JURNAL PENDIDIKAN VOKASI

JURNAL PENDIDIKAN VOKASI

Jurnal Pendidikan Vokasi
Vol. 12, No. 2, June 2022

ADGVI
ASOSIASI DOSEN & GURU VOKASI INDONESIA
IN COOPERATION WITH
GRADUATE SCHOOL OF
UNIVERSITAS NEGERI YOGYAKARTA

9 772476 940005

9 772088 286003

JURNAL PENDIDIKAN VOKASI

JURNAL PENDIDIKAN VOKASI

Jurnal Pendidikan Vokasi publishes three issues a year
in February, June and November
disseminating the result of scientific studies and research
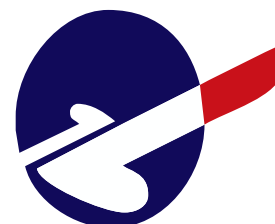
ADGVI

ASOSIASI DOSEN & GURU VOKASI INDONESIA
IN COOPERATION WITH
GRADUATE SCHOOL OF
UNIVERSITAS NEGERI YOGYAKARTA

Jurnal Pendidikan Vokasi
Vol. 12, No. 2, June 2022

The effect of online learning quality on vocational students' learning achievement during the Covid-19 Pandemic

Feri Ferdian * (ID)**, Hijriyantomi Suyuthie**
Universitas Negeri Padang, Indonesia.
* Corresponding Author. Email: feri_ferdian@fpp.unp.ac.id

ARTICLE INFO

ABSTRACT

This study aimed to analyze the effect of online learning quality on vocational students' learning achievement during the Covid-19 pandemic. This type of research uses a quantitative approach with ex post facto research, which aims to analyze exogenous variables (online learning quality) with endogenous variables (vocational students' learning achievement during the Covid-19 pandemic). The population of this study was 198 vocational students in the hotel management program Universitas Negeri Padang who took the front office operations two courses in the semester of January-June 2021. The sampling technique used in this study is total sampling. The number of successfully collected respondents was 174 people (87,9%). The data analysis technique used is simple linear regression analysis. The results showed that: (1) Online learning quality during the Covid-19 pandemic is a sufficient category, (2) Vocational students' learning achievements during the Covid-19 Pandemic are also in a good category, and (3) There is a significant influence on the online learning quality variable on the vocational students' learning Achievement during the Covid-19 Pandemic. The magnitude of the online learning quality variable's influence on the vocational students' learning achievement during the Covid-19 Pandemic is 2.7%, while other factors determine 97.3%. This finding also provides a basis for other researchers to look at and have a wider scope, especially those related to student learning achievement. Vocational programs in universities must design an attractive learning process development program for students while still paying attention to the quality of the learning process. This form of practical implication will encourage students to be more motivated to study well so that their learning achievement can be obtained as expected.

INTRODUCTION

The Covid-19 pandemic began to spread to Indonesia in February 2020 (Astuti & Mahardhika, 2020; Djalante et al., 2020; Olivia et al., 2020). As a result of the coronavirus, the outbreak has significantly impacted developments in various sectors, namely the education sector, tourism, the accommodation and food/beverage service business sector, the transportation sector, and other sectors (Anas, 2021; Xiong et al., 2021). One of the sectors mentioned in the education sector is a transfer of the learning process from face-to-face to online from their respective places. Various efforts to optimize the achievement of competencies produced by students remain a concern for lecturers as professional educators (Nambiar, 2020; Nishimura et al., 2021).

Online learning emphasizes students process the information presented by lecturers online (Ayu, 2020; Syauqi et al., 2020). This online learning requires the internet to access the e-learning platform that has been provided (Ippakayala & El-Ocla, 2017; Mpungose, 2020). Online learning is a choice that helps deliver teaching materials to students (Rapanta et al., 2020). A study showed that e-learning is effective for students regardless of the student's background (Acosta et al., 2018). E-learning is the future of education because it is interactive, interesting, and entertaining and will soon replace paper books in the form of touch screen tablets (Leindarita, 2021; Shaaban, 2020).

E-learning facilitates student self-study by taking control over the content, managing the learning sequence, setting the pace of learning, improving timing, and selecting media to meet learning objectives (Miedany, 2019; Talosa et al., 2021). In the learning process, students can access teaching materials provided on the e-learning platform (Aziz et al., 2019; Mardiah, 2020). In e-learning, students will be required to play an active role during the learning process. Student activity during the learning process will improve student learning achievement (Kristanto, 2017). The selection of learning media that suits the needs of students will be able to increase student activity (Situmorang et al., 2019).

The application of the learning process through e-learning must pay attention to the quality of the online learning process (Ayu, 2020; Bylieva et al., 2019). Improving and ensuring the quality of e-learning is a demand and need for higher education institutions so that e-learning practices can be successful (Hadullo et al., 2017). The content provided by lecturers in the e-learning platform certainly pays attention to quality and is easily understood by students (Linh et al., 2021; Medio et al., 2020). So that by paying attention to learning techniques and interesting content in the learning process through online media, the quality of learning could still be maintained.

Quality in the context of learning is a service provided to students during teaching and learning activities which is the interaction of learning components so that learning activities run effectively and efficiently (Al-Fraihat et al., 2020). Quality learning is effective learning as measured by the level of student satisfaction (Pham et al., 2019; Razinkina et al., 2018). Good learning must evaluate the learning to find deficiencies in the quality of learning. The relevance of learning is the suitability of learning activities with the course syllabus. Relevance is seen in the suitability of the material and assignments given to students during online learning. Attractiveness is the interest of students to take part in the online learning process (Fajri et al., 2021).

The attractiveness is seen in the content and appearance of the e-learning itself and the student's interest in taking part in online learning. Effectiveness is the achievement of learning objectives that students can achieve during online learning (Gherheș et al., 2021). In this study, the effectiveness of the quality of learning is seen from the level of student understanding of the material. The material in question includes study material and assignments given to help students master the competency achievements of vocational learning media courses.

Efficiency is a measure of completion of learning activities following the time provided. The efficiency of online learning quality is seen in the time provided to study the material and complete the tasks given by the lecturer through e-learning (Ayu, 2020). Online learning productivity is an opportunity for students to participate actively in learning. Student productivity is seen from the active role of students in the online learning process. Productivity is also seen in the ability of students to complete the assigned tasks (Shirish et al., 2021).

Learning achievements are a measure or level of success that a student can achieve based on the experience gained after an evaluation in a test and is usually manifested by grades or numbers (Putri et al., 2017). Learning achievements are expected to have cognitive, affective, and psychomotor changes from the subjects taught (Budiyanti et al., 2020; Sönmez, 2017). The cognitive area includes educational goals related to the understanding of theoretical knowledge acquired by students. The effective area has changed in interests, attitudes, values, and the development of appreciation.

The psychomotor area includes learning achievement related to skills in carrying out practical activities. Thus, what is meant by learning achievement in this study is the level of success that a student can achieve based on the experience gained after an evaluation in the form of a test that causes changes that include remembering, understanding, applying, analyzing, evaluating, and creating. In addition, it is also seen with affective and practical assessments and

In particular, learning for the front office operations 2 course, efforts to organize practical lectures are still being carried out even though they cannot be carried out directly in the front office labor. Efforts have been made to carry out the practice by students independently in their respective places following the job sheet provided by the lecturer. However, the efforts that have been made have not fully assisted in producing competencies according to the students learning achievement. The learning achievement evidence this as many as 28.33% of students have not been able to meet the expected practical competency achievements in the front office operations course assigned to the author in the January-June 2021 semester.

This dissatisfaction with learning achievement may be caused by the quality of the learning process that has not been maximally realized. With the discovery of this phenomenon, the authors are interested in researching a form of evaluation of the learning process that has been carried out entitled the effect of online learning quality on vocational students' learning achievement during the Covid-19 pandemic.

RESEARCH METHOD

This research was conducted with a quantitative approach with ex post facto research, which is a study that aims to analyze the effect of exogenous variables (online learning quality) on endogenous variables (learning achievement during the Covid-19 pandemic). The population of this study was 198 vocational students in the hotel management program Universitas Negeri Padang who took the front office operations 2 course in Hotel Management Program, Universitas Negeri Padang in January-June 2021.

The sampling technique used in this study is total sampling. The number of successfully collected respondents was 174 people (87.9%). The types of data in this study use primary and secondary data. The data collection technique in this study was conducted through a questionnaire distributed online for the variable of learning quality and grade of students learning outcomes for the variable of learning achievement. Online learning quality is measured based on indicators of relevance, attractiveness, effectiveness, efficiency, and productivity of learning (Pham et al., 2019; Razinkina et al., 2018). The instrument in this study was to use a questionnaire with a Likert scale. Before the questionnaire is used, first, the validity and reliability tests are carried out. The data analysis technique in this study used simple linear regression analysis.

RESULT AND DISCUSSION

Result

Online Learning Quality During the Covid-19 pandemic

Based on the research results on the quality of online learning during the Covid-19 pandemic, which was collected through questionnaires or questionnaires distributed to research respondents, a score was given for each respondent's answer according to the Likert scale. The questionnaire provided has been validated by experts. The questions given are logical questions related to the purpose of this research and lead to the next point. Data analysis was carried out with the help of SPSS version 21 software. Based on the data analyzed using SPSS version 21, data were obtained, as can be seen in Table 1.

Based on Table 1, data regarding the quality of online learning during the Covid-19 pandemic taken through a questionnaire totaling 19 statements given to 174 students obtained a mean value of 62.77, median 61.00, mode 57, standard deviation 12, 18, a minimum score of 42, a maximum score of 90 and a total score of 10,922. The results of the descriptive analysis indicate that the quality of online learning during the Covid-19 pandemic is in the sufficient category. This is because the average value of the respondents' answers is 62.77/19 statement items obtained a value of 3.3. The average response of 3.3 using a Likert scale of 5 is sufficient.

Table 1. Data Calculation Results of Online Learning Quality Statistics During the Covid-19 Pandemic

Statistics		
Online Learning Quality		
N	Valid	174
	Missing	0
Mean		62.7701
Median		61.0000
Mode		57.00ᵃ
Std. Deviation		12.17996
Minimum		42.00
Maximum		90.00
Sum		10922.00
a. Multiple modes exist. The smallest value is shown		

Student Learning Achievement

Based on the research results on the quality of online learning during the Covid-19 pandemic, which was collected through questionnaires or questionnaires distributed to research respondents, a score was given for each respondent's answer according to the Likert scale. By using the SPSS version 21.00 program, the following data is obtained in Table 2.

Table 2. Data Calculation of Student Learning Achievement Statistics

Statistics		
Learning Achievement		
N	Valid	174
	Missing	0
Mean		76.3966
Median		83.0000
Mode		83.00ᵃ
Std. Deviation		15.44927
Minimum		24.00
Maximum		93.00
Sum		13293.00
a. Multiple modes exist. The smallest value is shown		

Based on Table 2, it can be seen that data regarding student learning achievement in Front Office Operations 2 course obtained a mean value of 76.40, median 83.00, mode 83, the standard deviation of 15.45, minimum value of 24, maximum value of 93, and the total value of 13,293. Therefore, the results of the descriptive analysis indicated that student learning achievement in the Front Office Operations 2 course is in a good category. This is because the average value of respondents' answers is 76.40, which is in the range of 60-80, categorized as good.

Influence of Online Learning Quality on the Vocational Students' Learning Achievement During the Covid-19 Pandemic

Before using simple linear regression analysis, a prerequisite test was carried out: normality, homogeneity, and linearity (Denis, 2018). From the normality test, the data were normally distributed. Then the homogeneity test shows that the data come from populations with the same variance or homogeneous data. And the linearity test shows that the data is linear. The test results are eligible to use simple linear regression analysis. Hypothesis testing in this study uses simple linear regression techniques with the help of the SPSS 21.00 program. The following are the results of hypothesis testing in this study.

Table 3. Coefficient of Determination

		Model Summary		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.164[a]	.027	.021	15.28510
a. Predictors: (Constant), Online Learning Quality				

$$KP = r2 \times 100\% = 0.164 \times 100\% \quad\quad (1)$$

R square = 0.164, meaning that the contribution of online learning quality toward the vocational students' learning achievement during the Covid-19 pandemic was 16.4%, while other factors determined 83.6%.

Table 4. Results of Significance

		ANOVA[a]				
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1106.563	1	1106.563	4.736	.031[b]
	Residual	40185.075	172	233.634		
	Total	41291.638	173			
a. Dependent Variable: Learning Achievement						
b. Predictors: (Constant), Online Learning Quality						

F value hit 4,736 with sig. 0.031 < 0.05, meaning that online learning quality can significantly explain vocational students' learning achievement.

Table 5. The Regression Coefficient of Variable X Against Y

		Coefficients[a]				
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	89.430	6.100		14.661	.000
	Online Learning Quality	.208	.095	.164	2.176	.031
a. Dependent Variable: Learning Achievement						

From Table 5, the following regression equation is obtained: Y = a + bX = 89.430 + 0.208X. Based on Table 5, it is obtained a constant value (a) of 89,430. This number means that if there is no online learning quality (X), then the consistent value of the vocational students' learning achievement (Y) is 89,430. Then the regression coefficient value (b) is obtained of 0.208. This figure means that with each addition of one online learning quality unit (X), the vocational students' learning achievement (Y) will increase by 0.208.

Discussion

Online Learning Quality During the Covid-19 Pandemic

Based on the study results, in general, the value of the mean score is 3.3. In Table 1, it can be described that online learning quality is still in the sufficient category. This is expressed through the student's feelings that online learning quality during the Covid-19 pandemic is not as expected or in the sufficient category. The students feel less satisfied with the online learning quality during the Covid-19 pandemic than before the Covid-19 pandemic.

The study results found that students felt that relevance, attractiveness, effectiveness, efficiency, and productivity of learning did not meet the expectations they expected in the learning process. The limitations of the network and learning facilities they experience in their respective places make them feel online learning quality has not been optimal. In any case, it is hoped that the

quality of learning should be optimized. This is in line with Sulisworo (2016) and Hang (2021) that it is necessary to maintain the quality of learning in the teaching and learning process to produce quality human resources who will work in the industry.

Vocational Student Learning Achievement

Based on the study results in general, it can be described that vocational student learning achievement is still in a good category. The achievement of learning achievement is a benchmark used in achieving success in the learning process. In the results of this study, the achievement of learning outcomes obtained by students is not optimal after they follow the online learning process during the Covid-19 pandemic, so it is necessary to increase the achievement of learning in the future through innovative learning strategies. Of course, we expect very satisfying learning achievement as a measure of success because of the learning process. This study is in line with research by Dufrene and Young (2014) that the success of the learning process is seen by good learning achievement.

Influence of Online Learning Quality on the Vocational Students' Learning Achievement During the Covid-19 Pandemic

Online learning quality has a significant effect on vocational students' learning achievement during the Covid-19 pandemic with a regression coefficient of 0.208, meaning that if there is an increase in the value of online learning quality by one unit, it will increase students' learning achievement during the Covid -19 pandemic by 0.208 units and vice versa. So, it can be said that the online learning quality, which includes relevance, attractiveness, effectiveness, efficiency, and learning productivity, is the higher level of students' learning achievement during the Covid-19 pandemic.

The results also show the contribution of online learning quality to students' learning achievement during the Covid-19 pandemic, which is 16.4%. This finding also means that online learning quality significantly affects vocational students' learning achievement during the Covid-19 pandemic because relevance, attractiveness, effectiveness, efficiency, and learning productivity will increase vocational students' learning achievement during the Covid- 19 pandemic. In the context of this study, the quality of online learning can still be maintained even though it has not been managed optimally. The learning achievement can also be obtained well but improved with better learning quality. So the results of this study are in line with Prasetya and Harjanto (2020), Gopal et al. (2021), and Mahyoob (2021) that there is a positive influence of online learning quality on vocational students' learning achievement during the Covid-19 pandemic.

This study will also make a new contribution to the body of literature and have practical implications. This finding also provides a basis for other researchers to look at and have a wider scope, especially those related to student learning achievement. The study findings also provide significant insights and lead to various practical consequences for universities. Universities must monitor learning quality in the learning process by lecturers to students. These practical actions will increase learning achievement to be maintained properly so that these students can meet the competencies expected by the industrial world. Vocational programs in universities must design an attractive learning process development program for students while still paying attention to the quality of the learning process. This form of practical implication will encourage students to be more motivated to study well so that their learning achievement can be obtained as expected.

CONCLUSION

The overall findings showed that online learning quality affects the vocational students' learning achievement during the Covid-19 pandemic. Furthermore, online learning quality during the Covid-19 pandemic in Front Office Operation 2 is still a sufficient category, and vocational students' learning achievement during the Covid-19 pandemic is categorized as good. Students perceive that the quality of online learning they receive is sufficient or has not met their expectations optimally. This has an impact on learning achievement that has not been achieved optimally. In addition, the online learning experience is certainly different from the face-to-face learning process on campus.

Developing technology that can help the online learning process but cannot fully improve the quality of learning without face-to-face meetings in offline classes.

This study was limited to the time of the Covid-19 pandemic, and future research can be carried out in the post-Covid-19 periods. Furthermore, the sample of this study was limited to students studying Front Office Operation 2 in Hotel Management Universitas Negeri Padang. Future research should examine whether the related variables can broadly generalize to vocational education. On the other hand, this study relies on a cross-sectional design that only collects data once. Perhaps, further research should look at the longitudinal design by looking at the development of student learning achievement at the beginning of the lecture with the end of the lecture after they feel the benefits of the predictor variable, namely online learning quality used in the study. Another important area of research is to take a deeper look at the challenges of the online learning process, with the style of the current generation of students being heavily influenced by the negative impact of digital technology developments. Until now, the lack of such research is very interesting to study.

REFERENCES

Acosta, M. L., Sisley, A., Ross, J., Brailsford, I., Bhargava, A., Jacobs, R., & Anstice, N. (2018). Student acceptance of e-learning methods in the laboratory class in Optometry. *PLoS ONE*, *13*(12), 1–15. https://doi.org/10.1371/journal.pone.0209004

Al-Fraihat, D., Joy, M., & Sinclair, J. (2020). Evaluating e-learning systems success: An empirical study. *Computers in Human Behavior*, *102*, 67–86. https://doi.org/10.1016/j.chb.2019.08.004

Anas, M. (2021). Impact of pandemic COVID-19 on Local Government's financial performance in Indonesia. *Journal of Southwest Jiaotong University*, *56*(3), 196–206. https://doi.org/10.35741/issn.0258-2724.56.3.16

Astuti, P. B., & Mahardhika, A. S. (2020). COVID-19: How does it impact to the Indonesian economy? *Jurnal Inovasi Ekonomi*, *5*(02), 85–92. https://doi.org/10.22219/jiko.v5i02.11751

Ayu, M. (2020). Online learning: Leading e-learning at higher education. *The Journal of English Literacy Education: The Teaching and Learning of English As a Foreign Language*, *7*(1), 47–54. https://doi.org/10.36706/jele.v7i1.11515

Aziz, R. C., Hashim, N. A. A. N., Omar, R. N. R., Yusoff, A. M., Muhammad, N. H., Simpong, D. B., Abdullah, T., Zainuddin, S. A., & Safri, F. H. M. (2019). Teaching and learning in higher education: E-learning as a tool. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, *9*(1), 458–463. https://doi.org/10.35940/ijitee.A4188.119119

Budiyanti, N., Aziz, A. A., Palah, P., & Mansyur, A. S. (2020). The formulation of the goal of insan kamil as a basis for the development of Islamic Education curriculum. *IJECA (International Journal of Education and Curriculum Application)*, *3*(2), 81–90. https://doi.org/10.31764/ijeca.v3i2.2252

Bylieva, D., Lobatyuk, V., Safonova, A., & Rubtsova, A. (2019). Correlation between the Practical Aspect of the Course and the e-learning progress. *Education Sciences*, *9*(3), 1–14. https://doi.org/10.3390/educsci9030167

Denis, D. J. (2018). *SPSS data analysis for univariate, bivariate, and multivariate statistics*. John Wiley & Sons.

Djalante, R., Lassa, J., Setiamarga, D., Sudjatma, A., Indrawan, M., Haryanto, B., Mahfud, C., Sinapoy, M. S., Djalante, S., & Rafliana, I. (2020). Review and analysis of current responses to COVID-19 in Indonesia: Period of January to March 2020. *Progress in Disaster Science*, *6*, 100091. https://doi.org/10.1016/j.pdisas.2020.100091

Dufrene, C., & Young, A. (2014). Successful debriefing—Best methods to achieve positive learning outcomes: A literature review. *Nurse Education Today*, *34*(3), 372–376. https://doi.org/10.1016/j.nedt.2013.06.026

Fajri, Z., Baharun, H., Muali, C., Farida, L., & Wahyuningtiyas, Y. (2021). Student's learning motivation and interest; The effectiveness of online learning during COVID-19 pandemic. *Journal of Physics: Conference Series*, *1899*(1), 12178. https://doi.org/10.1088/1742-6596/1899/1/012178/meta

Gherheș, V., Stoian, C. E., Fărcașiu, M. A., & Stanici, M. (2021). E-learning vs. face-to-face learning: Analyzing students' preferences and behaviors. *Sustainability*, *13*(8), 4381. https://doi.org/10.3390/su13084381

Gopal, R., Singh, V., & Aggarwal, A. (2021). Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19. *Education and Information Technologies*, *26*(6), 6923–6947. https://doi.org/10.1007/s10639-021-10523-1

Hadullo, K., Oboko, R., & Omwenga, E. (2017). A model for evaluating e-learning systems quality in higher education in developing countries. *International Journal of Education and Development Using ICT*, *13*(2), 185–204. https://www.learntechlib.org/p/180643/

Hang, N. T. (2021). Digital education to improve the quality of human resources implementing digital transformation in the context of industrial revolution 4.0. *Revista Gestão Inovação e Tecnologias*, *11*(3), 311–323. https://doi.org/10.47059/revistageintec.v11i3.1940

Ippakayala, V. K., & El-Ocla, H. (2017). OLMS: Online Learning Management System for e-learning. *World Journal on Educational Technology: Current Issues*, *9*(3), 130–138. https://doi.org/10.18844/wjet.v6i3.1973

Kristanto, A. (2017). The development of instructional materials e-learning based on blended learning. *International Education Studies*, *10*(7), 10–17. https://doi.org/10.5539/ies.v10n7p10

Leindarita, B. (2021). Influence of communication and teaching lecturers competencies towards students online learning satisfaction in the time of Covid-19. *International Conference on Educational Sciences and Teacher Profession (ICETeP 2020)*, 98–102. https://doi.org/10.2991/assehr.k.210227.016

Linh, L. T. N., Lam, N. T., & Ngoc, N. H. (2021). Using e-learning platforms in online classes: A survey on tertiary English teachers' perceptions. *AsiaCALL Online Journal*, *12*(5), 34–53. https://doi.org/10.11251/acoj.12.05.004

Mahyoob, M. (2021). Online learning effectiveness during the COVID-19 pandemic: A case study of Saudi universities. *International Journal of Information and Communication Technology Education (IJICTE)*, *17*(4), 1–14. https://doi.org/10.4018/IJICTE.20211001.oa7

Mardiah, H. (2020). The use of e-learning to teach English in the time of the Covid-19 pandemic. *English Teaching and Linguistics Journal (ETLiJ)*, *1*(2), 45–55. https://doi.org/10.30596%2Fetlij.v1i2.4894

Medio, C. De, Limongelli, C., Sciarrone, F., & Temperini, M. (2020). MoodleREC: A recommendation system for creating courses using the moodle e-learning platform. *Computers in Human Behavior*, *104*, 106168. https://doi.org/10.1016/j.chb.2019.106168

Miedany, Y. El. (2019). E-learning, adaptive learning and mobile learning. In *Rheumatology teaching: The art and science of medical education* (pp. 235–258). Springer.

