 so it was concluded that there was an effect of nutritional health education on increasing maternal knowledge in preventing stunting in children.

Nutrition education interventions include providing knowledge and providing motivation towards changing attitudes and child feeding behavior. Nutrition education can increase the awareness and concern of mothers of toddlers about the problem of stunting and improve their ability to make decisions related to children's health and nutrition.

The results of this study are in line with the results of previous studies which show a p value of 0.002 < α (0.05), meaning that there is a significant difference in the average knowledge value of pregnant women before and after being given Booklet media about stunting Pregnant women are expected to increase their knowledge and instill positive attitudes in order to carry out stunting prevention behavior through activities to increase the search for health information through health seminars, counseling at posyandu and utilizing health promotion media. (Zahra, Fitriani dan Yogaswara, 2021).

Previous research states that maternal factors that have a significant relationship with the incidence of stunting in children are maternal knowledge about nutritional status in children, exclusive breastfeeding and complementary feeding. Nutritional knowledge has an impact on the mother's parenting to her child. Mothers with poor nutritional knowledge tend to pay less attention to the food intake given to their children, so that children have the opportunity to become malnourished and end up becoming stunted children. This can be a reflection that the mother's level of knowledge about nutrition is very supportive of child development and growth. Where in practice mothers are required to understand what are the factors that cause stunting tendencies. So that mothers can provide precise nutritional needs according to the needs of handling stunting cases. (Wati, Kusyani dan Fitriyah, 2021)

5. CONCLUSION

There is an effect of providing health education about nutrition on maternal knowledge in preventing stunting in children. Suggestion: nurses can carry out the role of educator through providing health promotion to mothers and the community as an effort to prevent stunting in children.

REFERENCES

Ginting, S., Simamora, A.C. dan Siregar, N. (2022) "Pengaruh Penyuluhan Kesehatan Dengan Media Audiovisual Terhadap Perubahan Pengetahuan, Sikap, dan Praktik Ibu Hamil Dalam Pencegahan Stunting di Kecamatan Doloksanggul Kabupaten Humbang Husundutan Tahun 2021," Journal of Healtcare Technology and Medicine, 8(1), hal. 2615–109.

Julita, S., Kusumarini, N. dan Aulia, N. (2023) "Pendidikan Kesehatan dengan Media Audiovisual untuk Meningkatkan Pengetahuan tentang Pencegahan Stunting," Jurnal Penelitian Kesehatan Suara Forikes, 14(April), hal. 254–256.

KemenkesRI (2021) Profil Kesehatan Indonesia, Pusdatin Kemenkes. Jakarta: Kementerian Kesehatan Republik Indonesia.

Khatimah, N.H., Iksan, M. dan Avila, D.Z. (2024) "Perbedaan Pengetahuan Dan Sikap Ibu Balita Sebelum Dan Sesudah Menggunakan Media Booklet Tentang Stunting," Jurnal Kesehatan Tambusai, 5, hal. 2662–2673.

Kuswanti, I. dan Azzahra, S.K. (2022) "Jurnal Kebidanan Indonesia," Jurnal Kebidanan Indonesia, 13(1), hal. 15–22.

Mardianti dan Yuli Farida (2020) "Faktor – faktor yang berhubungan dengan status imunisasi dasar pada bayi di Desa Rengasdengklok Selatan Kabupaten Karawang," Jurnal Kebidanan Indonesia, 5(3), hal. 248–253.

Mulyani, N.S. et al. (2022) "Peningkatan pengetahuan dan sikap ibu untuk pencegahan stunting di Kabupaten Aceh Besar," Jurnal PADE: Pengabdian & Edukasi, 4(1), hal. 28. Tersedia pada: https://doi.org/10.30867/pade.v4i1.810.

Munawaroh, H., Nada, N. K., Hasjiandito, A., Faisal, V. I. A., Heldanita, H., Anjarsari, I., & Fauziddin, M. (2022). Peranan Orang Tua Dalam Pemenuhan Gizi Seimbang Sebagai Upaya Pencegahan Stunting Pada Anak Usia 4-5 Tahun. Sentra Cendekia, 3(2), 47-60.

Notoatmodjo, S. (2014) Pendidikan Dan Perilaku Kesehatan. Jakarta: EGC.

Rini, W.N.E. (2020) "Pengaruh Penggunaan Media Audio Visual Terhadap Peningkatan Pengetahuan Ibu Tentang Stunting di Puskesmas Rawasari Kota Jambi Tahun 2019," Jurnal Kesmas Jambi, 4(1), hal. 23–27. Tersedia pada: https://doi.org/10.22437/jkmj.v4i1.8939.

Setyaningsih, P.H. dan Dari, E.W. (2019) "hubungan pengetahuan ibu tentang imunisasi dasar dengan kelengkapan imunisasi dasar di wilayah Kerja Puskesmas Larangan Utara Kota Tangerang.," Edudharma Journal, 3(2), hal. 44–55.

Siringoringo, E.T. et al. (2020) "Karakteristik keluarga dan tingkat kecukupan asupan zat gizi sebagai faktor resiko kejadian stunting pada baduta," Journal of Nutrition Collage, 9.

Surury, I. et al. (2021) "Analisis Faktor Risiko Ketidaklengkapan Imunisasi Dasar Pada Bayi Di Wilayah Jember," Jurnal Kedokteran dan Kesehatn, 17(1), hal. 18–26. Tersedia pada: https://doi.org/10.52264/jurnal_stikesalqodiri.v7i1.113.

Teja, N.M.A.Y.R., Mastryagung, G.A.D. dan Diyu, I.A.N.P. (2021) "Hubungan Pengetahuan Dan Paritas Dengan Anemia Pada Ibu Hamil," Jurnal Menara Medika, 3(2), hal. 143–147.

Wati, S.K., Kusyani, A. dan Fitriyah, E.T. (2021) "Pengaruh faktor ibu (pengetahuan ibu , pemberian ASI- eksklusif & MP-ASI) terhadap kejadian stunting pada anak," Journal of Health Science Community, 2(1), hal. 13.

Zahra, A.S., Fitriani, S. dan Yogaswara, D. (2021) "Perbedaan Pengetahuan dan Sikap Ibu Hamil Sebelum dan Sesudah Menggunakan Media Booklet tentang Stunting," Jurnal Penelitian dan Pengembangan Kesehatan Masyarakat Indonesia, 2(2), hal. 123–128. Tersedia pada: https://doi.org/10.15294/jppkmi.v2i2.52427.