Mpungose, C. B. (2020). Emergent transition from face-to-face to online learning in a South African University in the context of the Coronavirus pandemic. *Humanities and Social Sciences Communications*, *7*(1), 1–9. https://doi.org/10.1057/s41599-020-00603-x

Nambiar, D. (2020). The impact of online learning during COVID-19: Students' and teachers' perspective. *The International Journal of Indian Psychology*, *8*(2), 783–793. https://doi.org/10.25215/0802.094

Nishimura, Y., Ochi, K., Tokumasu, K., Obika, M., Hagiya, H., Kataoka, H., & Otsuka, F. (2021). Impact of the COVID-19 pandemic on the psychological distress of medical students in Japan: Cross-sectional survey study. *Journal of Medical Internet Research*, *23*(2), e25232. https://doi.org/10.2196/25232

Olivia, S., Gibson, J., & Nasrudin, R. an. (2020). Indonesia in the time of Covid-19. *Bulletin of Indonesian Economic Studies*, *56*(2), 143–174. https://doi.org/10.1080/00074918.2020.1798581

Pham, L., Limbu, Y. B., Bui, T. K., Nguyen, H. T., & Pham, H. T. (2019). Does e-learning service quality influence e-learning student satisfaction and loyalty? Evidence from Vietnam. *International Journal of Educational Technology in Higher Education*, *16*(1), 1–26. https://doi.org/10.1186/s41239-019-0136-3

Prasetya, T. A., & Harjanto, C. T. (2020). Pengaruh mutu pembelajaran online dan tingkat kepuasan mahasiswa terhadap hasil belajar saat pandemi Covid19. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *17*(2), 188–197. https://doi.org/10.23887/jptk-undiksha.v17i2.25286

Putri, R. H., Lesmono, A. D., & Aristya, P. D. (2017). Pengaruh model discovery learning terhadap motivasi belajar dan hasil belajar fisika siswa MAN Bondowoso. *Jurnal Pembelajaran Fisika*, *6*(2), 173–180. https://doi.org/10.19184/jpf.v6i2.5017

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education*, *2*(3), 923–945. https://doi.org/10.1007/s42438-020-00155-y

Razinkina, E., Pankova, L., Trostinskaya, I., Pozdeeva, E., Evseeva, L., & Tanova, A. (2018). Student satisfaction as an element of education quality monitoring in innovative higher education institution. *E3S Web of Conferences*, *33*, 03043. https://doi.org/10.1051/e3sconf/20183303043

Shaaban, S. S. A. (2020). TEFL professors'e-learning experiences during the COVID 19 pandemic. *European Journal of Foreign Language Teaching*, *5*(1), 82–97. https://doi.org/10.46827/ejfl.v5i1.3202

Shirish, A., Chandra, S., & Srivastava, S. C. (2021). Switching to online learning during COVID-19: Theorizing the role of IT mindfulness and techno eustress for facilitating productivity and creativity in student learning. *International Journal of Information Management*, *61*, 102394. https://doi.org/10.1016/j.ijinfomgt.2021.102394

Situmorang, E., Hutasuhut, S., & Maipita, I. (2019). The effect of e-learning, student facilitator and explaining model learning and self-regulated learning on 11th grade students learning outcomes of economic subject in Senior High School 1 Perbaungan School Year 2019/2020. *Budapest International Research and Critics in Linguistics and Education Journal (Birle Journal)*, *2*(4), 461–469. https://doi.org/10.33258/birle.v2i4.537

Sönmez, V. (2017). Association of cognitive, affective, psychomotor and intuitive domains in education, Sönmez Model. *Universal Journal of Educational Research*, *5*(3), 347–356. https://doi.org/10.13189/ujer.2017.050307

Sulisworo, D. (2016). The contribution of the education system quality to improve the nation's competitiveness of Indonesia. *Journal of Education and Learning*, *10*(2), 127–138. https://doi.org/10.11591/edulearn.v10i2.3468

Syauqi, K., Munadi, S., & Triyono, M. B. (2020). Students' perceptions in vocational education on online learning during the covid-19 pandemic. *International Journal of Evaluation and Research in Education (IJERE)*, *9*(4), 881–886. https://doi.org/10.11591/ijere.v9i4.20766

Talosa, A. D., Javier, B. S., & Dirain, E. L. (2021). The flexible-learning journey: phenomenological investigation of self-efficacy influencing factors among higher education students. *Linguistics and Culture Review*, *5*(S3), 422–434. https://doi.org/10.21744/lingcure.v5nS3.1590

Xiong, J., Tang, Z., Zhu, Y., Xu, K., Yin, Y., & Xi, Y. (2021). Change of consumption behaviours in the pandemic of COVID-19: Examining residents' consumption expenditure and driving determinants. *International Journal of Environmental Research and Public Health*, *18*(17), 9209. https://doi.org/10.3390/ijerph18179209

Learning independence and teacher teaching skills: Does it affect learning outcomes when face-to-face learning is limited?

Apri Nuryanto [1] * **, Rizki Ramadani [2]**
[1] Universitas Negeri Yogyakarta, Indonesia.
[2] Universitas Sarjanawiyata Tamansiswa, Indonesia.
* Corresponding Author. Email: apri_nuryanto@uny.ac.id

ARTICLE INFO

ABSTRACT

Limited face-to-face learning is a learning policy implemented by schools to prevent coronavirus transmission during the pandemic. Amidstface-to-face learning has become limited, so that it requires students to study more independently from home. Teachers are also required to maximize class time and are also required to be skilled in providing learning outside of student learning hours in class. This study aims to determine (1) the influence of student learning independence on learning outcomes, (2) the influence of teachers' teaching skills on learning outcomes, and (3) the influence of student learning independence and teacher teaching skills during limited face-to-face learning on student learning outcomes. The research method used is quantitative with a correlational approach. This research was conducted at SMK throughout Sleman Regency. Respondents were 26 schools with a total of 2209 students. The sample calculation used Slovin with 339 samples. Data collection using questionnaires and tests with the help of google forms. The data obtained were then analyzed with several techniques such as description analysis; normality, homogeneity, multicollinearity tests; and hypothesis tests consisting of simple regression tests and multiple regression tests. The study's results obtained 1.) Learning outcomes were positively and significantly influenced by student learning independence with a value of sig. $0.023 < 0.05$; 2.) Learning outcomes are positively and significantly influenced by the teaching skills of teachers with sig grades. $0.000 < 0.05$; and 3.) Learning outcomes are also positively and significantly influenced by student learning independence and teacher teaching skills with a value of sig. $0.000 < 0.05$.

INTRODUCTION

The spread of the coronavirus throughout the world until now has not been wholly completed. Even in some countries, there is still an increase in the number of humans infected with the virus. The coronavirus has infected many sectors due to social and physical distancing, including the education sector (Kim, 2020). According to Hossain et al. (2021), in Bangladesh, 60% of students experience fears of experiencing delays in academics, and students will experience stress. The implementation of online learning in Indonesia is still not running effectively (Baety & Munandar, 2021; Simamora, 2020; Yunus et al., 2021). In addition, it was stated that 63% of respondents stated that full online learning could not be carried out effectively (Haning, 2016). As a result, the learning results obtained by students have not been achieved optimally.

According to the results of an evaluation by the Directorate of Junior High School Republic of Indonesia (2022), there has been a decrease in learning outcomes due to online learning. The Indonesian government is trying to continue to overcome the problems of education caused by the Covid-19 pandemic by issuing policies related to education. Along with controlling the number of viruses spread in Indonesia, the Ministry of Education and Culture of the Republic of Indonesia issued a joint decree of four ministers (SKB) containing the implementation of limited face-to-face learning.

Sleman Regency implements limited face-to-face learning, which is then abbreviated (PTMT) starting in the first semester of the 2021/2022 school year (Sleman Regency Education Office, 2022). Seeing the spread of the Covid-19 virus in Sleman Regency is at level two, and the number of school residents who have had the second vaccine is 50%-79%, then based on the decree of the four Ministers, learning runs with 50% of the total number of students and a maximum of 6 hours of lessons every day (Anjany, 2021). Based on this data, learning in schools can be carried out longer than online learning at home, but in certain conditions learning is still often carried out at home, considering that the allowed capacity is only 50% of the capacity of students who can study at school. The Minister of Communication and Informatics of the Republic of Indonesia, Johnny G. Plate, quoted from Putri (2021), said that the implementation of PTMT, one of which aims to avoid a decrease in student learning outcomes and face-to-face learning in the classroom, will achieve better student learning outcomes than being carried out fully online.

However, the opposite is true during PTMT, and student learning outcomes are still not optimal. The results of temporary observations at SMK Muhammadiyah Melati, SMK Negeri 1 Cangkringan, and SMK Muhammadiyah Cangkringan stated that students' learning independence still needs to be improved, judging from the lack of enthusiasm of students during online study hours using Google Classroom or zoom. Students' assignments that are done at home yang collect on time, no more than 20% of the number of classes, and the tendency of students to study independently at home are still very lacking. A similar study by Hidayat et al. (2020) stated that the level of independence of students' learning is still low. This is because students do not have an online learning culture.

Learning independence is closely related to teacher teaching skills during the PTMT period, in line with the results of research conducted by Hardianti (2019), which states that there is an influence on student learning independence, and teacher teaching skills simultaneously affect student learning outcomes. This is in line with Harmaini (2019) opinion stated that there are still many teachers accustomed to using old learning patterns, so students' learning independence has not been formed properly. Based on this opinion, it can be understood that for students to be independent in learning, the teacher needs to use patterns or methods that are in accordance with current conditions.

Based on the results of observations at several vocational schools in Sleman Regency, in addition to the independence of student learning, which still needs to be improved, teacher teaching skills are still lacking, such as teaching skills, the use of technology, the use of methods, media, and the selection of materials that must be adjusted to limited face-to-face learning. This condition causes student learning outcomes not to reach the minimum standards that the teacher has determined. Rabiatun (2021) mentioned that the teacher's skills impact student learning outcomes in line with these observations. It is also strengthened by the results of research conducted by Theodora (2013) that there is a significant influence between teachers with high and low skills on student learning outcomes.

Based on the explanation that has been presented, the application of the face-to-face learning policy is limited in terms of student learning independence and teacher teaching skills which should be expected to influence student learning outcomes, but the observation results were found to be the opposite. So this study will examine whether the application of limited face-to-face learning with student learning independence and teacher teaching skills that exist today will affect student learning outcomes. It is also necessary to research whether student learning independence and teacher teaching skills in vocational schools throughout Sleman Regency in the implementation of limited face-to-face learning policies can affect student learning outcomes. The result of the research is expected to be used as a solution or evaluation in the world of education.

RESEARCH METHOD

The type of research used in this study is ex-post facto with a correlational approach, which is also part of quantitative research. This type of research is used to know the influence between one or more free variables on one or more fixed variables. This research was conducted in 26 vocational schools throughout Sleman Regency, especially Jautomotive affairs, consisting of 3 state schools and 23 private schools. The length of time used in this study was six months, from July 2021 until December 2021. A total of 2209 class X students are in Sleman County as a population. The sample used was 339 students. Sample calculations use the approach developed by Slovin (Sipayung & Gunawan, 2013).

The variables used in this study are the independent variable which consists of variables of student learning independence and teacher teaching skills. In contrast, the dependent variable consists of student learning outcomes. The data collection techniques used in each variable are questionnaires and multiple-choice tests to measure student learning outcomes. The next step is data triangulation by interviewing each stakeholder in the school where the research occurs. The purpose of data triangulation in this study is to confirm and strengthen the data obtained, which will then be used as research results. The three instruments on each variable were then tested for validity by experts, and a constructed test was conducted with a sample of 25 students using product moment calculations. The trial results can be seen in Table 1, and the reliability test concluded that each instrument has very high reliability.

Table 1. Instrument of Validity Test

Variable Instruments	Valid	Invalid
Teacher teaching skills	27	5
Student Learning Independence	16	4
Learning Outcomes	20	5

The data analysis technique consists of three stages, namely: (1) descriptive analysis consisting of the calculation of the mean, mode, median, and standard deviation, (2) prerequisite tests consisting of normality, homogeneity, and multicollinearity tests, and (3) test hypotheses using a simple regression test used to test between one variable and another, and a double regression test is used to test between more than one variable with one or more variables (Gunawan, 2020).

RESULT AND DISCUSSION

Data Description

The data that has been collected is first carried out with a description of the data with the help of SPSS (statistical package for the social sciences) software version 16. Data analysis on student learning independence variables was obtained and described as follows: the smallest answer was 29, the largest answer was 62, the average score of 43.2, the median by 35, the mode by 35, and the standard deviation by 6.1. The variable frequency distribution of student learning independence can be seen in Figure 1.
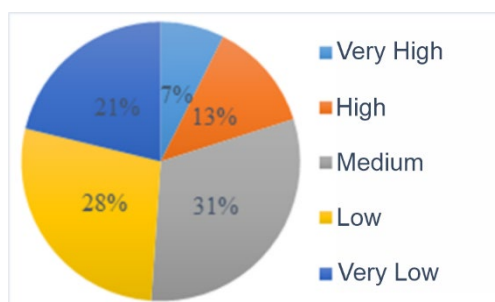
Figure 1. Frequency Distribution of Teacher Teaching Skills

Based on Figure 1, the most data frequency distribution is on the medium criteria, with a total of 31%. It can be explained that the data obtained from the variables of the most teaching skills exist in the medium category. Data analysis on the variables of teacher teaching skills was obtained and described as follows: the lowest answer is 62, the largest answer is 104, the average score is 82.8, the median is 83, the mode is 84, the standard deviation by 8.4. The variable frequency distribution of teacher teaching skills can be seen in Figure 2.
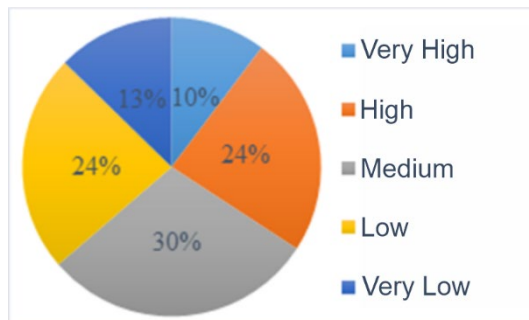
Figure 2. Frequency Distribution of Student Learning Independence

Based on Figure 2, most data frequency distributions are on medium criteria with a total of 30%. These results illustrate that the data obtained from most student independence variables are in the moderate category. Data analysis on student learning outcome variables was obtained and described as follows: the lowest answer is 35, the largest answer is 90, the average score is 69.2, the median is 70, the mode is 75, and the standard deviation by 11.2. The variable frequency distribution of student learning outcomes can be seen in Figure 3.
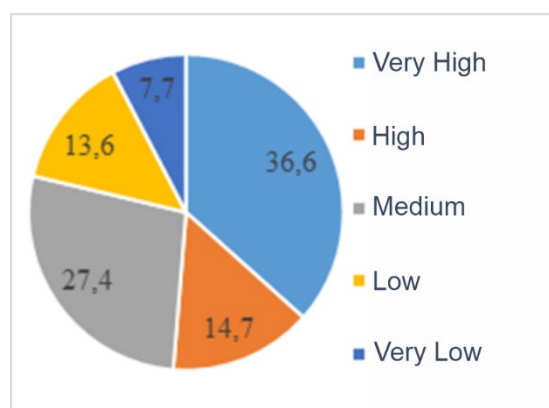
Figure 3. Frequency Distribution of Learning Outcomes

Based on Figure 3, most data frequency distributions are based on very high criteria, with a total of 36.6%. This means that the data obtained from the variables of student learning outcomes is very high.

Test Analysis Prerequisites

Then after the data description was carried out, an instrument prerequisite test consisting of three tests was carried out, the analysis using the help of SPSS software version 16 tests including 1.) Normality test using Kolmogorov-Smirnov formula, the results of the analysis obtained values of sig. $0.110 > 0.05$ based on the obtained figures can be concluded that the data have a normal distribution; 2.) The linearity test between student learning independence variables and student learning outcomes obtained a value of $0.290 > 0.05$ which means that the data has a linear relationship. A linear test is also carried out between variables the teacher's teaching skills on student learning outcomes obtained a score of 0.189 which means that the data has a linear relationship; and

3.) The data multicollinearity test was tested between student learning independence variables on student learning outcomes, the analysis was carried out using tolerance obtained a value of 0.161 > 0.10 and while the VIF value was obtained by a value of 1.624 < 10.0 based on data it can be concluded that the multicollinearity test does not occur multicollinearity, the test between the variables of the teacher's teaching skills to student learning outcomes, the analysis carried out using tolerance obtained a value of 0.538 > 0.10 and while the VIF value obtained a value of 1.86 < 10.0 based on these data it can be concluded that the multicollinearity test does not occur multicollinearity.

Hypothesis Test

Considering that the instrument analysis requirements have all been met, the data are tested for hypotheses with the help of SPSS version 16 software, and decision-making is seen from the sig. value compared to a significant level of 5%. There are three hypotheses in this study.

The first hypothesis of the analysis between the variables of student learning independence towards student learning outcomes obtained a value of sig. 0.023 < 0.05 and a regression coefficient value of 0.234 based on these values can be concluded that there was a positive and significant influence between student learning independence and student learning outcomes at SMK in Sleman during the implementation of limited face-to-face learning. The results of in-depth interviews with several SMK teachers throughout Sleman Regency stated that there is an influence on student learning outcomes. It's just that there is still a need to increase student learning independence. Compared to fully online learning conditions, learning during a pandemic slowly increases student independence and learning outcomes.

The second hypothesis of the analysis between the variables of the teacher's teaching skills to student learning outcomes obtained a value of sig. 0.00 < 0.05, and the value of the regression coefficient obtained a value of 0.295 based on the value obtained. It can be concluded that there is a positive and significant influence between the teaching skills of teachers and the learning outcomes of students in SMK throughout Sleman Regency during the application of face-to-face learning limited face. The results of in-depth interviews with SMK teachers throughout Sleman Regency stated that the role of teachers in the learning process during face-to-face learning is limited, the better the teacher's teaching skills in adapting to a time when face-to-face learning is limited, the influence on learning outcomes is also getting better, skills that need to be adapted include teachers must be skilled in transferring the right methods, media, materials so that they can be taught by students considering the limited face-to-face time applied in vocational schools throughout Sleman Regency and the importance of teachers mastering technology to make up for the lack of study hours in schools.

The third hypothesis of the analysis between student learning independence and teacher teaching skills on student learning outcomes in SMK throughout Sleman Regency obtained a value of sig. 0.00 < 0.05 based on the value of positive and significant influence on student learning outcomes in vocational schools throughout Sleman Regency during the implementation of PTMT. In line with the analysis, in-depth interviews with SMK teachers throughout Sleman Regency stated that the influence of these two variables was very pronounced. If you look at the independence of student learning, it still needs improvement and encouragement from teachers so that students can independently learn online. So, in this case, it is also necessary to teach teachers so that limited face-to-face time can be maximized, and teachers can provide motivation and enthusiasm for teachers to continue increasing student learning independence. The synergy between student independence and learning skills can be built, ultimately affecting student learning outcomes.

CONCLUSION

Based on the results of data analysis that has been carried out, which is strengthened by in-depth interviews, it is concluded that there is a positive and significant influence between student learning independence on learning outcomes and values (signification 0.0 23 < 0.05) in line with the analysis the results of the interview also showed something similar, then there was a positive and significant influence between the teacher's teaching skills on student learning outcomes with a sig value (signification of 0.000 < 0.05) in line with the interview results, only for now the skills of

teachers need adaptation and improvement on the use of supporting technologies. There is a positive and significant influence between the teaching skills of teachers and the independence of student learning together on student learning outcomes on metal base formation materials in vocational schools throughout Sleman Regency, indicated by grades (signification of 0.000 < 0.05). This is also similar to the results of interviews, which state that students' learning independence can increase due to the support of good teacher teaching skills to support the maximum achievement of learning outcomes.

REFERENCES

Anjany, W. S. (2021). *Satu tahun kebijakan PJJ, saatnya lakukan evaluasi*. Kompasiana. https://www.kompasiana.com/wulansulistia0484/60e9558e56b45c73a56f0392/satu-tahun-kebijakan-pjj-saatnya-lakukan-evaluasi

Baety, D. N., & Munandar, D. R. (2021). Analisis efektifitas pembelajaran daring dalam menghadapi wabah pandemi Covid-19. *EDUKATIF: Jurnal Ilmu Pendidikan*, *3*(3), 880–989. https://doi.org/10.31004/edukatif.v3i3.476

Dinas Pendidikan Kabupaten Sleman. (2022). *Pengaturan Pembelajaran di Masa Pemberlakuan PPKM Level 3*. Dinas Pendidikan Kabupaten Sleman. https://disdik.slemankab.go.id/wp-content/uploads/2022/03/4.-SURAT-EDARAN-PTM-PJJ.pdf

Direktorat Sekolah Menengah Pertama. (2022). *Penyesuaian SKB 4 Menteri tentang pembelajaran di masa pandemi Covid-19*. ditsmp.kemdikbud.go.id. https://ditsmp.kemdikbud.go.id/penyesuaian-skb-4-menteri-tentang-pembelajaran-di-masa-pandemi-covid-19/

Gunawan, C. (2020). *Mahir menguasai SPSS: Panduan praktis mengolah data penelitian*. Deepublish.

Haning, M. (2016). Are they ready to teach with technology? An investigation of technology instruction in music teacher education programs. *Journal of Music Teacher Education*, *25*(3), 78–90. https://doi.org/10.1177/1057083715577696

Hardianti, H. (2019). *Pengaruh kemandirian belajar siswa dan keterampilan mengajar guru terhadap hasil belajar akuntansi pada siswa kelas XI program keahlian akuntansi dan keuangan lembaga SMK Negeri 1 Mamuju* [Universitas Negeri Makassar]. http://eprints.unm.ac.id/14792/

Harmaini, L. (2019). The influence of flipped classroom and learning independence models on student learning outcomes of class X office administration vocational school. *Proceedings of the 2nd Padang International Conference on Education, Economics, Business and Accounting (PICEEBA-2 2018)*, *64*, 344–351. https://doi.org/10.2991/piceeba2-18.2019.109

Hidayat, D. R., Rohaya, A., Nadine, F., & Ramadhan, H. (2020). Kemandirian belajar peserta didik dalam pembelajaran daring pada masa pandemi COVID-19. *Perspektif Ilmu Pendidikan*, *34*(2), 147–154. https://doi.org/10.21009/PIP.342.9

Hossain, M. J., Ahmmed, F., Rahman, S. M. A., Sanam, S., Emran, T. Bin, & Mitra, S. (2021). Impact of online education on fear of academic delay and psychological distress among university students following one year of COVID-19 outbreak in Bangladesh. *Heliyon*, *7*(6), e07388. https://doi.org/10.1016/j.heliyon.2021.e07388

Kim, E.-A. (2020). Social distancing and public health guidelines at workplaces in Korea: Responses to Coronavirus Disease-19. *Safety and Health at Work*, *11*(3), 275–283. https://doi.org/10.1016/j.shaw.2020.07.006

Putri, I. (2021, September). 3 alasan pemerintah percepat sekolah tatap muka terbatas. *Detik News*. https://news.detik.com/berita/d-5710196/3-alasan-pemerintah-percepat-sekolah-tatap-muka-terbatas

Rabiatun, N. (2021). *Pengaruh keterampilan mengajar guru terhadap hasil belajar siswa pada mata pelajaran PPKN di kelas V SD Negeri 72 Kota Bengkulu* [Institut Agama Islam Negeri Bengkulu]. http://repository.iainbengkulu.ac.id/5320/

Simamora, R. M. (2020). The Challenges of online learning during the COVID-19 pandemic: An essay analysis of performing arts education students. *Studies in Learning and Teaching*, *1*(2), 86–103. https://doi.org/10.46627/silet.v1i2.38

Sipayung, E., & Gunawan, A. S. (2013). Pengembangan sistem penilaian kualitas pelayanan dengan metode Importance Performance Analysis (IPA). *Jurnal Telematika*, *8*(1), 22–28. https://journal.ithb.ac.id/telematika/article/view/67

Theodora, B. D. (2013). *Pengaruh keterampilan mengajar guru terhadap hasil belajar siswa SMA Negeri se-Kota Malang yang dikontrol dengan variasi sumber belajar* [Universitas Negeri Malang]. http://repository.um.ac.id/61192/

Yunus, M., Setiawan, D. F., & Wuryandini, E. (2021). Persepsi mahasiswa terhadap pembelajaran online pada masa pandemi COVID-19. *Jesya (Jurnal Ekonomi Dan Ekonomi Syariah)*, *4*(2), 1196–1202. https://doi.org/10.36778/jesya.v4i2.476

The effect of maritime English vocabulary for beginners Module on the vocabulary learning outcomes

Mochamad Abduh, Juliandri Hasnur, Syafni Yelvi Siska *
Universitas Negeri Padang, Indonesia.
* Corresponding Author. Email: siska.gusrial.4014@gmail.com

ARTICLE INFO

ABSTRACT

This research started from the problem of the current Covid-19 pandemic condition and situation, which makes cadets have to study online and most by themselves. In addition, it is based on the fact that there has been no specific module discussing basic terms or maritime English vocabulary specifically for each department. The purpose of this study is to reveal whether there is an effect of using the maritime English vocabulary for beginners module on the vocabulary learning outcomes and how effective the use of the module is for cadets of Batch V Nautical Department, Shipping Polytechnic, West Sumatra. This type of research is experimental with the one-group pre-test and post-test design (pre-experimental design). This research was carried out in all classes of the nautical department Batch V, which consisted of 3 categories; Nautical A, Nautical B, and Nautical C. The sample used purposive sampling in this research, so the writer only took cadets in nautical majors, with a total sample of 60 persons. Based on the results, it was found that there was an effect of using the maritime English vocabulary for beginners module on the learning outcomes of maritime English vocabulary for Nautical Department cadets Batch V. Furthermore, from the results of questionnaire data processing, it can be concluded that the use of maritime English vocabulary for beginners module in maritime English vocabulary learning is effective for Nautical Department cadets Batch V in West Sumatra Merchant Marine Polytechnic in 2021.

INTRODUCTION

The teaching and learning process is the main activity in running a system in every educational institution. Learning activities must be organized and directed so that the teaching and learning process occurs optimally, effectively, and efficiently and provides reciprocity between cadets and lecturers. Before the teaching and learning process begins in the classroom, a lecturer or educator must organize the learning content to be taught, learning aids, learning objectives, and other learning tools. The preparation from the lecturer benefits not only the lecturer but also the students. Masruddin (2018) mentioned that material development help students and the lecturer conduct teaching and learning process in the classroom. The preparation of materials strengthens students' motivation in the learning process and supports any learning activity.

One of the essential things that an educator must prepare for the success of the learning process is effective and efficient learning media. Learning media are all tools and intermediaries in delivering teaching materials from educators to students. This learning media must be developed and

used by the times, conditions, and situations. In addition to assisting educators in delivering information and learning materials, learning media must also be by students' characteristics, interests, and performance levels. So, the students can use learning media either with the help of their lecturers or without guidance or study independently. Learning media will also support the learning outcomes of students or students later. According to Thang and Koh (2017), students' learning outcomes expected in this twenty-first century include critical thinking, creativity, teamwork, authentic problem-solving, and self-directed learning. These learning outcomes will make the students become effective future workers. So, it is essential to understand how students transfer and implement their knowledge and competencies beyond the lesson context. One of the ways is through effective learning media.

Regarding the current Covid-19 pandemic situation, educators and students must always be ready for all offline and online learning conditions. A teacher or educator's responsibility is to prepare effective learning media for students, meaning that they can be used with or without teacher assistance. This is because one of the efforts teachers can carry out as learning facilitators are providing opportunities for students to learn individually inside and outside school hours. To achieve this, we need media to convey subject matter to students and help them construct their knowledge/understanding. This media can be made by the teacher or by asking for help from a third party outside the learning system. Media that can meet the learning needs of students individually is a module. Sawarynski and Baxa (2019) explain that the module is an educational response to offer best practices in the dimensions of learning, both online and offline, and in the cognitive, affective and psychomotor aspects.

The module is one of the learning media, or educators write teaching materials to make it easier for students to learn the material independently, either through electronic modules or print modules. Yulastri et al. (2018) stated that a module is a specific unit of teaching materials that contains a lesson that the students should know. A module is a stand-alone that can be made by the teacher or educator based on the curriculum or syllabus and the use of the module in the teaching and learning programs aimed to achieve an educational goal. A module is suitable for all students levels because it makes it easier for students to understand the lesson.

The West Sumatra Merchant Marine Polytechnic, better known as the Politeknik Pelayaran Sumatera Barat, is one of the state vocational higher education institutions in the shipping sector under the auspices of the Ministry of Transportation, which is a higher education institution that produces ready-to-use workers. As a vocational education institution, its education system emphasizes practice rather than theory. The learning system in class is 60% practical and 40% theory with the hope that graduates have the provision of work skills by their fields and majors as well as the demands of the industry in which they work. Hamid et al. (2020) agree that vocational education's focus is on improving the technical competence of students and making students have skills that cannot be replaced by technology. Vocational education is needed in this era since students with skills which is required in the job market.

One of its visions and missions is to be able to produce internationally competitive graduates. The West Sumatra Merchant Marine Polytechnic is committed and tries its best to realize its vision and mission. Many things have been done by the West Sumatra Merchant Marine Polytechnic educational institution to realize its vision and mission. One of them is encouraging lecturers to develop teaching materials in the form of modules for each subject they teach. Using teaching materials or modules is expected to solve some of the problems that have occurred so far in each subject's teaching and learning process. Papadopoulou (2021) assumes that a module aims to facilitate students' critical engagement and technical and practical skills.

One of the compulsory subjects for cadets of the West Sumatra Merchant Marine Polytechnic is Maritime English. Maritime English is one of the ESP (English for Specific Purposes) which discusses specific material in the maritime, shipping, and marine fields. Because it belongs to ESP, Maritime English learning for cadets must start from the basics, such as learning terms or vocabulary. This is because cadets must understand and master the words and language widely used in this field before learning practical communication skills related to shipping.

Sofa and Dewi (2020) indicated that English for Specific Purposes (ESP) courses are made to help students master English to use English effectively in their professional field or workplace later on. Teaching and learning components in ESP involve instructional goals, the role of the

instructors and students, learning methods and strategies, learning materials, learning media, and an evaluation system. The communication standards used in shipping are also based on the SMCP (Standard Marine Communication Phrases), which uses maritime English. To be able to communicate effectively in the shipping world, the cadets must first be able to master English terms and vocabulary in the shipping field.

Regarding the importance of maritime English skills for West Sumatra Merchant Marine Polytechnic cadets, maritime English learning must be carried out effectively. Effective learning does not depend on time and conditions. This means that cadets as learners can learn with or without the help of lecturers and can learn in any conditions and situations, both inside and outside the classroom, either directly (face to face) or online learning. One way to implement effective learning is to provide modules as learning media. Cadets can maximize their role in SCL (students-centered learning) learning by using the module.

The use of modules in maritime English learning is also based on several things. First, the current condition and situation of the Covid-19 pandemic make cadets have to study outside the campus, namely online (in the network) from their respective residences. Under these conditions, using modules will help the lecturers deliver materials and assignment lessons. It will also help the cadets understand the material well because they have their learning materials. Second, no module has discussed basic terms or maritime English vocabulary specifically for each department. Learning materials commonly used by cadets of the West Sumatra Merchant Marine Polytechnic are in the form of a printed book, "English for Mariners," by Tony Grice, which contains general material for all majors. Other learning materials are in the form of assignment sheets and printouts of material from the internet. So, the module will help cadets understand and master maritime English terms and vocabulary well.

Vocabulary is the main element in language skills. The ideas and quality of a person's language skills depend on the quantity and quality of vocabulary. Wilkins in Thornbury (2002) states that without grammar very little can be conveyed, without vocabulary nothing can be conveyed. It means that without vocabulary, there is nothing that someone in a language can get. Mastery of a person's vocabulary cannot be obtained from a dictionary alone, like the way students studied in ancient times. With the development of the times and science and technology in education, vocabulary teaching will be more interesting if using pictures or pointing at objects directly.

Therefore, the use of the maritime English vocabulary for beginners module is considered essential to apply to cadets. The maritime English vocabulary for beginners module is a maritime English module that explicitly explains basic terms and vocabulary that cadets in the shipping sector must know. This module is a printed module also available in an e-module that contains photographs and vocabulary that refers to the photograph. This module is done according to each department, namely the module for the nautical department and nautical technology. The maritime English vocabulary for beginners module is designed excitingly to explain vocabulary and terms according to pictures or objects. This will make it easier for cadets to remember and memorize words on board using maritime English.

There are several advantages of teaching maritime English vocabulary using the maritime English vocabulary for beginners module. First, with pictures, vocabulary learning will be more interesting for cadets and make it easier for them to understand knowledge. Second, learning to use this module is a shortcut for cadets in understanding terms and vocabulary in the shipping sector. By getting accustomed to seeing photographs according to natural things, cadets will be able to recognize the object's name well without needing to use a dictionary again. Third, cadets do not need to translate every vocabulary or term into Indonesian. They look at the picture and memorize the name because the words or language used in this module are those used on ships.

In addition, very few maritime English books and modules are circulating in the market, even though there is a level or level of readability classified for the ability of intermediate and above students (middle). Meanwhile, the English skills of cadets at the Shipping Polytechnic of West Sumatra are only classified as basic skills (basic/beginner). Therefore, the maritime English vocabulary for beginners module is a solution for solving this problem that will help cadets improve their understanding and learning outcomes of Maritime English vocabulary.

Learning media cannot be said to be good if it cannot be used by teachers and students and influences learning outcomes. Therefore, the level of usability (usefulness) and significance was analyzed in student learning outcomes. Usefulness refers to the condition of the learning modules developed that can be easily used by students so that the learning carried out is meaningful, interesting, fun, valuable for students' lives, and can increase their creativity in education and have a degree of effectiveness on student learning outcomes. While the point of the module is a test carried out on products that have been developed by involving potential product users. The effectiveness test of the maritime English vocabulary for beginners module in this study was obtained, improving cadets' learning outcomes.

Furthermore, the effect of the maritime English vocabulary for beginners module needs to be seen as a follow-up step from the initial development and as an effort to develop better learning modules in the future. The principle of creating the maritime English vocabulary for beginners module using ADDIE consists of five stages, namely: analysis, design, development, implementation, and evaluation. So, this module has only arrived at the third stage, namely development, while research using this module embodies the fourth step of the module development process, namely implementation. Furthermore, the results of this research will be able to realize the final module development step, namely evaluation.

The results of research from Sukra and Handayani (2015) showed that modules significantly influence learning outcomes, especially in learning English. A module can help optimize learning objectives. Before being used or used as a handbook, lecturers should first study whether the teaching materials can improve student learning outcomes or not. Before being distributed to students or published, it is necessary to research modules or teaching materials in their influence on student learning outcomes.

Based on the description above, the researcher is interested in conducting a study entitled The Effect of the maritime English vocabulary for beginners module on maritime English vocabulary learning outcomes. The purpose of this study is to reveal: 1.) The effect of using the maritime English vocabulary for beginners module on the learning outcomes of maritime English vocabulary for cadets in Batch V, Nautical Department, West Sumatra Merchant Marine Polytechnic in 2021; and 2.) The effectiveness of using the maritime English vocabulary for beginners module for cadets Batch V, Nautical Department, West Sumatra Merchant Marine Polytechnic in 2021.

In this research, the readers will know the effect of the maritime English vocabulary for beginners module. Then, the readers will know how effective the maritime English vocabulary for beginners module is for the cadets by reading the cadets' perception percentage. With a significant effect and cadets' good perception of the maritime English vocabulary for beginners module, this module can properly use by the cadets as one of the sources in learning maritime English vocabulary.

RESEARCH METHOD

This type of research is experimental with the one-group pretest-posttest design (pre-experimental design). Creswell in King (1991) states that there are four types of empirical research, pre-experimental designs, true experiments, quasi-experiments and single-subject designs. This type of research is pre-experimental, also known as the one-group pretest-posttest design, in which researchers study one group and provide intervention during the action or treatment. This type of research does not require a control class compared to acting classes. The design of this research can be seen in Figure 1.

$$O_1 \ X \ O_2$$

Figure 1. Research Design

In this design, observations were made two times, namely before and after the investigation. The statements made before the experiment (O1) are called the pretest, and the comments made after

the investigation (O2) are called the post-test. Based on the description of the type of research above, in this study, the researcher used a group with the same major, namely the nautical department.

This research was carried out in all classes of the nautical department Batch V in West Sumatra Merchant Marine Polytechnic in 2021, which consisted of 3 types: Nautical A, Nautical B, and Nautical C. This research was conducted online (virtual). The population of this research is cadets in Batch V of the West Sumatra Merchant Marine Polytechnic in 2021. The total population in each department is described in Table 1.

Table 1. Research Population

No.	Major	Male	Female	Total
1	Nautical	48	12	60
2	Technology nautical	58	1	59
3	Sea transportation	27	13	40
	Total			159

The sample is part of the population and the characteristics of the people. In this research, the writer chose the selection using purposive sampling (Creswell & Creswell, 2017). Because the writer aims to see the effect of using the maritime English vocabulary for beginners module for the deck department on the results of maritime English vocabulary learning for cadets, the writer only took cadets majoring in nautical in this research. The marine department consists of three categories: Nautical A, Nautical B, and Nautical C, with 60 persons.

The research instrument was used to obtain research data. The research instruments used in this study were tests and questionnaires (questionnaires). In this study, the researcher conducted a test validity test based on content and construct validity. Content validity, namely the accuracy of an instrument in terms of the material being tested. Construct validity, namely the validity obtained through rational analysis of the test according to the field being tested, namely the content of the test (Mahrens & Lehmann, 1984).

After the instrument is constructed based on specific theories' measured aspects, it is consulted with experts. This is called expert judgment. To carry out content and construct validity, the researcher asked for the help of 2 validators according to the field of this research. An instrument is considered reliable if it can measure accurately and consistently from time to time. The reliability test is carried out using the Alpha coefficient formula.

To determine the effectiveness of the learning module, the researcher used additional instruments in the form of a questionnaire or questionnaire. In this study, the researcher used a questionnaire containing questions about the knowledge and experience of the respondents after the action was taken. Researchers used a questionnaire with a Guttman scale. The Guttman scale is a scale used to get firm answers from respondents; namely, there are only two intervals such as agree-disagree, yes-no, true-false, positive-negative, ever-never, and so on.

Answers from respondents can be made with the highest score, "one," and the lowest score, "zero." For alternative answers in this questionnaire or questionnaire, the researcher sets an assessment category for yes = one and no = 0. The grid or question indicator in the questionnaire is based on the grid of a module comprised of 3 types: the feasibility of exhibit and production, growing cadets' experience, and increasing motivation for cadets to learn.

The researcher used specialist judgment to assess the validity of the questionnaire instrument. After the device is made about the aspects to be measured based on a particular theory, it is consulted with experts. Experts were asked for their opinions about the instruments that had been made. Perhaps the experts will decide: the tool can be used without repair, there are repairs, and maybe a complete overhaul. In this study, the researcher will conduct validity using expert judgment with two validators who are experts in their fields.

Research data analysis tests whether the proposed hypothesis is accepted or rejected. SPSS will be used to test the hypothesis using the paired sample t-test. Paired sample t-test on pretest and posttest is used to compare the difference between two means of two paired samples with the assumption that the data are usually distributed. Paired samples come from the same subject, and each variable is taken in different situations and circumstances. The criteria for testing the hypotheses

are: (1) Accept H1 if the significance value (2-tailed) < 0.05, which indicates a significant difference between the initial variable and the final variable, and (2) Reject H1 if the Significance Value (2-tailed) > 0.05 which indicates there is no significant difference between the initial variable and the final variable.

The data analysis for the questionnaire means simplifying data into a form that is easier to read and implement. Data analysis was carried out to ensure that the information collected would be clear and explicit. By the type of additional instrument, namely a questionnaire, the data analysis technique used to analyze the data in this study is quantitative descriptive analysis. After the quantitative data is collected, the data analysis technique in this study refers to the opinion of Creswell and Creswell (2017), which is as follows: 1.) Editing, the writer checks the answers given by the respondents so that they get clear guidelines about the data; 2.) Coding, the answers of the respondents are classified by marking or code on each answer; and 3.) Tabulation/tally is to carry out calculations as well as insert them into the table.

RESULT AND DISCUSSION

The results of the study are presented to answer the research objectives, namely to see whether there is an effect of using the maritime English vocabulary for beginners module on the learning outcomes of maritime English vocabulary for cadets in Batch V of the Nautical Department, West Sumatra Merchant Marine Polytechnic in 2021. Furthermore, the effectiveness of using the maritime English vocabulary for beginners module for cadets in Batch V of the Nautical Department in West Sumatra Merchant Marine Polytechnic in 2021.

Description of Research Data

The data description describes the pre-test and post-test results from cadets Batch V of the Nautical Department in West Sumatra Merchant Marine Polytechnic. After conducting the pre-test at the beginning to see the initial abilities of the cadets, the researchers held learning meetings four times. The cadets are taught using the maritime English vocabulary for beginners module. After learning for four sessions is completed, the cadets of Batch V of the Nautical Department, consisting of 3 categories, namely Nautical A, Nautical B, and Nautical C, are given a final test or Post-test to see the results of learning Maritime English vocabulary.

Pre-Test Results

The pre-test or initial test is helpful to see the initial abilities of cadets majoring in nautical before being taught using the maritime English vocabulary for beginners module. The results of the pre-test of 60 cadets are presented in Table 2.

Table 2. Pre-test Result

Data	Nautical A	Nautical B	Nautical C
Highest Score	33.89	31.8	33.05
Lowest Score	12.97	5.439	14.23
Mean	25.1	22.1	23
Median	25.1	24.3	21.5
Mode	18	27.6	15.1

Based on Table 2, it can be concluded that the mean or class average value in the three nautical categories above is not too different, namely Nautical A 25.1, Nautical B 22.1 and Nautical C 23. This explains that the initial abilities of cadets are almost the same.

Post-Test Results

The post-test or final test is intended to see the results of learning maritime English vocabulary for cadets majoring in nautical after being taught using the maritime English vocabulary for beginners module. From pre-test results, 60 cadets were divided into three classes: Nautical A, Nautical B, and Nautical C. The data were obtained in Table 3.

Table 3. Post-test Result

Data	Nautical A	Nautical B	Nautical C
Highest Score	85.77	88.7	92.89
Lowest Score	34.6	40.17	40.17
Mean	62.7	60.4	68.8
Median	64.9	60.5	68.2
Mode	66.9	64.4	62

Based on Table 3, it can be concluded that the mean or average value of the classes in the three nautical types above has increased from the pre-test and post-test, namely Nautical A from 25.1 to 62.7, Nautical B, which was initially 22.1 to 60.4 and Nautical C from the beginning 23 becomes 68.8. This explains that the results of maritime English vocabulary for cadets majoring in nautical after being taught using the maritime English vocabulary for beginners module are good. The difference in the results of Maritime English vocabulary learning for cadets from the Nautical Department in the Pre-test and Post-test can be seen in Figure 2.
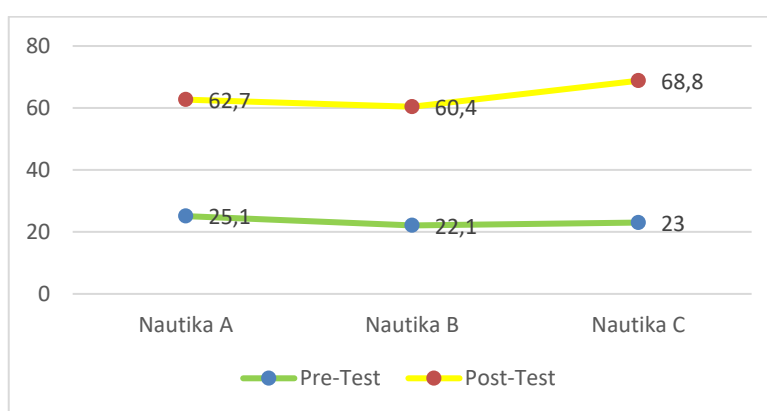
Figure 1. Average Score in the Pre-test and Post-test

From Figure 1, it can be concluded that there is a difference in the pre-test and post-t est scores of cadets in Batch V in the Nautical Department. The cadets' Post-Test scores have increased from the Pre-Test scores. This means that the results of learning maritime English vocabulary for Nautical cadets using the maritime English vocabulary for beginners module can be said well.

Hypothesis Testing (T-Test)

The hypothesis tested in this study was whether using the maritime English vocabulary for beginners module affected the learning outcomes of Maritime English vocabulary for cadets in Batch V Nautical Department at West Sumatra Merchant Marine Polytechnic in 2021. Hypothesis testing in this study used a T-test through SPSS assistance using the Paired Sample T-Test. The T-test is a test that aims to determine whether cadets have a difference in learning outcomes before being taught using the maritime English vocabulary for beginners module and after being prepared using the maritime English vocabulary for beginners module. The T-Test was carried out on the Pre-Test and Post-Test scores of cadets in one group of 60 persons. The test calculation is assisted by using SPSS. The test results can be seen in Table 4.

The results of the calculation of the SPSS statistical data in Table 4 are the Paired Sample T-Test conducted in the Marine Department Batch V, divided into three classes: Nautical A, Nautical B, and Nautical C, with a total of 60 cadets. This T-test aims to see the difference in the average scores on the Pre-Test and Post-Test. The criterion for testing the hypothesis is that if the significance value (2-tailed) is less than or less than 0.05, then H1 is accepted, which means that there is an effect of using the maritime English vocabulary for beginners module on the learning outcomes of maritime English vocabulary cadets in the Nautical Department Batch V, West Sumatra Merchant Marine Polytechnic in 2021. However, suppose the significance value (2-tailed) is more significant than

0.05. In that case, H1 is rejected, and H0 is accepted, which means no effect of using the maritime English vocabulary for beginners module on maritime English vocabulary learning outcomes cadets Batch V Nautical Department of the West Sumatra Merchant Marine Polytechnic in 2021.

Table 4. T-Test Pre-Test and Post-Test of the Nautical Department, Batch V

Data	Score
Mean	-40.60669
Std. Deviation	13.78493
Std. Error Mean	1.77963
t	-22.818
df	59
One-sided p	<.001
Two sided p	<.001

Based on the calculation results of the T-Test Paired Sample T-Test using SPSS above, it is known that the difference in the mean Pre-Test and Post-Test cadets in the Department of Nautical is 40,60669. The significance value of the pre-test and post-test data for nautical cadets is 0.001, which means it is smaller or less than 0.05 (0.001 < 0.05), then H1 is accepted, which means that there is an effect of using the maritime English vocabulary for beginners module on the results of learning English vocabulary maritime cadets Batch V Nautical Department of West Sumatra Merchant Marine Polytechnic in 2021.

Description of Research Questionnaire

Filling out the questionnaire was carried out by all cadets of the Nautical Department Batch V of the West Sumatra Merchant Marine Polytechnic in 2021, with the total number of respondents being 60 persons. The results of filling out the questionnaire can be presented in Table 5.

Table 5. Questionnaire Results

Questions	Percentage	
	Yes	No
Do you understand the language used in the "Maritime English Vocabulary for Beginners" module?	85%	15%
Are you interested in the appearance of this module?	88.33%	11.67%
Are you interested in this module's design (cover, text, image, print, paper quality)?	88.33%	11.67%
Does this module's material design (text and images) help you improve and widen your maritime English knowledge?	88.33%	11.67%
Did the material design of this module make you want to learn more about the material?	85%	15%
Is the "Maritime English Vocabulary for Beginners" module useful in learning maritime English?	88.33%	11.67%
Did this module help you understand maritime English concepts and terminology?	85%	15%
Is it easy to remember maritime English vocabulary using this module?	88.33%	11.67%
Is it easier to understand the lecturer's explanation when learning using this module?	88.33%	11.67%
Is it easy to do assignments using this module?	85%	15%
Do you enjoy learning maritime English using modules?	86.67%	13.33%
Do you have high motivation to learn by using this module?	85%	15%
Is maritime English learning more effective by using modules?	81.67%	18.33%
Are you burdened and find it challenging to use this module?	33.33%	66.67%
Do you agree that this module should be further developed as a media for learning maritime English?	85%	15%

Based on the questionnaire results above, it can be concluded that 85% of cadets in the Nautical Department can understand the language used in the maritime English vocabulary for beginners module. Then, 88.33% of cadets were interested in the appearance of this module,

interested in the design (cover, writing, pictures, prints, paper quality) of the module, and the material design (text and images) presented in this module helped the cadets improve and wider maritime English knowledge.

Furthermore, 85% of cadets stated that the material design of this module made them want to study the material further, and this module helped them understand maritime English concepts and terminology. Also, 88.33% of cadets revealed that using the maritime English vocabulary for the beginner's module helped them learn maritime English. It was easy to remember nautical English vocabulary using this module, and it was easier to understand the lecturer's explanation when learning using this module.

As many as 85% of cadets find it easy to do assignments using this module. They are highly motivated to learn by using it and agree that this module is developed further as a medium for learning maritime English. Then, 86.67% of cadets said they were happy if they learned marine English using the module. 81.67% said that learning maritime English was more effective using this module. Finally, 66.67% of cadets in the Nautical Department felt that they were not burdened and found it not difficult to use this module.

Based on the description of the questionnaire result, it can be concluded that the use of the maritime English vocabulary for beginners module is adequate for cadets in Batch V of the Nautical Department at the West Sumatra Merchant Marine Polytechnic. In addition to short answers in the questionnaire questions about the effectiveness of using the module, the researcher also asked questions in the form of a brief description of the cadets' opinions on the development of this Maritime English learning module.

The question is, "Which part do you think needs to be developed about this module?". The cadets' responses to these questions vary. Still, in general, they thought that the appearance and content of the module were very good, easy to understand, and attracted their interest in learning. However, to develop a better and more practical module in the future, the cadets gave some opinions about the parts that need to be developed. Some cadets think the module should present a more diverse image design.

Furthermore, they stated that modules like this exist in the form of learning applications via smartphones or e-learning modules. They can be used anywhere, especially when online learning (virtual) due to the current covid-19 pandemic. In this module, further discussion of images is added on each part of the ship, the image is bigger, and the description of the functions and uses of its features is added. There is additional information on each sub-heading of the ship. Furthermore, this module adds the meaning of Indonesian vocabulary to make it easier for novice learners to understand.

Discussion

Based on the results of data processing, it was found that the significance value of the pre-test and post-test data for Nautical Department cadets was 0.001, which means it is smaller or less than 0.05 (0.001 < 0.05), then H1 is accepted, which means that there is an effect of using the module maritime English vocabulary for beginners on the results of maritime English vocabulary learning for cadets Batch V in the Nautical Department of West Sumatra Merchant Marine Polytechnic in 2021. This proves that learning modules can support the success of cadets' learning.

Syafriyeti et al. (2020) assume that the module is a learning guide that will direct all lecturer activities in the learning process and a substance of competence that should be taught to students. Suitable teaching materials are all forms of materials that can help organize a learning interaction. Modules, in this case, are teaching materials that are systematically arranged in language that is easily understood by students, according to their age and level of knowledge, so that they can study independently with minimal guidance from educators.

The use of modules in learning in higher education, as implemented at the West Sumatra Merchant Marine Polytechnic, aims to enable cadets to study independently without or with lecturers. So, lecturers act as facilitators, while cadets can maximize their competence to be active in learning. The maritime English vocabulary for beginners module can improve the results of cadets' maritime English vocabulary learning because it contains core vocabulary or core material that cadets must

master in the shipping field, especially in the Nautical Department. This is supported by the opinion of Afrila (2019) which reveals that that the benefits of making teaching materials or modules can be felt both by educators and students. The benefits of the module for educators include: (1) assisting in the implementation of learning activities, (2) it can be submitted as an assessed work to increase educator credit scores for promotion purposes, and (3) increasing income for educators if their work is published. While the benefits of the module for students include: learning activities are more interesting and students get more opportunities to study independently with the guidance of educators.

The existence of the influence of the use of the maritime English vocabulary for beginners module on the learning outcomes of maritime English vocabulary for cadets in Batch V of the Nautical Department West Sumatra Merchant Marine Polytechnic in 2021 as seen from the results of the significance of the pre-test and post-test scores proves that the module is one of the teaching and learning materials that are suitable for use in maritime English courses. The cadets' vocabulary learning outcomes increase because they can learn on their own through the module and are more focused after being guided by the lecturer. This kind of learning is called the new paradigm of knowledge, which is student-centered.

Muhsin (2018) revealed that the paradigm of education and teaching has shifted from the old paradigm (teacher-oriented) to a new paradigm (student-oriented and integrated) which requires a change in the pattern of learning approaches, especially in English and English subjects. Generally, in language lessons, in the old method, the path to mastery of the field of science is oriented to the content of learning. At the same time, current learners emphasize the development of cognition, affection, and skills. Teachers are no longer just giving material but are more assigned as facilitators, motivators, and dynamic actors for students' academic and social development.

From the results of the research questionnaire, it can be explained that the maritime English vocabulary for beginners module is effective in the results of maritime English vocabulary learning for cadets. This is because the language and speech in the module are easy to understand, so cadets are increasingly interested in learning. This is in line with the opinion of Sawitri et al. (2017), which states that the language in the module is a communication tool to convey textbook material from textbook developers to students. Language determines the success of delivering the message. The correct language can facilitate understanding and cause or increase learning motivation.

The results of the research questionnaire analysis also concluded that the maritime English vocabulary for beginners module could motivate cadets to learn independently without the help of a lecturer because the vocabulary material presented has been grouped based on more specific units. According to Wahyuningrum (2019), the module must contain self-instructional characteristics, which means that a person or learning participant can teach themselves, not depending on other parties. To fulfill the self-instructional character, the module must; contains formulated objectives, contains learning materials that are packaged into small or specific units to facilitate complete learning; provide examples and illustrations that support the clarity of the presentation of learning materials; and contextual, namely the materials presented related to the atmosphere or context of the task and the user's environment; and use simple and communicative language.

Hasanah (2016) explains that learning will be effective if there is a process of construction and reconstruction of cognitive structures. This principle is in line with the thoughts reconstructed by students. The use of the maritime English vocabulary for beginners module in maritime English vocabulary learning explicitly refers to the process of cognitive rebuilding structures through the learning steps of clarifying the main concepts, namely the idea of learning Maritime English vocabulary, ship parts, steps for deepening the material which is structured and continued. by memorizing or practicing the language in each part of the ship to strengthen the cognitive organization.

Furthermore, learning will be effective if using the system. Learning is a systematic process through design, implementation, and evaluation stages. Three central components interact in this learning: lecturers, cadets, and learning materials through the maritime English vocabulary for beginners module.

The result of this research is that there is a significant effect of using modules in maritime English vocabulary learning. The positive response of cadets or I to the use of the maritime English

vocabulary for beginners module in maritime English vocabulary learning is also shown by Pathoni's et al. (2017) research results which show that the use of modules in physics learning is quite effective with an excellent category. This is because the modules used are by the competencies expected from the physics education study program curriculum. This is important to achieve the targets of lectures so that the quality of student learning can be improved.

Furthermore, the results of research from Lokaria (2016) explain that using modules in education can improve student learning outcomes in Biochemistry learning. There is a difference in the value of students who are taught using a module with students who are without a module. Furthermore, the activeness of students who were taught using the module was categorized as good, while students who were not taught using the module were categorized as moderate. So, the maritime English vocabulary for beginners module can also be said to be effective in learning English vocabulary because it can improve cadets' vocabulary learning outcomes.

CONCLUSION

Based on the study's results, it was found that the maritime English vocabulary for beginners module affected the learning outcomes of maritime English vocabulary for cadets in Batch V Nautical Department at West Sumatra Merchant Marine Polytechnic in 2021. Furthermore, from the results of questionnaire data processing, it can be concluded that using the module maritime English vocabulary for beginners in maritime English vocabulary learning is effective for cadets of the Batch V Nautical Department of the West Sumatra Merchant Marine Polytechnic in 2021. This research was carried out on Batch V Nautical Department cadets of the West Sumatra Merchant Marine Polytechnic. Based on this research, some suggestions that are appropriate from the results of the study can be put forward: The Head of Study Program at the West Sumatra Merchant Marine Polytechnic should direct each lecturer to do learning modules and develop learning modules such as learning modules in the Maritime English course that has been used in this research, namely the maritime English vocabulary for beginners module. This aims to make it easier for lecturers to deliver learning materials and make it easier for students to study independently at the home of the learning conditions due to the current Covid-19 pandemic. Then, other researchers who wish to research the use of modules in the teaching and learning process are expected to review existing research so that the aspects and preparation of the questionnaires are more relevant. Because in this research instrument, the researcher only focuses on the efficacy of using the module in general but has not explored in detail and depth how the level of point of a module is. So that assessing the effectiveness of a learning module can be a basis for analysis to conduct research and development of a module for the future.

ACKNOWLEDGMENTS

REFERENCES

Afrila, D. (2019). Pengaruh penggunaan modul terhadap hasil belajar mahasiswa pada mata kuliah statistik pendidikan. *The 2nd Proceeding Annual National Conference for Economics and Economics Education Research*, *2*, 295–306. http://econference.stkip-pgri-sumbar.ac.id/index.php/NCSE/ANCE3R/paper/view/511

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publication.

Hamid, M. A., Yuliawati, L., & Aribowo, D. (2020). Feasibility of electromechanical basic work e-module as a new learning media for vocational students. *Journal of Education and Learning (EduLearn)*, *14*(2), 199–211. https://doi.org/10.11591/edulearn.v14i2.15923

Hasanah, H. U. (2016). Respon mahasiswa terhadap pembelajaran grammar berbasis website. *NUANSA: Jurnal Penelitian Ilmu Sosial Dan Keagamaan Islam*, *13*(1), 274–282. https://doi.org/10.19105/nuansa.v13i1.880

King, G. R. D. (1991). Creswell's appreciation of Arabian architecture. *Muqarnas*, *8*, 94–102. https://doi.org/10.2307/1523157

Lokaria, E. (2016). Pengaruh penggunaan modul biokimia pada mahasiswa pendidikan biologi STKIP-PGRI Lubuklinggau. *Jurnal Bioedukatika*, *4*(1), 23–26. https://doi.org/10.26555/bioedukatika.v4i1.4738

Mahrens, W. A., & Lehmann, I. J. (1984). *Measurement and evaluation in education and psychology* (2nd ed.). Holt-Saunders (Japan).

Masruddin, M. (2018). Designing appropriate English learning materials for syariah economy and syariah banking study program students at IAIN Palopo. *The Asian ESP Journal*, *14*(4), 42–45. https://www.researchgate.net/publication/329356026_Designing_appropriate_English_learning_materials_for_Syariah_Economy_and_Syariah_banking_study_program_students_at_IAIN_Palopo

Muhsin, M. (2018). Peningkatan kualitas pembelajaran Bahasa Inggris melalui pelatihan pengembangan modul di Madrasah Tsanawiyah Kabupaten Sigi Sulteng. *Jurnal Dedikasi Masyarakat*, *1*(2), 79–89. https://doi.org/10.31850/jdm.v1i2.329

Papadopoulou, M. (2021). A student, a practitioner or a researcher? An attempt to reconcile the three roles through an undergraduate action research module. *Educational Action Research*, *29*(2), 206–225. https://doi.org/10.1080/09650792.2021.1886959

Pathoni, H., Jufrida, J., Saputri, I., & Sari, W. (2017). Persepsi mahasiswa terhadap e-modul pembelajaran mata kuliah fisika atom dan inti. *Jurnal Eksakta Pendidikan (Jep)*, *1*(1), 55–62. https://doi.org/10.24036/jep/vol1-iss1/35

Sawarynski, K. E., & Baxa, D. M. (2019). Utilization of an online module bank for a research training curriculum: Development, implementation, evolution, evaluation, and lessons learned. *Medical Education Online*, *24*(1), 1611297. https://doi.org/10.1080/10872981.2019.1611297

Sawitri, A. M., Subchan, W., & Asyiah, I. N. (2017). Respon siswa terhadap penggunaan modul Mnemonik dengan metode RWP (Reading-Writing-Presentation) dalam pembelajaran biologi di SMK Analisis Kesehatan. *Jurnal Pembelajaran Dan Pendidikan Sains*, *1*(1), 1–8. http://jurnal.unej.ac.id/index.php/jpps/article/view/6408

Sofa, N., & Dewi, S. P. (2020). English Language learning at Language Education and Training Centre of Ministry of Defense An Ethnographic Study at English intensive course LXXXVI-intermediate level. *The Asian ESP Journal*, *16*(1), 29–44. https://www.asian-esp-journal.com/volume-16-issue-1-2-february-2020/

Sukra, I. N., & Handayani, L. N. C. (2015). Pengaruh penggunaan buku ajar (modul) terhadap hasil belajar Bahasa Inggris untuk akuntansi. *Jurnal Teknodik*, *19*(1), 96–103. https://doi.org/10.32550/teknodik.v19i1.150

Syafriyeti, R., Atnur, W. N., & Watrianthos, R. (2020). Pengembangan model problem-based learning untuk mengetahui keterampilan pembelajaran dan refleksi mahasiswa pendidikan biologi. *Jurnal BIOEDUIN: Program Studi Pendidikan Biologi*, *11*(2), 70–78. https://doi.org/10.15575/bioeduin.v11i2.14311

Thang, F. K., & Koh, J. H. L. (2017). Deepening and transferring twenty-first century learning through a lower secondary Integrated Science module. *Learning: Research and Practice*, *3*(2), 148–162. https://doi.org/10.1080/23735082.2017.1335426

Thornbury, S. (2002). *How to teach vocabulary* (1st ed.). Pearson Education ESL.

Wahyuningrum, T. (2019). Efektivitas penggunaan modul terhadap peningkatan nilai akhir siswa pada pelajaran Bahasa Inggris. *Dinamika Bahasa Dan Budaya*, *14*(1), 1–9. https://doi.org/10.35315/bb.v14i1.6710

Yulastri, A., Hidayat, H., Ganefri, G., Edya, F., & Islami, S. (2018). Learning outcomes with the application of product based entrepreneurship module in vocational higher education. *Jurnal Pendidikan Vokasi*, *8*(2), 120–131. https://doi.org/10.21831/jpv.v8i2.15310

A lesson learned from the integration of BIM in construction engineering education in an Indonesian Polytechnic

Abdi Suryadinata Telaga *
Politeknik Manufaktur Astra, Indonesia.
* Corresponding Author. Email: abdi.telaga@polman.astra.ac.id

ARTICLE INFO

ABSTRACT

The Indonesian construction industry has increasingly adopted Building Information Modeling (BIM). One of the barriers to adopting BIM is BIM skills among graduates are still rare. Therefore, higher education institutions have to adopt BIM into their curriculum. However, as BIM is a new concept in construction engineering, many higher education institutions have a problem integrating BIM. Therefore, the paper proffers a syllabus to integrate BIM in a vocational higher education institution. The research methodology follows the Tyler model of curriculum development. It started with a review of prominent BIM integration into higher education research. Then, discussion with BIM practitioners from the industry to acquire information on current BIM-related job specifications in Indonesia. The team teacher then discussed and analyzed the results to create an initial syllabus. Further, the students' performance and feedback are observed during two years of course offering from 2019 to 2021. Improvement of the syllabus is based on observation and feedback results. The progress has increased students' performance in the BIM course. The students' performance is excellent even though the course was offered online due to a pandemic.

INTRODUCTION

Nowadays, building information modeling (BIM) utilization in Indonesian construction industries has increased. BIM implementation in Indonesia in 2019 was reported at 60% (Hatmoko et al., 2019) and increased from 38% in 2016 (Hanifah, 2016). Construction companies have started to adopt BIM to increase productivity (Sopaheluwakan & Adi, 2020). BIM is a new concept that helps engineers to understand construction comprehensively, starting from design (3D), construction scheduling (4D), cost information (5D), and project lifecycle (6D). Therefore, the engineer can virtually see the overall building project before developing the actual building. Engineers can view the construction 3D model and find any incorrect design, such as detecting any clash (Azhar et al., 2012).

Further, engineers can simulate the building development to perfect the solution. As a result, many companies have seen the real benefit of BIM in reducing project costs. BIM utilization in a 20-story building project in Indonesia has diminished project planning time to 50%, requires less human resources by 26,66%, %, and cut down personnel costs to 52,25% compared to the conventional method (Permatasari et al., 2016). Lu et al. (2014) studied BIM utilization contribution to cost reduction in AEC (Architecture, Engineering, and Construction) projects in Hong Kong is 6.92%.

Due to increasing infrastructure projects in Indonesia, graduates' demand for BIM capabilities is also growing. However, Indonesia is still lagging behind other developing countries (Puspita & Patriotika, 2021). Telaga (2018) showed that BIM maturity in Indonesia is still at level 1. While big companies have started to adopt BIM, small and medium companies (SME) adoption still needs to improve due to low awareness of BIM (Fitriani et al., 2018). Further, SME companies must invest in BIM software and recruit BIM-skilled engineers. As the demand is growing, industries need help recruiting graduate BIM-skilled engineers. The insufficient workforce with BIM skills shows that there is still a gap between industry and higher education. Therefore, integrating BIM into AEC higher educational institution curriculum is eminent to increase BIM adoption (Agirachman et al., 2018).

Currently, Indonesian higher institutions' awareness of integrating BIM into AEC education has increased. Universities in Indonesia have started to offer BIM courses at the undergraduate level (Gegana & Widjarnarso, 2015). However, many higher institutions still need help integrating BIM into their curriculum due to a relatively new construction concept. Another reason is the high initial cost of setting up a BIM laboratory. While some BIM software is free for educational purposes, the software requires a high-performance computing PC.

Furthermore, a densely educational curriculum poses a barrier for lecturers to add new courses to address BIM. Many lecturers also do not have BIM experience or lack BIM training. Likewise, higher education institutions must consider it wisely before adding specific BIM courses. BIM is not merely about 3D drawing or modeling but also about transforming student mindset to view construction as a whole project (Hedayati et al., 2015).

Tyler's approach is a linear and straightforward approach to curriculum development. The Tyler approach consists of school objectives, identifying students' educational experiences, organizing experience, and evaluating purposes. Although the Tyler approach has been challenged over the last 70 years, the Tyler model approach is still widely applied because of its simplicity (Cruickshank, 2018). Further, the Tyler model is logical, follows a sequential process, and teaches success based on the evaluation phase. Therefore it is suitable for developing a new course that uses unique technology such as BIM. While DACUM (Develop a Curriculum) is also a model of vocational curriculum development. DACUM requires experts to discuss job analysis (Wijanarka, 2014). BIM is a relatively new technology in the Indonesian construction industry. Therefore, BIM experts that could conduct two-day workshops for job analysis for DACUM were not readily available. Consequently, the Tyler model approach is more appropriate for this curriculum development.

Several research studies have tried integrating BIM into the Civil and construction engineering curriculum. Han et al. (2013) used the Tyler approach to develop a BIM curriculum and followed three stages of curriculum development preparation, development, and improvement. During the preparation stages to obtain the benefits, challenges, and purpose of BIM, they interviewed eight experts consisting of directors and engineers to bring their expectations of BIM skills of newly graduated (Han et al., 2013). Mcgough et al. (2013) started from the level of BIM competency required for students and emphasized that the module replicates the project that the industries desire. Therefore, the graduates comprehensively understand BIM working practices and low-impact design (Mcgough et al., 2013).

Ali et al. (2016) interviewed 15 construction professionals to gain insight into BIM utilization for quantity surveyor jobs in the Malaysian construction industry. The professionals have more than ten years of construction industry experience (Ali et al., 2016). Furthermore, Wong et al., (2011) tated that the industry prefers recruiting graduates who can implement BIM practically. Therefore, understanding BIM usage in construction jobs is essential. Thus, a perspective from an industry professional is required to develop the right BIM curriculum for students.

BIM is a new concept in the construction industry; BIM is a 3D model process that integrates all stages and stakeholders in construction development. Therefore, BIM requires collaboration among stakeholders to ensure the model developed is correct. Students may have yet to be aware of the partnership. Therefore, collaboration work during learning BIM is a necessity.

Tisdel and Mulva (2007) concluded that collaboration among students, mentors, and project owners in a real-world case study increases students' interest in the BIM course. Further, the

collaborative approach makes students and mentors more adaptive to construction work's dynamic nature (Tisdel & Mulva, 2007). Similarly, Olowa et al. (2021) used BIM to teach construction project cash flow to students. The students were divided into groups. Each student represents typical roles in construction work as a developer, contractor, and subcontractor (Olowa et al., 2021). Each group was given an exercise to learn to negotiate project cash flow to meet cash flow constraints in a project. Likewise, Adamu and Thorpe (2016) stated that students require a role-playing exercise to prepare students to have the necessary skills in the construction industry. By teaching students to act in different roles, the students can understand the different perspectives of other jobs in the construction industry. Therefore, they can collaborate better.

Visualization is an essential feature of BIM that can teach students to understand the whole construction process. Kim (2012) found that rich visualization of BIM improves students' understanding of detail in building. However, BIM aims not to teach visualization or 3D models of the building but to teach students a comprehensive understanding of architectural and construction projects (Banihasjemi & Webber, 2019). Therefore, students must complete the required data to ensure the building is correctly built because BIM is a digital building representation. Therefore, improving them to quantify the material needed for the building development.

Moreover, the students can learn to understand the interaction between components in BIM. Current BIM software has many capabilities. Therefore, by understanding material information and quantity calculation, the student can also learn to calculate load structure and simulate project construction and building energy consumption. Integrating BIM into vocational higher institution perspectives from construction industry professionals is essential. Moreover, the syllabus should encourage students to collaborate in preparing them well for the workforce. Furthermore, visualization is used to help students understand the whole concept of construction development.

Lectures must carefully assess current student knowledge about construction engineering before adding BIM knowledge. Many students still need to understand individual subjects and job specifications within the construction industry. Consequently, the students still need a clear idea to implement the knowledge gained to perform a specific task in the AEC industry. Therefore, preparing diploma-level graduates' skills to meet BIM industry needs in traditional construction methods (design-bid-build) is a necessity. Therefore, the paper attempts to proffer a strategy to integrate BIM education smoothly into building construction engineering programs in Indonesian vocational higher education.

As a vocational higher institution, Astra Polytechnic offers a BIM course in Building Construction Engineering associate degree program to support the availability of BIM skilled workforces. Because the vocational institution is a job-focused education, the curriculum differs from a university. Vocational education must have at least 60% of their courses practice courses. Therefore, the syllabus should focus more on visualization. The following sections will highlight the methodology and present the proposed syllabus for Indonesian vocational higher institutions.

RESEARCH METHOD

Developing the syllabus to produce the BIM course in the higher vocational institution that meets the industry demands requires two years of development. It started from 2019 to 2021. At every end of the BIM courses, a teaching team consisting of an instructor with experience as a BIM engineer and a lecturer revisits and discusses the course to improve the course content.

The curriculum development follows Tyler's approach. The first stage of the Tyler approach is to determine the objective of teaching BIM in vocational higher education. Therefore, to obtain the aim of BIM teaching, the first step is to review the literature to receive insight from previous BIM integration to higher institution research. Therefore, the teaching team can learn from the content of BIM courses from other countries and the expectation of the course's outcome for undergraduate and diploma levels.

Because the orientation is skill-based at the diploma level, the designed course prepares students to work after graduation. Therefore, the course must be a practice course. Likewise, using proprietary software in the study is preferable to open source. Furthermore, the students can take the certification exam after completing the course or graduate to be more competitive in the job market.

The second step is to gain an industrial perspective on BIM usage in the construction industry in Indonesia through discussion with construction industry professionals. The team teacher discussed with a BIM manager and BIM engineer of one Indonesian construction company to understand the task of BIM engineers in their company. The discussion was an open discussion to know the expectation of the industry. The first and second steps aim to develop the objective of BIM teaching.

Following the discussion results, the third step is to analyze the task to understand the skill required to complete the BIM-related job. During the meeting, the team agrees that the job description must have a clear boundary between bachelor and diploma levels. At the same time, the industry is more relaxed regarding education level as long as the employee can finish the task. However, the job description impacts syllabus development in an educational institution. The job task analysis results provide a learning and organizing experience for the students as the second and third stages of the Tyler approach.

The Polytechnic has two classes consisting of 15 students in a regular class and 30 students in an employee class 2019. For the year 2020, there were 24 students in the regular class and 17 students in the employee class. A regular class has students without working experience, and an employee class caters to construction company employees. Therefore, some students have had experience with BIM before. However, the syllabus content of the two types must be similar, and both classes can follow the course. Therefore, the syllabus starts from the beginning, regardless of students' experience of BIM.

The team teacher observed the students during the course to see whether the students could follow the system. The observation is important because the system was the first in the polytechnic. The observation results provide insight for the team to revise course content. Further, the team analyzes the midterm exam and final project. The analysis is based on the average exam and final results score. The results and feedback from students were used to improve the course content. The students' feedback was obtained at the last meeting of the class. The students spoke about their experiences while attending the class. Over the two years of the BIM course, there has been a change in content and software to the curriculum and overcoming licensing problems. The complete research method diagram is shown in Figure 1.
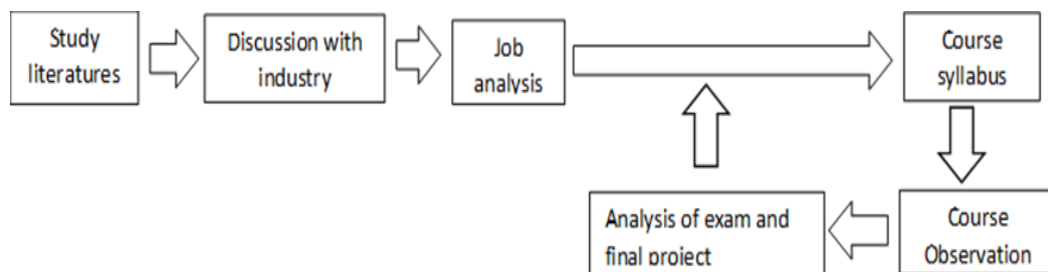
Figure 1. Research Methodology

RESULT AND DISCUSSION

After discussions with industry professionals, Indonesia's construction industry still follows a traditional design-bid-build (DBB) process. The result is similar to Marzuki and Tamin (2017) study, which reported that 99% of Indonesian public works still use the DBB process. The process follows a sequential process, which does not overlap with the following procedure. Therefore, the project owner separately awards contracts to the architectural and construction companies. The architecture company creates a design and makes the construction documents. The project owners then invite qualified contractors to bid for the projects. If necessary, the contractors must estimate the total construction cost for particular construction works. The contractors also could ask subcontractors to calculate the cost of the pieces.

Further discussion with industrial professionals discovered that small and medium (SME) companies in Indonesia still use 2D and 3D drawings. The professional statement is supported by

research from Hatmoko et al. (2019) that stated the Indonesian construction industry still used 2D drawings because the document approval from the government still used 2D drawings. The situation means that the Indonesian construction industry is still in the pre-BIM stage [3]. Therefore, there is a need for big construction companies to redraw the drawing into BIM manually. Therefore, the companies require construction workers who can redraw 2D and 3D drawings into BIM. Furthermore, the worker must also be able to put material detail into IM so that the construction material costs can be calculated automatically using BIM software. The task is to support the quantity surveyor (QS) profession.

The building construction technology study program in an Indonesian Polytechnic needs to be specifically addressed QS program. However, due to the demand for construction industries jobs. The program graduate must be able to redraw 2D and 3D illustrations to BIM software and develop the BIM model. The discussion result aligns with the Ali et al. (2016) study of BIM in Malaysia for a diploma-level QS program. Diploma graduates are limited to mastering BIM for visualization and quantification. Conversely, degree-level graduates are expected to integrate construction project planning and scheduling tasks in BIM. Table 1 presents the BIM framework for QS students in Malaysia.

Table 1. BIM skills for QS students in Malaysia

Object	Visualization	Quantification	Planning & Scheduling	Management
Medium	1. Draughtsmanship 2. Construction Technology 3. Construction Services	1. Measurement 2. Cost Estimating	1. Cost Planning and Scheduling 2. Cost Analysis	1. Contract 2. Professional Practice 3. Project Management
Diploma level outcome	Capability to acknowledge the 2D design and basic 3D model	Ability to perform quantity take-off software and use spreadsheet software to calculate the total material cost.	1. Capability to utilize software to acknowledge cost planning and scheduling fundamental principles. 2. Capability to utilize digital data to acknowledge project economic value.	Capability to acknowledge legal implications, procedural aspects of a project, and project complexity.
Degree level outcome	Capability to acknowledge the 2D design and basic 3D model	Ability to perform quantity take-off software and use spreadsheet software to calculate the total material cost.	1. Capability to utilize software to evaluate cost planning and scheduling fundamental principles. 2. Capability to utilize digital data to evaluate cost analysis project economic value. 3. Capability to integrate 4D and 5D through BIM in the project.	1. Capability to assess legal implication, procedural aspect of a project, and project complexity. 2. Capability to manage a project.

Source: (Ali et al., 2016)

Based on Table 1, QS education at diploma and degree levels has similar outcomes for visualization and quantification. The difference between those two is planning, scheduling, and management objects. The degree-level graduates should evaluate the economic cost of a project through digital data and BIM. Moreover, the graduate also should be capable of assessing legal aspect implications and managing a construction project.

The QS education framework in Malaysia is similar to the industry professional explanation of BIM engineer job specifications in Indonesia. In Indonesia, diploma-level BIM engineers make

the BIM based on 2D and 3D drawings and perform quantity take-off. The degree-level engineers then check the result and calculate the project's economic value and schedule. Further, the engineers use the model and calculation to make a bidding document. Table 1 shows that QS education in Malaysia focuses on quantification objects. By contrast, in Indonesia, the expected outcome for diploma-level BIM engineers in the Indonesian construction industry is the capability to perform quantity take-off and make a BIM model correctly. In particular, following the Tyler model, the objective of teaching BIM is the ability to convert 2D and 3D drawings to BIM and create BIM 3D models.

The BIM syllabus must gradually progress from 2D and 3D to BIM from an industry perspective. Furthermore, vocational education aims to train graduates who are relatively ready to work. The students must have skill competency after completing each year of study. Therefore, the BIM syllabus also must consider the occupation that can be filled after completing each course.

Table 2 shows BIM integration in the construction engineering syllabus of vocational higher education institutions. Students learn to draw 2D and 3D using drawing software in semester 2 of the technical drawing course. Therefore, in the subsequent semester, the students should be able to draw and read 2D and 3D documents. The institution divided BIM courses into two-semester, the 3rd semester and the 4th semester. The courses are divided into two parts because the first semester teaches fundamental BIM, and the 2nd semester is for advanced BIM. Therefore, Table 2 explains stage 2 of the Tyler model.

Table 2. BIM Integration in Vocational Higher Education Syllabus

Semester	Object	Outcome	Occupation
2	Visualization	Capable of drawing 2D and developing 3D models using drawing software.	Drafter
3	Visualization	Capable of converting the 2D and 3D drawings to BIM software.	BIM Technician
4	Visualization	Capable of making 3D architecture models.	BIM Junior Engineer

The polytechnic created a 3rd-semester course named Building Information Modelling functions as a transition from technical drawing to BIM. Therefore, in this course, the students learn the architectural part of BIM. The students practice making BIM models starting from building layouts, column grids, structural design, floors and roofs, exteriors, and interiors. The course consists of mechanical, electrical, and plumbing (MEP), and reinforcement modeling. The team teacher creates a mid-term exam to check the student's understanding. The exam is to convert a 2D drawing into BIM to conform to the job specification of BIM engineers in the Indonesian industry.

In the 4th semester, the polytechnic created a course named Civil Manufactured. The objective of the study is to teach advanced BIM. Project scheduling (4D) and cost estimation (5D). However, the industry demands that diploma-level graduates can perform quantity take-off. Therefore, the syllabus focuses on 5D BIM, where the students learn to put detailed information on building materials and quantification from a construction project. Moreover, in practice, project scheduling is part of project management which is the role of a degree-level engineer.

Teaching project scheduling is more complex than quantity take-off because the students need to visualize the time dimension of the project. By contrast, teaching quantity take-off is more straightforward. By adding information about material price, the BIM software can automatically calculate the material volume and the associated cost. Thus, the students verify the project quantification using spreadsheet software. However, the syllabus still consists of 4D BIM to teach students the construction project schedule concept and additional knowledge.

The BIM course started in the odd semester of 2019. The course is conducted full day or 8 hours every week. The teaching team observed the pace of students in completing the targeted exercise. BIM is a practice course taught in the laboratory. Thus, in each lab session, the instructor hands out training. The instructors demonstrate and explain the module's key concepts so the students can follow the module. At the beginning of the course, the students focus on completing the drawing instead of understanding the concept. The teacher also found that the students initially thought BIM

software was another drawing tool. Many students found it challenging to draw and ensure that all the dimensions were correct; otherwise, the mistakes affected the whole model. The teaching team needs to remind the students of the engineering concept behind the exercise, including the software's database.

The objective of BIM teaching in the polytechnic is the capability to model based on 2D drawing. Therefore, the third step of the Tyler model is to organize the student experience to make a model based on the 2D illustration. Thus the students must learn the basic concept of modeling. Therefore, the course content until midterm exams consists of building layout, architectural, and structural design. The software used until the midterm exam is Revit Autodesk and Tekla. Revit Autodesk is used to make a BIM model, and Tekla is for reinforcement modeling. However, the midterm exam does not include reinforcement modeling. Therefore, the exam only asked the students to make a BIM model from a 4-story building of 2D drawing. The midterm exam results show that the students can convert a 2D illustration into a BIM model with an average score of 86 out of 100. The students learn to make interior and exterior BIM models for the rest of the semester. The course should cover MEP based on the syllabus created. However, the students needed help following the contents. Therefore, the MEP module was moved to the next semester.

At the end of the semester, there was a final group project as a final exam. Each group of students consists of four students. The group was then asked to make a BIM model of a 4-story building. There was no restriction on building purpose, but the students' BIM model must be a complete model, including architectural components and structural layout. Because the students only had studied basic structure load calculation and were exposed to limited building codes. Therefore, the common sense of students to make the model is essential. The students presented the models to the team teachers. Furthermore, the project grading is based on the completeness, complexity of the model, and engineering logic of the designed model.

The students were given two weeks to complete the project. The majority of the students were excited about the projects. In the final presentation, all groups made interesting buildings with high complexity. However, none of the groups can complete the model 100%. Furthermore, the average score of the students is 77. The reasons for that are insufficient time and high-spec computer requirements to complete the model because the student could not access the laboratory and had to do the project at home. The project also did not require the students to make the reinforcement modeling. Therefore, the project can be completed only using Revit Software Autodesk.

The advanced BIM course named civil manufacture started in the even semester of 2019/2020. It started in February 2020. The course consisted of MEP, project scheduling (4D), and cost estimation (5D). However, since March 2020, most courses have had to be done online due to the pandemic, hampering students' learning. The institution only allowed teaching of the line for practice courses. While the course was a practice course, because the course could be done using a computer, the course was then conducted online. The study was undertaken still 8 hours a day.

However, the learning process poses some issues due to the pandemic, where most students returned to their homes. The students had problems with computer requirements, poor internet connection, and high internet costs. Therefore, the class was divided into two sessions. Morning sessions were from around 8:00 to 9:00, and the afternoon session was from 13:30 to 14:30. During the morning session, the instructor explained the exercise for the day. The instructor then checked the student's progress later in the afternoon session.

Although the teaching team tried their best to optimize the learning process, problems occurred every session. Notably, the infrastructure problems discourage some students from attending class. However, the students had to submit their work to the server at the end of the class. So that the team teacher can still track the student's progress. Despite the challenge, the students still observe the exercise passionately.

The average student's exercise completion rate was 75%, with one student completing 100% and only two completing below 60%. Because of the pandemic, the teaching team decided to skip the midterm exam. The final project was used as a final exam. The students are divided into groups similar to the previous semester. They are asked to add MEP to the last semester's model or a new model. However, considering the students' computer equipment and the pandemic situation, the final project did not include quantity take-off. Even though quantity take-off is one of the significant skill

criteria, the students could make good MEP models despite the online course. The average score for the final project was 84, and only one group needed to remember to make a mechanical model.

In 2020/2021, the pandemic continues; however, teachers and students have adapted to online learning. both building information modelling and civil manufacturing courses were conducted online. Learning from the previous year, the teaching team discussed improving teaching material. As a result, the team simplified each exercise and added quantity take-off and working drawings. Therefore, in 2020/2021, the contents until the midterm exam consist of dimension, architectural elements, structural elements, simple quantity take-off, and working drawing.

The concept of the midterm exam is still similar to last year's. The students were still asked to make a BIM model from a 2D drawing. However, because of syllabus content addition, the students were asked to perform quantity take-off and create a working drawing. The performance was similar to last year's last student. The average score of the students was 87. The final project is also similar to the previous year. The students had to make a group of 4 or 5 students. Then they had to make a BIM model of a 4-story building, but with reinforcement modeling. The grading criteria are also similar. The student's performance was better than last year, with an average score of 92. The score reflected that improving the syllabus with simplified exercises could improve students' understanding of students. Furthermore, despite the content addition, online learning did not affect student performance.

Civil manufacturing course or advanced BIM in 2020/2021 was still in a pandemic. Learning from last year, the team teacher also improved the course syllabus. The content was similar to the previous year but still consisted of MEP, BIM 4D, and 5D. However, exercises were made more straightforward than the last year. Therefore, the students could complete the activity within 8 hours practice session. The grading criteria are also similar, and only the final project is at the end of the semester. The students were also asked to add MEP from the BIM model they had made previously. However, because the students were better prepared to do online classes than last year, they could complete 4D and 5D exercises. Therefore, the final project included project scheduling and cost estimation. The student's performance was slightly better than last year, with an average score of 81.

Based on the observation in the industry and advice from the professionals. The team teacher eventually used Autodesk Revit for BIM architectural and MEP modeling, Tekla for reinforcement modeling, and Autodesk Naviswork for BIM 4D and 5D modeling in the course syllabus because the software was widely used in the industry. However, feedback from the students, particularly in the BIM course, installing three software is becoming a burden for students' computers. Because Autodesk Revit also has a capability for reinforcement modeling as Tekla. Therefore, in 2021/2022, the course only uses Autodesk Revit and Naviswork.

The designed BIM courses are divided into two semesters to prepare students to meet industry standards. The Building Information Modelling course is offered in the third semester to give fundamental BIM skills. The course is a continuation of technical drawing. Furthermore, the students learn architectural, structural, and reinforcement modeling during the 3rd semester. Then, the students could learn advanced BIM in the 4th semester. Civil manufacturing's advanced BIM course teaches MEP modeling, project scheduling, and cost estimation.

The team teacher needs two years of observation to create the appropriate syllabus. The students who studied BIM have excellent performance despite a pandemic that forces students to learn online. The student grades increase following syllabus improvement. Therefore, observing students during the course is essential to fine-tune the course content. Furthermore, the students' results show that the student can follow the syllabus. Therefore, the students are ready to take the BIM junior engineers job after graduating. Moreover, the student's grades validate that the syllabus is suitable for higher vocational students.

CONCLUSION

Construction companies in Indonesia are starting to use BIM. At the same time, the government policy drives BIM usage in Indonesia. The companies have seen the benefit of BIM in reducing construction time and cost. Particularly during a tender process where BIM accelerates the project cost calculation process. Therefore, Indonesia's demand for a workforce with BIM skills is

eminent. However, higher education institution in Indonesia offering BIM courses is still rare. The one that gives BIM courses still needs help effectively integrating the industry demand and curriculum. Notably in higher vocational education, where the approach is practical. Therefore, the paper proffers a syllabus to integrate BIM in a vocational higher education institution. The syllabus has resulted from applying the Tyler model curriculum development. The works of literature study and construction industry professional discussion serve to identify the teaching objective of the course. Further, analysis of the task of BIM engineers serves as input for designing and organizing learning experiences for students. In the last stages, the course evaluation during two years of BIM teaching from 2019 to 2021 is analyzed to improve the syllabus. Further, the syllabus has been applied to the students. Therefore, higher vocational education in building construction can use the research results as references to develop a strategy to integrate BIM into the building construction engineering curriculum. A natural continuation of this research is to obtain feedback from the graduates who work in the BIM sectors.

REFERENCES

Adamu, Z., & Thorpe, T. (2016). How universities are teaching BIM: A review and case study from the UK. *Journal of Information Technology in Construction*, *21*, 119–139. https://openresearch.lsbu.ac.uk/item/87314

Agirachman, F. A., Putra, I. F., & Angkawijaya, A. (2018). Initial study on building information modeling adoption urgency for architecture engineering and construction industry in indonesia. *MATEC Web of Conferences*, *147*, 06002. https://doi.org/10.1051/matecconf/201814706002

Ali, K. N., Mustaffa, N. E., Keat, Q. J., & Enegbuma, W. I. (2016). Building information modelling (BIM) educational framework for quantity surveying students: The Malaysian perspective. *Journal of Information Technology in Construction*, *21*(Special issue 9th AiC BIM Academic Symposium & Job Task Analysis Review Conference), 140–151. https://www.itcon.org/paper/2016/9

Azhar, S., Khalfan, M., & Maqsood, T. (2012). Building information modeling (BIM): Now and beyond. *Australasian Journal of Construction Economics and Building (AJCEB Incorporating Special Issue on BIM)*, *12*(4), 15–28. https://search.informit.org/doi/abs/10.3316/informit.013120167780649

Banihasjemi, S., & Webber, R. (2019). *BIM Education - Global – 2019 update report*. https://www.icis.org/wp-content/uploads/2019/05/BIM_Education_Global_2019_Update_Report_V6.0.pdf

Cruickshank, V. (2018). Considering Tyler's curriculum model in health and physical education. *Journal of Education and Educational Development*, *5*(1), 207–214. https://doi.org/10.22555/joeed.v5i1.1443

Fitriani, H., Budiarto, A., Ajayi, S., & Idris, Y. (2018). Implementing BIM in architecture, engineering and construction companies: Perceived benefits and barriers among local contractors in Palembang, Indonesia. *International Journal of Construction Supply Chain Management*, *9*(1), 20–34. https://doi.org/10.14424/ijcscm901019-20-34

Gegana, G., & Widjarnarso, T. H. (2015). BIM Course development and its future Integration at University of Indonesia and Institute of Technology Bandung, Indonesia. *9th BIM Academic Symposium & Job Task Analysis Review*, 10–17.

Han, A. Y., Chung-Suk, C., & Namhun, L. (2013). Building information modeling: Systematic course development for undergraduate construction students. *Journal of Professional Issues in Engineering Education and Practice*, *139*(4), 290–300. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000164

Hanifah, Y. (2016). Awareness dan pemanfaatan BIM: Studi eksplorasi. *Temu Ilmiah IPLBI 2016*, 49–54. https://www.researchgate.net/profile/Yulita-Hanifah/publication/343827993_Awareness_dan_Pemanfaatan_BIM_Studi_Eksplorasi/links/5f43aea1a6fdcccc43f57027/Awareness-dan-Pemanfaatan-BIM-Studi-Eksplorasi.pdf

Hatmoko, J. U. D., Fundra, Y., Wibowo, M. A., & Zhabrinna, Z. (2019). Investigating Building Information Modelling (BIM) adoption in Indonesia construction industry. *MATEC Web of Conferences*, *258*, 02006. https://doi.org/10.1051/matecconf/201925802006

Hedayati, A., Mohandes, S. R., & Preece, C. (2015). Studying the obstacles to implementing BIM in educational system and making some recommendations. *Journal of Basic and Applied Scientific Research*, *5*(3), 29–35. https://www.researchgate.net/publication/273523998_Studying_the_Obstacles_to_Implementing_BIM_in_Educational_System_and_Making_Some_Recommendations

Kim, J.-L. (2012). Use of BIM for effective visualization teaching approach in construction education. *Journal of Professional Issues in Engineering Education and Practice*, *138*(3), 214–223. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000102

Lu, W., Fung, A., Peng, Y., Liang, C., & Rowlinson, S. (2014). Cost-benefit analysis of Building Information Modeling implementation in building projects through demystification of time-effort distribution curves. *Building and Environment*, *82*, 317–327. https://doi.org/10.1016/j.buildenv.2014.08.030

Marzuki, P. F., & Tamin, R. Z. (2017). Challenges of design-build method implementation in public works project delivery. In E. Pellicer, J. M. Adam, V. Yepes, A. Singh, & S. Yazdani (Eds.), *Proceedings of the Ninth International Structural Engineering and Construction Conference* (pp. 1–6). ISEC Press. https://doi.org/10.14455/ISEC.res.2017.119

Mcgough, D., Ahmed, A., & Austin, S. (2013). Integration of BIM in higher education: Case study of the adoption of bim into coventry university's department of civil engineering, architecture and building. *Sustainable Building and Construction Conference 2013*. https://doi.org/10.13140/2.1.1240.8642

Olowa, T., Witt, E., & Lill, I. (2021). Building information modelling (BIM) – enabled construction education: teaching project cash flow concepts. *International Journal of Construction Management*, 1–12. https://doi.org/10.1080/15623599.2021.1979300

Permatasari, C. A. B., Adhi, R. P., Hidayat, A., & Hari Nugroho. (2016). Perbandingan Efisiensi Waktu, Biaya, dan Sumber Daya Manusia Antara Metode Building Information Modelling (BIM) dan Konvensional (Studi Kasus: Perencanaan Gedung 20 Lantai). *JURNAL KARYA TEKNIK SIPIL*, *5*(2), 220–229.

Puspita, N. R., & Patriotika, F. (2021). BIM Implementation in Public Construction Projects in Indonesia. *IOP Conference Series: Materials Science and Engineering*, *1156*(1), 12008. https://doi.org/10.1088/1757-899x/1156/1/012008

Sopaheluwakan, M. P., & Adi, T. J. W. (2020). Adoption and implementation of building information modeling (BIM) by the government in the Indonesian construction industry. *IOP Conference Series. Materials Science and Engineering*, *930*(1). https://doi.org/10.1088/1757-899X/930/1/012020

Telaga, A. S. (2018). A review of BIM (Building Information Modeling) implementation in Indonesia construction industry. *IOP Conference Series: Materials Science and Engineering*, *352*, 012030. https://doi.org/10.1088/1757-899X/352/1/012030

Tisdel, R. C., & Mulva, S. (2007). A case study of a design-build competition in a construction program. *Proceedings of the 43rd Annual Conference by Associated Schools of Construction*.

https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=834c3449aab102b98d0 3a633f260cf04196896c5

Wijanarka, B. (2014). Comparison between the DACUM and work process analysis for vocational school curriculum development to meet workplace need. *Nternational Conference On Vocational Education And Training (ICVET)*. http://staff.uny.ac.id/sites/default/files/penelitian/dr-bernadus-sentot-wijanarka-mt/bernardussentoticvet2014.docx

Wong, K. D. A., Wong, K. W. F., & Nadeem, A. (2011). Building information modelling for tertiary construction education in Hong Kong. *Electronic Journal of Information Technology in Construction*, *16*, 467–476. https://itcon.org/papers/2011_27.content.04564.pdf

The effect of linguistic intelligence and memory on air traffic control performance of field aviation polytechnic

Nisa Azhari Saragih *, Gustianingsih Gustianingsih, Ridwan Hanafiah (ID)
Universitas Sumatera Utara, Indonesia.
* Corresponding Author. Email: nisaazharisaragih@rocketmail.com

ARTICLE INFO

ABSTRACT

Some research has been conducted to understand how general knowledge and short-term memory affect academic achievement. However, research that links these two predictors with air traffic control performance in a laboratory has not been found. Twenty-four ATC cadets participated in this research. This is associative research with multiple correlation analysis that aims to find the correlation between linguistic intelligence and short-term memory toward cadets' air traffic control performance in Aerodrome Control Tower (TWR) Laboratory. The research instruments used are oral proficiency interview, Intelligence Structure Test (IST), and air traffic control simulation. Data obtained, then, are analyzed by using the product-moment method of correlation. The results show that there is a positive correlation among the three variables with the level of closeness that falls in the high category that can be seen from the correlation coefficient value. In fact, linguistic intelligence and short-term memory both contribute to air traffic control performance during simulations. These findings offer several implications for the training program to promote success in learning air traffic control, especially in the laboratory.

INTRODUCTION

In the last several decades, many aviation accidents had occurred every day and resulting in fatalities in many aspects, not only aircrew and passengers but also people and property on the ground when the crashed aircraft falls into dense urban areas (Li et al., 2022). According to International Civil Aviation Organization (2001), one of the factors that cause incidents and accidents is the use of non-standard procedures and phraseology. Proper and efficient communication between flight personnel and ATC is a crucial determinant of aviation safety in the commercial aviation industry (Clark & Williams, 2020; Yen, 2014).

The Air Traffic Controller (ATC) profession requires an extremely high level of knowledge and expertise, as well as the practical application of specific skills related to the cognitive domains (e.g., spatial perception, information processing, logical reasoning, decision making), aspects of communication, and human relations (Costa, 1996). Air Traffic Controller, abbreviated as ATC or controller, is generally considered one of the many professions requiring a high mental load (Budiman et al., 2013; Costa, 1996; Fathimahhayati et al., 2018). Various studies related to this profession have also been conducted (Agustini, 2019; Rachmadina & Puspitadewi, 2019; Rahmati & Izadpanah, 2021; Rakas & Yang, 2007; Suarez, 2007; Yen, 2014). In this field of work, decisions

need to be made within seconds. This requires a high mental load, such as thinking, making decisions, calculating, remembering, observing, and monitoring things quickly in a short time while working.

When carrying out their duties, ATCs always have to communicate. In terms of communicating, ATC and pilots are required to master the communication procedure called Radiotelephone (RTF), which is a means of communication used by ATC in giving orders (e.g., GIA 212 runway 23 cleared to land), as well as information to pilots (e.g., GIA 212 runway is wet) (International Civil Aviation Organization, 2001). Yen (2014) added that communication barriers between pilots and ATC could cause problems and even fatal flight accidents. Furthermore, a review conducted on 340 accidents over nine months in 1988 by Morrison and Wright, Yen (2014) found that 42% of the total accidents could be attributed to communication errors.

Earlier, Rakas and Yang (2007) reiterated that communication problems caused 70% of operational errors and pilot deviations. It could be seen in several accidents, including the fall of a Boeing cargo plane on a hill on February 19, 1989, in Malaysia. The instruction "… descend two four zero zero" from the ATC, which the pilot misinterpreted as "… to 400," was the cause of this accident (retrieved from http://aviation-safety.net/database). In this case, the message receiver (pilot) received the message incorrectly because the message sender (controller) uttered an incomplete message. Unclear communication can affect flight traffic's smooth flow and even lead to incidents or accidents.

The effective performance of the ATM (Air Traffic Management) system depends on competent and qualified air traffic management professionals. Air Traffic Controllers (ATCs) managing and operating this system must have a shared understanding of what is expected of them in terms of performance wherever they may work to support a globally interoperable system and achieve optimum capacity within acceptable safety limits (International Civil Aviation Organization, 2007). This shared understanding becomes critical when considering the increasing traffic and the growing complexity and interconnectedness of the systems involved. Then, it must be separate from the initial process, namely training which is essential for performing control duties at operational units and supports qualified air traffic controllers in maintaining their competence.

ATC training is competency-based training characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards (International Civil Aviation Organization, 2007). Competencies allow people to formulate solutions for complex and challenging situations, including those they are experiencing for the first time (International Civil Aviation Organization, 2007). Air traffic controllers must be able to deal with these situations effectively and simultaneously ensure that they are done safely and securely, even when they perform air traffic simulations in the laboratory.

In aviation safety, clear and effective communications are as important as technical skills (Tajima, 2004). Communication is also related to linguistic intelligence. In general, intelligence is defined as a person's ability to acquire knowledge, then master it and put it into practice when facing problems. Gardner (1993) an expert known in the theory of multiple intelligences, defines intelligence as the ability to solve problems and produce products in various circumstances and real situations. Furthermore, Gardner (1993) defines linguistic intelligence as the ability to use and process words effectively, both oral (verbal) and written (nonverbal).

Besides verbal intelligence, memory is another factor traditionally associated with academic achievement (Bayliss et al., 2003; Bull et al., 2008). Memory is the awareness of one or more experiences in the past that come back to life. Memory is also defined as the spiritual ability to receive (keep in mind), store, and raise awareness (reproduce) of things that have been stored (Umainingsih et al., 2017). From a psycholinguistic point of view, the memory contains an impulse to a claim through a network regarding an event or events in the past, which is called the reconstruction process (Ridwan, 2006).

There are three systems in memory: sensory, short-term, and long-term (Hilgard et al., 1979). Furthermore, the memory that plays a significant role and is needed in the completion of most cognitive tasks is short-term memory. This memory is also often associated with performance in reading and mathematics (Bayliss et al., 2005; Bull et al., 2008; del Valle & Urquijo, 2015; Hulme et al., 2007; Swanson & Kim, 2007). Additionally, the correlation between memory and academic

performance was found among children, adolescents, and adults (Bull et al., 2008; Engle et al., 1999; Swanson & Kim, 2007).

In ATC training, cadets have to decide or quickly choose phraseologies that are in accordance with the conditions experienced when providing air traffic services at the Aerodrome Control Tower (TWR) Laboratory. They need to communicate with radio transmission as the primary way to exchange information between controllers and others. In this situation, cadets are required to recall phrases to establish communication. Furthermore, the phraseologies that have been memorized will be conveyed through verbal instructions or information. Using non-standard phraseology can lead to misunderstanding, breakdown of the communication process, or eventually to loss of separation.

As stated above, due to their correlation with academics, linguistic intelligence, and memory, either individually or simultaneously, both appear to affect the performance of adolescents when performing learning activities which in this case are simulations in the laboratory. Therefore, this study was designed to analyze the correlation and influence of linguistic intelligence and short-term memory on the performance of adolescents in the laboratory during air traffic control simulations.

RESEARCH METHOD

According to the level of explanation, this type of research is classified as associative or relationship research aiming to reveal the relationship between two or more variables (Siregar, 2013). This research is also a study with multiple correlation analysis, namely the analysis used to determine the strength of the relationship between three or more variables and to determine the contribution given partially or simultaneously by the independent variables to the value of the dependent variable (Siregar, 2013).

The population used in this study were level II ATC candidates at the Politeknik Penerbangan Medan's Diploma III Air Traffic Control Study Program. There were 24 cadets, categorized as a saturated sampling method because all population members were the samples. This technique is often used when the population is small and less than thirty people (Sugiyono, 2011). The data collection technique chosen in this study was a test. The test is a set of stimuli given to the sample to get an answer which is then used as the basis for determining a numerical score. In the test, research instruments are used, also known as research measuring instruments, in the form of intelligence tests and air traffic control simulations. Before testing the hypothesis, it is necessary to test the normality and linearity of the data first as a prerequisite test. These tests were carried out to obtain the data distribution and determine the linear nature of the distribution of the variable data. From the normality test, data is usually distributed if the probability value or significance level of the data is more significant than 0.05 ($p > 0.05$), while data with a significance level less than 0.05 ($p < 0.05$) is not normally distributed. After then, the data was analyzed using the product-moment correlation technique.

RESULT AND DISCUSSION

Result

The measuring instrument used to obtain data on linguistic intelligence and short-term memory abilities of cadets are the Intelligence Structure Test (IST). The subtests conducted to measure linguistic intelligence include SE/completing sentences subtest, WA/finding synonyms subtest, the AN/finding word relationships subtest, and GE/finding homonyms test. The ME/Aufgaben/memorizing words subtest is conducted to measure short-term memory. From the test results, the scoring is then carried out based on the scoring provisions that have been set for each question item. The test results showed in Table 1.

Table 1. Test Result

No.	Data	X1	X2	Y
1	Lowest score	86	85	62
2	Highest score	108	109	81
3	Mean	99.25	98.79	73.96
4	Median	101	99	75
5	Modus	103	99	75

Based on the data results, categorization is divided into low, medium, and high categories, as presented in Table 2 and Table 3.

Table 2. Categorization of Linguistic Intelligence Score

No.	Interval	Frequency	Percentage	Details
1	$X \leq 94$	4	17%	Low
2	$94 < X \leq 104$	18	75%	Medium
3	$104 < X$	2	8%	High
	Total	24	100%	

It can be seen from the data presented in Table 2 that 4% of the total cadets are in a low category, 75% are in the medium category, and 2% are in the high category. From this categorization, the level II cadets of the Diploma III Air Traffic Control Program at the Politeknik Penerbangan Medan have relatively average linguistic intelligence with a percentage of 75%.

Table 3. Memory Score Categorization

No.	Interval	Freqeuncy	Percentage	Details
1	$X \leq 75$	0	0%	Low
2	$65 < X \leq 89$	2	8,3%	Medium
3	$89 < X$	12	91,7%	High
	Total	24	100%	

Furthermore, Table 3 shows that level II ATC cadets in the Diploma III Air Traffic Control Study Program at the Politeknik Penerbangan Medan have a relatively high short-term memory (high category) with a percentage of 91.7%. Then, an Air Traffic Control simulation was used as the research instrument to obtain data on the Y variable or air traffic control performance. Each item of expected performance is scored according to the existing scoring guidelines.

Additionally, the simula-tion results are as follows the lowest value of 62, the highest value of 81, and an average value of 73.96. Based on the result data, the simulation result score data were then categorized in the TWR Laboratory to place respondents in tiered categories: low, medium, and high. The categorization of the results of the simulation of air traffic control performance in the TWR Laboratory is presented in Table 4.

Table 4. Air Traffic Control Performance Score Categorization

No.	Interval	Frequency	Percentage	Details
1	$X \leq 65$	2	8,3%	Low
2	$65 < X \leq 75$	13	54,2%	Medium
3	$75 < X$	9	37,5%	High
	Total	24	100%	

Table 4 shows that 54.2% of level II cadets' air traffic control performance results in the Diploma Study Program in Air Traffic Control of Politeknik Penerbangan Medan are in the medium category. In the prerequisite test, the Kolmogorov-Smirnov Tes of Normality is used as the normality test, which is analyzed by statistical applications. From the normality test, it is concluded that the three variables tested, namely linguistic intelligence, short-term memory, and air traffic control

performance of cadets, have Asymp. Sig, which is greater than 0.05 (Table 5). Hence, the three variables are normally distributed.

Table 5. Normality Test

Data	Kolmogorf-Smirnov Asymp. Sig.
X1	
X2	0.162
Y	

The following prerequisite test is a linearity test with a significance level (α) of 5%. Two variables will be said to have a linear relationship if the deviation from linearity sig. is more significant than 0.05. From the results of the linearity test, it is concluded that there is a linear and significant relationship between the variables X1 and Y as well as variables X2 and Y, as evidenced by the deviation from linearity sig. > α or Fcount < Ftable value as shown in Table 6 and Table 7.

Table 6. X1 and Y Linearity Test

Linearity Test	
Deviation from Linearity Sig.	0,941
α	0,05
F_{count}	0,388
F_{table}	3,47

Table 7. X2 and Y Linearity Test

Linearity Test	
Deviation from Linearity Sig.	0,869
α	0,05
F_{count}	0,454
F_{table}	3,47

Linguistic Intelligence Correlation with Air Traffic Control Performance

Pearson product-moment correlation coefficient is a correlation analysis used to see the effect between variables. With the help of statistical applications, the results of the correlation analysis of linguistic intelligence with air traffic control performance are presented in Table 8.

Table 8. Linguistic Intelligence Correlation with Air Traffic Control Performance

Effect of X1 on Y	
Constant number	17,448
Reaction coefficient number	0,921
R	0,881
R2	0,776
Sig	0,000
α	0,05
r_{count}	8,726
r_{table}	0,404

Value of Sig. < α can be seen in Table 8 shows that linguistic intelligence is related to air traffic control performance. Furthermore, the significance test also displayed the value of rcount > rtable, which means that linguistic intelligence significantly influences cadets' air traffic control performance in the TWR Laboratory.

Correlation between Memory and Air Traffic Control Performance

The results of the correlation analysis between memory and air traffic control performance are presented in Table 9.

Table 9. Correlation between Memory and Air Traffic Control Performance

Effect of X2 on Y	
Constant number	12,871
Reaction coefficient number	0,618
R	0,763
R2	0,582
Sig	0,000
α	0,05
r_{count}	5,540
r_{table}	0,404

From Table 9, it can be seen that the value of Sig. < α. Hence, it can be determined that the short-term memory variable is related to the air traffic control performance variable. Furthermore, based on the significance test, the rcount value is 5.540 while the rtable is 0.404. If rcount > rtable, it means that short-term memory ability also has a significant effect on cadets' air traffic control performance.

Linguistic Intelligence and Memory Double Regression of Air Traffic Control Performance

Multiple regression tests can be carried out to see the correlation between the three variables, as presented in Table 10.

Table 10. Double Regression

Effect of X1, X2 on Y	
R	0,881
R2	0,777
Sig	0,000
F	0,05
F_{count}	36,528
F_{table}	3,47

The value of Fcount > Ftable shown in Table 10 indicates a significant influence between linguistic intelligence and short-term memory on cadets' air traffic control performance when conducting simulations in the laboratory.

Discussion

Cadets with a good level of linguistic intelligence can process words and have a satisfactory form of speech. Instructions, information, or permissions are written in English when the cadets perform air traffic control simulations. Providing precise and efficient information, instructions, and permissions is influential in the safety of aviation traffic. The data from the intelligence structure test in this study showed that 75% of the cadets had medium linguistic intelligence.

Gardner (1993) defines intelligence as the ability to solve problems or create value products in one or more cultural and societal settings. In the theory of multiple intelligences (multiple intelligences or MI), Gardner refers to intelligence as a collection of mental abilities, talents, or skills. Gardner's theory offers a broader view of intelligence and suggests that intelligence is a continuum that can be developed throughout life. According to Gardner in Jasmine (2016), most people can adequately develop this type of intelligence.

Someone with linguistic intelligence can organize thoughts clearly and use the ability competently through words to express his/her thoughts orally. This speaking skill is the central and most visible aspect of this intelligence. However, this intelligence is used for communication skills and, more importantly, the ability to express one's thoughts, desires, and opinions.

In the implementation of air traffic control simulations, cadets were required to be able to receive or input the information received from several of their co-workers, including pilots, to then

store it and then reproduce the information when needed. With the re-emergence of information in aviation traffic services, cadets must continue to comply with the rules of in-flight communication. This is, of course, the basis that memory is also closely related to cadets' air traffic control performance.

In English, contextually, the word memory or remembrance refers to remember, remind, and recollection (Ridwan, 2006). The word memory also includes meanings: keeping facts and recalling facts back to the mind, succeeding in remembering, and the time over which the memory goes back. From the point of view of psycholinguistics studies, memory contains an impetus for claims regarding past events through a network called the reconstruction process (Ridwan, 2006). Furthermore, Ridwan (2006) stated that this includes demands, incentives, or claims.

In terms of structure, memory in its reconstruction process goes through three stages, namely: (1) The input stage refers to making notes about the message/content someone hears or reads from a discourse. Furthermore, one can carry out an interpretation of the content and then store it in memory. It should be noted that memory is different from rote. If memorization focuses on the outer form, memory is more concerned with content, message, and meaning (internal form); (2) Storage stage pertains to memorizing and storing several words or phrases. In this stage, storage can be classified into short-term or long-term memory. Short-term memory covers a short period and is relatively easy to remember, e.g., a number sequence of no more than 7 or 8 digits. As for long-term memory, it takes a longer time and differs in the limitations of ability between one person and another. Remembering phrases with long word sequences, let alone unrelated ones, requires high skill and memory; and (3) In The output stage, in this stage, someone recalls and reuses the stored information so that it can produce something.

Memory as a process refers to the dynamics of the mechanisms associated with acquiring and recalling information from the past (Crowder, 1993). This process is divided into three stages: recalling information that has been learned in the past, recognizing information, remembering, and connecting various other information so that it becomes a complex concept or story (Hilgard et al., 1979; Khodijah, 2014). Someone who can remember a thing or event indicates that the person has experienced it or has stored the relevant information in his consciousness and will bring it back at some time.

All information received will go through sensory memory in the memory system and last for a brief period. Furthermore, the information will be sent to short-term memory and stored for only about 15-30 seconds. If the information is still memorized, the short-term memory then forwards it to the long-term memory, which is a permanent storage place for information.

From the results of the intelligence structure test, which measures memory ability, it can be seen that 91.7% of the cadets have high short-term memory abilities. Moreover, from the calculation of the regression equation between short-term memory and air traffic control performance, the formula $Y = 12.871 + 0.618X$ is obtained. If $X = 0$, then the equation $Y = 12.871$ is obtained. Thus, if the cadets do not have good short-term memory, it is estimated that they will get a 12.871 score due to air traffic control performance in the TWR Laboratory.

Concerning the positive X coefficient, the relationship between short-term memory and air traffic control performance is also positive. Hence, the greater the short-term memory ability possessed by the cadets, the more excellent the opportunity for better results of the cadets' air traffic control performance in the laboratory TWR. According to the value of $r = 0.763$, it can also be concluded that the short-term memory of the cadets contributes to 58.2% of the impact on air traffic control performance. According to Ling and Catling (2012), short-term memory is one-factor affecting individual intelligence. Therefore, a good memory is expected to positively impact cadets' performance during air traffic control simulations.

According to the results of air traffic control performance obtained from the simulations, 8.3% or two cadets have simulation results in the low category, 54.2% or 13 cadets in the medium category, and 37.5% or nine cadets are in the high category. The performance itself is defined as the result of an implementation or treatment. In the study of Psycholinguistics, Chomsky in Chaer (2009) defines performance as linguistic treatment or language implementation in the form of producing sentences in actual or real conditions. Moving forward from this definition, performance in air traffic control can also be defined as the implementation of communication (verbal and nonverbal) between

the controller and the pilot or other related parties in terms of air traffic control. This communication is carried out in average and emergencies by providing instructions and information needed during the flight, such as weather information, flight navigation, and flight traffic conditions.

In carrying out the duties of a controller, there are five objectives of air traffic services or known as objectives of the air traffic services, that must be followed, namely:

> *Prevent collisions between aircraft; prevent collisions between aircraft in the maneuvering area and obstructions in that area; expedite and maintain an orderly flow of air traffic; provide advice and helpful information for the safe and efficient conduct of flights; notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.* (International Civil Aviation Organization, 2001)

From all these objectives, it is clear that the controller is an important part of the aviation traffic service because preventing collisions between aircraft with obstacles in the vicinity is the main task of this profession.

During the learning period at the TWR Laboratory, prospective ATC cadets also carry out the same roles, tasks, and goals as a controller, i.e., conducting air traffic control simulations which, of course, must be safe, secure, and efficient. The implementation of this simulation is based on a predetermined expected performance, from now on referred to as air traffic control performance. Air traffic control performance consists of several aspects, one of which is the communication/clearance/instruction/information provided by prospective ATC students who act as controllers. This becomes incredibly important because all services an ATC provides are stated in permissions, instructions, and information.

From the analysis results, linguistic intelligence and short-term memory ability, either individually or together, have a significant relationship with air traffic control performance. This is based on the significance test results, each of which shows that the rcount values are 8.726 and 5.540 > rtable value = 0.404.

Interestingly, this study's findings align with a recent study by Robres et al. (2021), who suggested that better short-term memory is associated with better academic achievement and will remain stable for the next level, even with higher academic demands. Suppose these findings are related to this research, then, of course. In that case, part of the success of air traffic control performance which is part of the academic achievement of ATC cadets, will be determined by short-term memory abilities. In this case, research by Robres et al. (2021) above strengthens the results of this study. Hence, good short-term memory is important for ATC prospective cadets to provide satisfactory air traffic control performance results in the TWR Laboratory.

Furthermore, to improve the cadets' air traffic control performance during simulations at the TWR Laboratory, teachers at the Politeknik Penerbangan Medan should support cadets in developing abilities and skills based on short-term memory abilities. Several studies have found various ways to develop or improve a person's short-term memory skills. This increase in ability is also supported by the latest research that proved the continuous production of new neurons or neurogenesis in the brain until adulthood. As a result, abilities, and intelligence can still be developed (Boldrini et al., 2018; Cope & Gould, 2019; Kempermann et al., 2018). This research also shows that even from entering adulthood until reaching adulthood, it is still possible to develop the abilities of each individual.

CONCLUSION

This study's results indicate a positive relationship and a significant effect, as indicated by a correlation value of 0.881 (powerful correlation) between linguistic intelligence and air traffic control performance and 0.763 (strong correlation) between memory and air traffic control performance. Furthermore, the level of proximity of the relationship between the three variables is considered extremely strong due to the correlation coefficient value being 0.881, which means that the two predictors in this study contributed 77.7% to cadets' performance in the TWR Laboratory. However, this study did not consider linguistic factors affecting memory, such as language type, input, time (period, time), and results (output). Furthermore, due to the limitations of this research, it is hoped that future studies will develop this research with a wider sample or add other variables that are

thought to affect air traffic control performance to meet a higher level of contribution in the field of air traffic control.

ACKNOWLEDGEMENTS

REFERENCES

Agustini, E. D. (2019). Pengkajian Phraseology (Bahasa) pemanduan lalu lintas penerbangan Makassar Advanced Air Traffic Services di Bandara Internasional Sultan Hasanuddin-Makassar. *Warta Penelitian Perhubungan*, *24*(1), 70–88. https://doi.org/10.25104/warlit.v24i1.985

Bayliss, D. M., Jarrold, C., Baddeley, A. D., & Gunn, D. M. (2005). The relationship between short-term memory and working memory: Complex span made simple? *Memory*, *13*(3–4), 414–421. https://doi.org/10.1080/09658210344000332

Bayliss, D. M., Jarrold, C., Gunn, D. M., & Baddeley, A. D. (2003). The complexities of complex span: Explaining individual differences in working memory in children and adults. *Journal of Experimental Psychology: General*, *132*(1), 71–92. https://doi.org/10.1037/0096-3445.132.1.71

Boldrini, M., Fulmore, C. A., Tartt, A. N., Dwork, A. J., Mann, J. J., Boldrini, M., Fulmore, C. A., Tartt, A. N., Simeon, L. R., Pavlova, I., & Poposka, V. (2018). Human hippocampal neurogenesis persists throughout aging. *Cell Stem Cell*, *22*(4), 589-599.e5. https://doi.org/10.1016/j.stem.2018.03.015

Budiman, J., Pujangkoro, S. A., & Anizar. (2013). Analisis beban kerja operator air traffic control bandara XYZ dengan menggunakan metode NASA-TLX. *Jurnal Teknik Industri FT USU*, *3*(3), 15–20. https://www.neliti.com/publications/219430/analisis-beban-kerja-operator-air-traffic-control-bandara-xyz-dengan-menggunakan

Bull, R., Espy, K. A., & Wiebe, S. A. (2008). Short-term memory, working memory, and executive functioning in preschoolers: Longitudinal predictors of mathematical achievement at age 7 years. *Developmental Neuropsychology*, *33*(3), 205–228. https://doi.org/10.1080/87565640801982312

Chaer, A. (2009). *Psikolinguistik: Kajian teoretik*. Rineka Cipta.

Clark, L., & Williams, G. J. (2020). English Language proficiency in radiotelephony: A survey about its effect on the safety and efficiency of aviation. *The ESPecialist*, *41*(4), 1–21. https://doi.org/10.23925/2318-7115.2020v41i4a9

Cope, E. C., & Gould, E. (2019). Adult neurogenesis, glia, and the extracellular matrix. *Cell Stem Cell*, *24*(5), 690–705. https://doi.org/10.1016/j.stem.2019.03.023

Costa, G. (1996). *Occupational stress and stress prevention in air traffic control*. https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_250120.pdf

Crowder, R. G. (1993). Short-term memory: Where do we stand? *Memory & Cognition*, *21*(2), 142–145. https://doi.org/10.3758/BF03202725

del Valle, M. V., & Urquijo, S. (2015). Relaciones de las estrategias de codificación mnésica y la capacidad de aprendizaje con el desempeño académico de estudiantes universitarios. *Psicología Educativa*, *21*(1), 27–37. https://doi.org/10.1016/j.pse.2015.02.004

Engle, R. W., Tuholski, S. W., Laughlin, J. E., & Conway, A. R. A. (1999). Working memory, short-term memory, and general fluid intelligence: A latent-variable approach. *Journal of Experimental Psychology: General*, *128*(3), 309–331. https://doi.org/10.1037/0096-3445.128.3.309

Fathimahhayati, L. D., Tambunan, W., & Putri, R. A. (2018). Analisis beban kerja mental pada operator Air Traffic Controller (ATC) dengan metode subjektif dan objektif (Studi kasus: Airnav Bandar Udara XYZ). *Angkasa: Jurnal Ilmiah Bidang Teknologi*, *10*(1), 69–76. https://doi.org/10.28989/angkasa.v10i1.205

Gardner, H. (1993). *Multiple Intelligences (kecerdasan majemuk) teori dalam praktik* (L. Saputra (ed.)). Interaksara.

Hilgard, E. R., Atkinson, R. C., & Atkinson, R. L. (1979). *Introduction to psychology* (Seventh Ed). Harcourt Brace Jovanovich.

Hulme, C., Goetz, K., Gooch, D., Adams, J., & Snowling, M. J. (2007). Paired-associate learning, phoneme awareness, and learning to read. *Journal of Experimental Child Psychology*, *96*(2), 150–166. https://doi.org/10.1016/j.jecp.2006.09.002

International Civil Aviation Organization. (2001). *Annex 11 - Air Traffic Services* (13th ed.). International Civil Aviation Organization. https://skyrise.aero/wp-content/uploads/2017/03/ICAO-Annex-11-Air-traffic-services.pdf

International Civil Aviation Organization. (2007). *Manual of radiotelephony* (4th ed.). https://www.ealts.com/documents/ICAO Doc 9432 Manual of Radiotelephony (4th ed. 2007).pdf

Jasmine, J. (2016). *Metode mengajar multipple intelligences* (A. Salim (ed.); P. Purwanto (trans.)). Nuansa Cendekia.

Kempermann, G., Gage, F. H., Aigner, L., Song, H., Curtis, M. A., Thuret, S., Kuhn, H. G., Jessberger, S., Frankland, P. W., Cameron, H. A., Gould, E., & Hen, R. (2018). Human adult neurogenesis: Evidence and remaining questions. *Cell Stem Cell*, *23*(1), 25–30. https://doi.org/10.1016/j.stem.2018.04.004

Khodijah, N. (2014). *Psikologi belajar*. Remaja Rosdakarya.

Li, Y., Zhang, Y., Wang, L., & Guan, X. (2022). Research on potential ground risk regions of aircraft crashes based on ADS-B flight tracking data and GIS. *Journal of Transportation Safety & Security*, *14*(1), 152–176. https://doi.org/10.1080/19439962.2020.1754981

Ling, J., & Catling, J. (2012). *Psikologi kognitif*. Erlangga.

Rachmadina, K. M., & Puspitadewi, N. W. S. (2019). Hubungan antara fatigue dengan safety performances pada pekerja ATC (Air Traffic Controller). *Character: Jurnal Penelitian Psikologi*, *6*(4), 1–6. https://jurnalmahasiswa.unesa.ac.id/index.php/40/article/view/29853

Rahmati, M., & Izadpanah, S. (2021). A study of the proficiency and performance of Iranian Air Traffic Controllers: Attitude, work experience and specific aviation English courses. *Asian-Pacific Journal of Second and Foreign Language Education*, *6*(1), 1–22. https://doi.org/10.1186/s40862-020-00105-y

Rakas, J., & Yang, S. (2007). Analysis of multiple open message transactions and controller-pilot miscommunications. *7th USA/Europe Air Traffic Management R&D Seminar*, 1–11. https://www.researchgate.net/profile/Jasenka-Rakas/publication/228678418_Analysis_of_Multiple_Open_Message_Transactions_and_Controller-Pilot_Miscommunications/links/00463520ee19c2ce1e000000/Analysis-of-Multiple-Open-Message-Transactions-and-Controller-Pil

Ridwan, T. A. (2006). *Bahasa dan linguistik*. PT. Mestika.

Robres, A. Q., Andrade, A. G., Ortega, Z., & Ramajo, S. S. (2021). Intelligence quotient, short-term memory and study habits as academic achievement predictors of elementary school: A follow-up study. *Studies in Educational Evaluation*, *70*, 101020. https://doi.org/10.1016/j.stueduc.2021.101020

Siregar, S. (2013). *Metode penelitian kuantitatif: Dilengkapi dengan perhitungan manual & SPSS*. Kencana.

Suarez, R. (2007). *The effects of foreign accent and language on reaction time and accuracy in an Air Traffic Control task* [Embry-Riddle Aeronautical University]. https://commons.erau.edu/cgi/viewcontent.cgi?article=1278&context=db-theses

Sugiyono, S. (2011). *Metode penelitian administrasi*. Alfabeta.

Swanson, H. L., & Kim, K. (2007). Working memory, short-term memory, and naming speed as predictors of children's mathematical performance. *Intelligence*, *35*(2), 151–168. https://doi.org/10.1016/j.intell.2006.07.001

Tajima, A. (2004). Fatal miscommunication: English in aviation safety. *World Englishes*, *23*(3), 451–470. https://doi.org/10.1111/j.0883-2919.2004.00368.x

Umainingsih, M. B., Alexon, & Kurniah, N. (2017). Penerapan model pembelajaran untuk meningkatkan daya ingat dan prestasi belajar matematika. *Diadik : Jurnal Ilmiah Teknologi Pendidikan*, *7*(2), 87–97. https://doi.org/10.33369/diadik.v7i2.3687

Yen, J.-R. (2014). Modelling the oral communication performance of Air Traffic Control. *Journal of Air Transport Studies*, *5*(1), 39–54. https://doi.org/10.38008/jats.v5i1.72

Developing augmented reality on differential system, competency system, and power transfer in vocational education

Dandi Firman Dani *, Sulaeman Deni Ramdani [iD]**, Deddy Supriyatna** [iD]

Universitas Sultan Ageng Tirtayasa, Indonesia.

* Corresponding Author. Email: firmandandi0@gmail.com

ARTICLE INFO

ABSTRACT

This study aimed to know: (1) Describe the development of augmented reality books in the differential system; and (2) Analyze the feasibility level of the application on the augmented reality book differential system. This study uses research and development (R&D) with the waterfall development design model, which includes four stages: analysis, design, coding or implementation, and testing. This study's sample was 11th-grade vocational high school students majoring in automotive light vehicle engineering. Application testing uses black-box testing by testing functionality without testing the internal structure or function of the application. The data collection used in this study included three media experts, three material experts, and 30 user responses (students) with data analysis techniques using descriptive analysis. The results of this study are (1) augmented reality books and applications on the android platform as learning media on the differential system, and (2) feasibility analysis by media expert validation with an average value of 80%, material experts with an average value of 84% and user responses with an average value of 90 % with a total value of 85% with the 'very eligible' category to be used as a learning medium in the differential system of chassis and power transfer competencies. Research products can be used as an attractive alternative learning media by utilizing digital technology that can display 3D objects in detail on the competence of the differential system.

INTRODUCTION

Vocational high schools (SMK) are formal educational institutions that focus on preparing students for competencies in specific fields (Putra & Novelan, 2020). Vocational High School is devoted to preparing students to compete in the world of work and have competence and creativity following the needs of today's industry (Amin, 2017). Compared to schools in general, SMK has specific characteristics, including: (1) being Oriented to the competence of students in the world of work, (2) the need for equipment and logistics that are more realistic and expensive, (3) the curriculum focuses on cognitive, affective and psychomotor development, (4) sensitive to the development of society, technology, and the business world, and (5) closely related to society and the business world (Khurniawan, 2016). The existence of SMK is expected to be an institution that can print graduates into skilled and professional workers (Farman et al., 2018). This can happen if the learning process in schools can be synchronized with the needs of the industry, which is run on an ongoing basis.

Applying to learning with industrial standards in vocational schools prioritizes the achievement of students' competencies and hard skills, and soft skills. Soft skills are born from the practice of student experience, including individual and social communication, while hard skills are students' abilities in a particular field (Putri et al., 2019). Improving students' hard and soft skills can be achieved through a planned learning process concerning industry standards. Planned learning creates a practical and interactive atmosphere (Junaedi, 2019). The application of learning media is packaged attractively as a supporting medium in transferring knowledge from educators to students.

For learning activities to attract students' interest so that the learning atmosphere is more conducive and fun, it can be influenced by various factors, one of which is the selection of the learning media used (Hakim, 2018). Learning media is an intermediary that facilitates the communication process between educators and students. Currently, learning media continues to develop, especially in the industrial era 4.0, where the development of information technology is increasingly rapid through the use of the internet, causing learning media to be more diverse and innovative.

The development of digital technology in education is increasingly directing learning documents in digital learning materials (Ramdani et al., 2021; A. K. Sari et al., 2020). Learning media are grouped into four types, namely (1) visual media involving the sense of sight, (2) audio media involving the sense of hearing, (3) audiovisual media involving the senses of sight and hearing, (4) multimedia involving several types of media and integrated equipment in the learning process (Asyhar, 2011). The development of information technology is required educators to mix technology and learning into learning media that is fun, creative, innovative, and effective. One of the developments of learning media now is using Augmented Reality technology.

Augmented reality is a technology that unites the natural and virtual worlds by entering graphic, audio, sensory, touch, smell, and taste information from the real-world environment into the virtual world so that users can interact with virtual images (Papanastasiou et al., 2019). Augmented reality was discovered around 1957-1962 by Norton Heilig. Then in 1966, it developed into Head Mounted Display (HMD). Then in the 2000 era, to be precise, 2009-2010, Augmented Reality (AR) continued to be developed from FLARToolkit to become the current augmented reality (Hakim, 2018). The existence of augmented reality presents many advantages compared to other technologies, namely: (1) interactive, (2) effective, (3) easy to use in various media, (4) simple depiction of objects, (5) does not cost a lot, and (6) easy to use (Hakim, 2018). These advantages have made augmented reality the best choice for developing interactive learning media.

Based on a preliminary study in the form of distributing questionnaires to students in SMK, percentage data on the level of interest in learning media that use augmented reality technology can be seen in Figure 1.
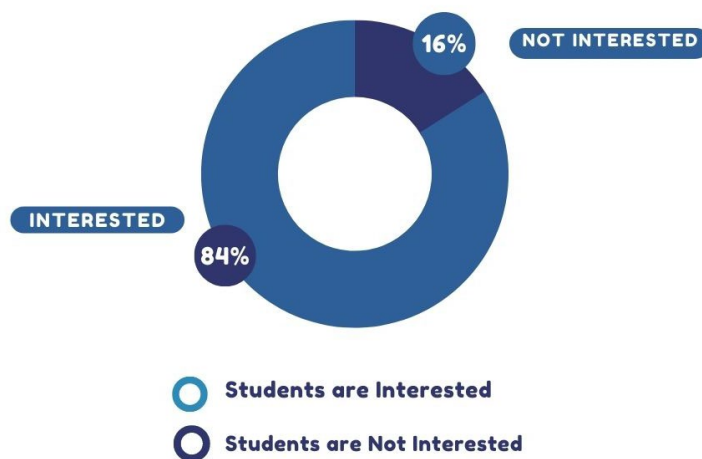

Figure 1. Data on the Percentage Level of Interest of SMK Students in AR

In the picture above, based on the distribution of questionnaires to 11th-grade students of the light vehicle engineering department, as many as 84% of students agreed with the existence of learning media using augmented reality technology as an innovation. As many as 16% stated that students disagreed. This shows that student interest in learning media using augmented reality technology is enormous.

According to Kiryakova et al. (2018), the role of technology and information, such as augmented reality, in education is critical because it can create conditions and accessibility. The augmented reality application is suitable for use at every level of education with various learning materials (R. M. M. Sari & Priatna, 2020). Augmented reality can help students learn, especially in Vocational High Schools (SMK) (Sulistyoko & Armanto, 2020). Augmented reality in vocational high schools, especially in the Automotive Light Vehicle Engineering (TKRO) department, requires tools to achieve successful learning. This technology will be very profitable and efficient because institutions do not need to present fundamental tools that can be cost-effective. At the same time, students can still perform realistic interactive learning (Kurniawan & Masugino, 2020). However, it is miserable that augmented reality in the TKRO department still needs to be used more. This is influenced by several factors, one of which is the lack of understanding of educators on augmented reality (Ismail & Nasrulloh, 2020).

Automotive Light Vehicle Engineering (TKRO) is an automotive engineering expertise program focusing on technology and engineering (Utomo, 2020). Through this program, students are expected to be able to repair and maintain vehicles independently. A differential system is one of the essential competencies in Automotive Light Vehicle Engineering (TKRO). A differential is a tool that is devoted to the transfer of car power. The goal is to compensate for the difference in speed at the rear wheels while passing through a cornering field (Utomo, 2020). Based on the results of interviews with teachers majoring in Automotive Light Vehicle Engineering (TKRO) at SMK Negeri 4 Serang City, the differential system is one of the essential competencies that can be a priority in applying augmented reality technology to learning media.

This is due to several factors, namely: (1) Many small components on the inside of the differential make it difficult for educators to explain the meaning and function of these components so that augmented reality can be a solution by projecting 3D objects with complex concepts, especially when combined with audio and animation, educators need to explain repeatedly in class (Yuliono et al., 2018); (2) The use of learning media is still conventional and only relies on power points and learning modules, so if augmented reality is applied, it will attract the interest of students and make the learning atmosphere in the classroom more interactive; and (3) The availability of trainer tools that are not up to standard can be solved by augmented reality because institutions do not need to present fundamental tools so that they can be cost-effective. At the same time, students can still carry out practical, interactive learning.

Problems in vocational high schools include the availability of practical tools and the use of conventional learning media. Augmented reality as a learning medium born of advances in information technology today will greatly assist educators in transferring knowledge to students so that it can be the right solution. Based on the description above, it is necessary to conduct a study regarding the development of augmented reality books on differential system competence chassis and power transfer for vocational high schools with the research objectives, namely; (1) describes the development of the augmented reality book on the differential system, and (2) analyzes the feasibility level of the application on the augmented reality book differential system. This research develops augmented reality technology into learning media in the form of AR Books and applications on the Android platform to support the differential system's competence.

RESEARCH METHOD

This study uses a Research and Development (R&D) approach with a Waterfall development design model, which consists of 4 stages: needs analysis, design, coding, and testing (Yuliono et al., 2018).
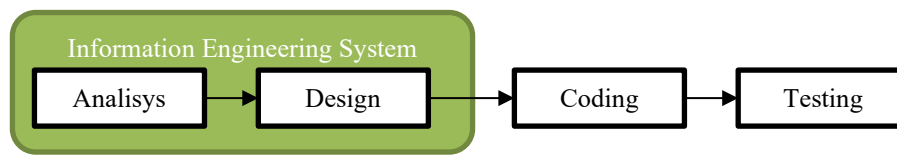
Figure 2. Waterfall Model

Needs Analysis

The needs analysis stage is a way to find the information needed to support application development. At this stage, interviews and observations were carried out with teaching teachers at SMKN 4 Serang City as well as distributing questionnaires and simulating the use of applications to 11th grade students majoring in automotive light vehicle engineering to find out the students' interest in augmented reality. The research population was 90 people who came from classes A, B and C. After that, they prepared all the supporting software and hardware needs to make augmented reality books and develop applications.

Design

The design stage is the step of designing what needs are contained in the Augmented Reality application that will be developed. Several design processes are carried out at this stage, namely, system architecture design, 3D object design, and user interface design.

Coding

The design that has been made is then applied, or coding is carried out into the application that will be developed in the form of a differential system learning media. The software used in this coding is Unity 3D with the programming language C sharp.

Testing

The stages of designing and coding differential system learning media with Augmented Reality have been completed. Furthermore, testing with black box testing and feasibility tests by material and media experts.

Research Subject

The subjects of this research are media experts consisting of 1 lecturer of Informatics Engineering, Universitas Serang Raya and 2 senior programmers who work at the Pension Fund of Bank Negara Indonesia (BNI) and PT Karios Utama Indonesia, material experts consisting of 2 instructors in the automotive field, the Training Center Vocational and Productivity (BBPVP) Bandung and 1 teacher at SMKN 4 Serang City. The user response involved 30 students of grade 11 majoring in TKR at SMKN 4 Serang City. The time of research was carried out from March - December 2021.

Data Collection Technique

Data collection techniques are steps to obtain data during observation so that research results can be used as new theories or discoveries (Sidiq & Choiri, 2019). To obtain information and data in this study using data collection techniques such as observation, interviews, and literature studies to get the necessary information to analyze the developed media needs. The questionnaire aims to determine the assessment of media experts, materials, and users on the products made.

Research Instruments

Aspects and indicators of the research instrument are based on three instruments aimed at media experts, material experts, and users (Wahono, 2006).

Table 1. Media Expert Instruments

Aspect	Indicator	Question
Visual Communication	Media suitability with Basic Competencies and Objectives	1,2
	Audiovisual	3,4,6,7,10
	Text	5,8,9
	Layout Interactive	11,12,15,16
Software engineering	Smooth operation and media compatibility	13,17
	Usability	14,18

Table 2. Material Expert Instruments

Aspect	Indicator	Question
Learning design	Goal relevance learning with basic competencies	1,2,3
	Audiovisual compatibility	4,5,6
	Grammar	7,8
Material Depth	Material Actuality	9,10,11,12
	The accuracy of the evaluation tool	13,14
Benefit	Overcoming the limitations of practical tools	15,16
	Benefit for teachers and students	17,18

Table 3. User Instruments

Aspect	Indicator	Question
Learning design	Interactivity	1,2
	Flexibility	3,4
	Grammar	5,6
Visual Communication	Display (Audiovisual)	8,10,11,12,13
	Text	7,14
Software	Ease of operation	15,16,17
	Usability	9,18,19
Material Depth	Material actuality	9,18,19
	Evaluation Accuracy	20,21
	Giving motivation to learn	22,23
Benefit	Overcoming the limitations of practical tools	24,25
	Increase spirit	26,27

Data Analysis Technique

The data analysis technique uses descriptive qualitative data analysis generated from interviews, observations, and comments or suggestions of validators to be used as a reference for improving learning media and quantitative descriptive data analysis generated from the distribution of validator and user questionnaires to determine the feasibility of the learning media developed.

Table 4. Categories of Likert Scale

Score	Interpretation
4	Very Appropriate
3	Appropriate
2	Less appropriate
1	Not appropriate

The average percentage of student responses for each component is calculated using the Formula 1 (Sugiyono, 2013).

$$P = \frac{\sum x}{N} \times 100\%$$ (1)

Information:

P   = Gained percentage of respondents of experts and users

$\sum x$ = Total score for each criterion selected by the respondent

N   = Total ideal score

The validation criteria or level of attainment used in the development of instructional media can be seen in Table 5. Based on the Table 5, the eligibility criteria accepted in this study are at least included in the "Appropriate " criteria with an achievement level in the 62.50 - 81.24% range.

Table 5. Achievement Level of Media Development

Achievement Level	Criteria
81,25 - 100%	Very Appropriate
62,50 – 81,24%	Appropriate
43,75 – 61,40%	Less appropriate
25% - 43,74%	Not appropriate

RESULT AND DISCUSSION

The results of learning media development are the augmented reality application of differential system competencies on the android platform and AR Book as supporting applications.

Figure 3. Application Name and Logo

The name of the augmented reality application for differential system competence is called "Ruang Otomotif AR".

Figure 4. Splash Screen

The splash screen page is an application name branding that appears a few seconds before entering the main menu page. This page displays the application logo in the form of a ring gear as a characteristic of the differential system with the application name "Ruang Otomotif." The bottom of the page displays the Unity 3D logo as a software developer.
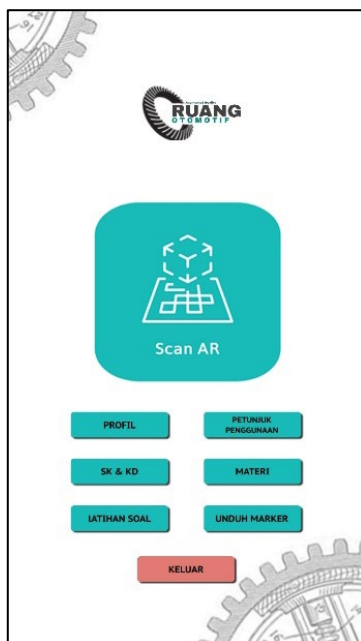
Figure 5. Main Menu

The main menu page is the main page that displays several buttons that are linked to other pages. The main page display has the application logo as well as several menus presented by the application that can be accessed by users, including; the augmented reality scan menu to scan the camera on markers, developer profile menu, Competency Standards & Basic Competence (SK&KD) menu, namely the differential system, manual user menu as a user guide in running applications, differential system material menu, practice questions menu, marker download menu, and application exit menu.

Figure 6. Instructions for Use

Figure 7. Developer Profile
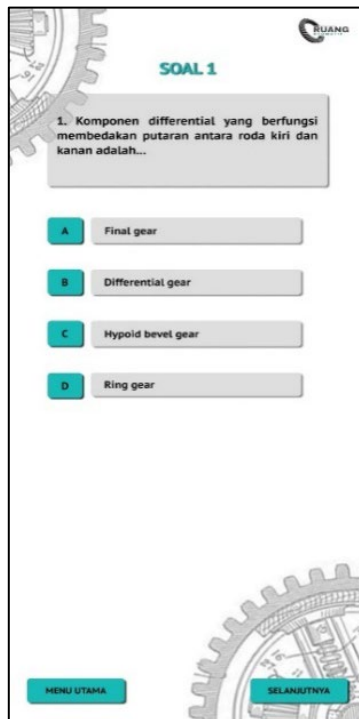
Figure 8. Learning Materials

Figure 8 shows the learning material page that summarizes the material and references the differential system. The material presented in 5 slides includes understanding differential, differential function, final drive parts, differential parts, how the differential works when going straight and turning, and inspection before and after being unloaded. This page is an initial introduction and theoretical guide for users to understand differential systems before projecting 3D objects on the AR scan menu.
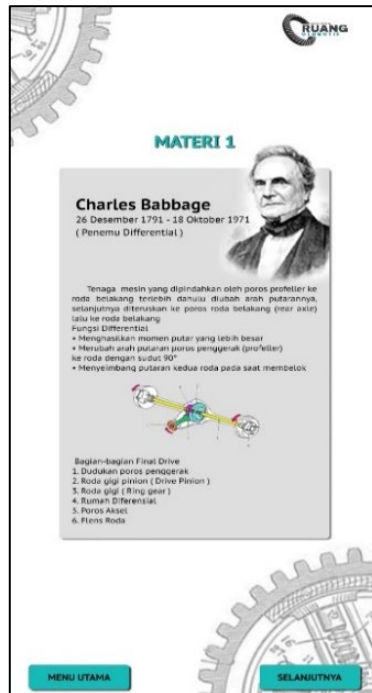
Figure 9. Practice Questions

Figure 9 shows 10 practice questions that cover the material on differential systems. The practice questions consist of multiple choice, where the user can choose one answer to determine whether it is correct. The purpose of this page is to become a benchmark in knowing the extent of user understanding after studying the material. In addition to the application, there is also an AR Book that functions as a support for the application. The AR Book contains instructions for use, and a summary of materials and markers for performing AR scans can be seen in Figure 10, Figure 11, and Figure 12.

Figure 10. AR Book Cover

Figure 11. Foreword and Developer Profile
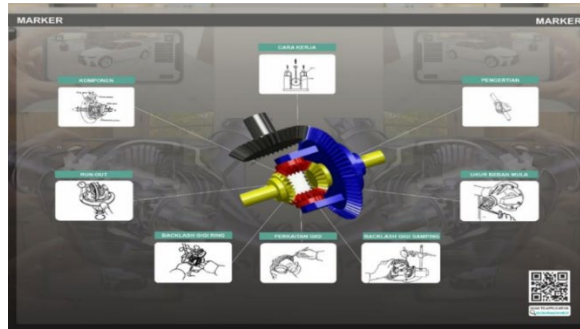
Figure 12. Main Marker in AR Book

The augmented reality scan page is a page for scanning markers by clicking the scan button. Users can directly pair the marker with the camera and wait a few seconds. The application will project a 3D differential object.
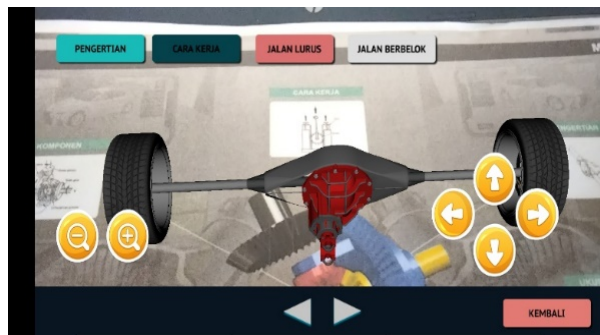
Figure 13. AR Scan Understanding Differential
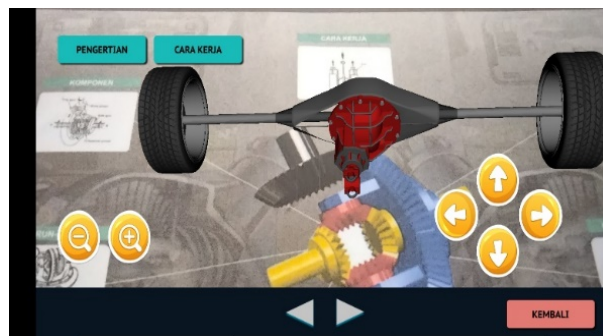
Figure 14. AR Scan How Differential Works

Figures 15 and Figure 16 are the first scenes that display 3D objects on the understanding and workings of differential materials. In addition, users can use zoom-in and zoom-out buttons to further clarify the observation of 3D objects, additional audio to explain the material, and motion animation on 3D objects to make the application more interactive.
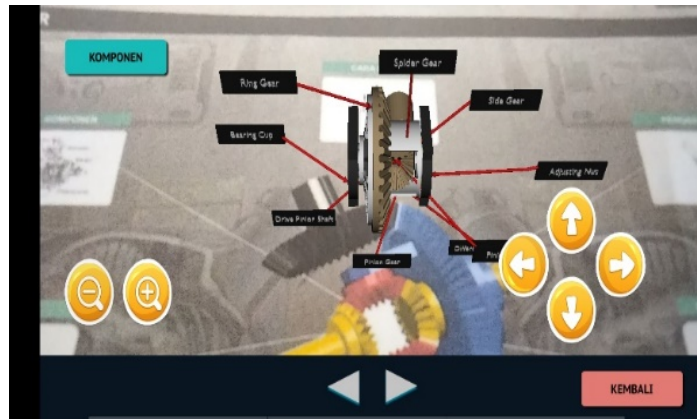
Figure 15. AR Scan Component Introduction

Figure 17 is the second scene displaying differential 3D objects in component recognition material. There are arrows and component name signs on this page that make it easier for users to identify all differential components. In addition, there are zoom-in and zoom-out buttons that users can use to further clarify the observation of 3D objects, additional audio explaining the function of each component, and motion animation on 3D objects to make the application more interactive.

Figure 18 is the third scene, a periodic differential inspection by displaying 3D objects with additional audio to explain the details and inspection procedures. In addition, users can use zoom-in and zoom-out buttons to further clarify the observation of 3D objects to make the application more interactive. Differentials' inspections include side gear inspection, run out, initial load, ring gear, and gear linkage.

Figure 16. Side Dental Examination

Figure 17. Run Out Check

Figure 18. Starting Load Check

Figure 19. Ring Dental Examination

Black Box Testing Results

The way to determine the application's performance is to test the functionality without understanding the program code by testing black box testing. Testing is done by installing the application using an Android version of the device with different device specifications. The following table shows the results of the black box testing of the augmented reality system differential application with 5 other devices with the symbol (P), as can be seen in Table 6.

Table 6. Device Specifications for Testing

Statement	P1 Works (F)		P2		P3 Not Working (TF)		P4		P5	
	F	TF	F	TF	F	TF	F	TF	F	TF
Successfully Install Apk	√		√		√		√		√	
Functions of Each Button	√		√		√		√		√	
Rotation function (zoom in & zoom out 3D objects)	√		√		√		√		√	
Scan Camera function (Displaying 3D objects)	√		√		√		√		√	
Motion animation function	√		√		√		√		√	
Showing Correct Answer	√		√		√		√		√	
Audio Function	√		√		√		√		√	
Download Marker Function	√		√		√		√		√	

Validity Test Results

Media Expert

The feasibility of learning media for the augmented reality differential system application assessed by three media experts includes visual communication and software engineering, as seen in Table 7. Based on Table 7, the average value of the results of media expert validation in the visual communication aspect is 80%, with software engineering an average value of 81% and the overall average value of 80% in the "Appropriate " category.

Table 7. Results of the Media Expert Assessment Recapitulation

Aspect	Maximum Score	Total Score	Percentage	Category
Visual Communication	168	133	80%	Appropriate
Software engineering	46	39	81%	Very Appropriate
Average Amount	214	172	80%	Appropriate

Material Export

The feasibility of the augmented reality differential system application assessed by three material experts includes aspects of learning design, material depth, and benefits, as seen in Table 8. Based on Table 8, the average value of the results of material expert validation in the learning design aspect with an average value of 82%, the depth of material with an average value of 77%, benefits with an average value of 94%, and the overall average value of 84% in the "Very Appropriate" category.

Table 8. Results of the Material Expert Assessment Recapitulation

Aspect	Maximum Score	Total Score	Percentage	Category
Learning Design	96	79	82%	Very Appropriate
Material Depth	72	57	77%	Appropriate
Benefit	48	45	94%	Very Appropriate
Average Amount	26	181	84%	Very Appropriate

User Response

The augmented reality differential system application is rated by 30 users to determine how the user responds to the application. The aspects used are visual communication, software engineering, learning design, depth of material, and benefits, as seen in Table 9.

Table 9. Results of User Response Assessment Recapitulation

Aspect	Maximum Score	Total Score	Percentage	Category
Learning Design	720	618	86%	Very Appropriate
Visual Communication	840	765	92%	Very Appropriate
Software engineering	360	327	91%	Very Appropriate
Material Depth	840	771	92%	Very Appropriate
Benefit	480	424	89%	Very Appropriate
Average Amount	3240	2905	90%	Very Appropriate

Based on Table 9, the average value of the results of the assessment of user responses in the learning design aspect with an average value of 86%, visual communication with an average value of 92%, software engineering with an average value of 91%, depth of material with an average value of 92%, benefits with an average value 89% and the results of the overall average value of 90% with the "Very Appropriate " category.
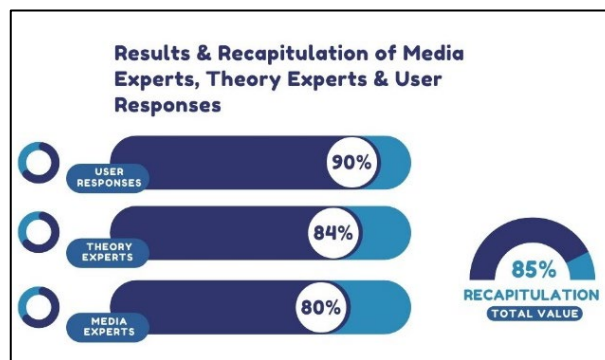
Figure 20. Results of Assessment Recapitulation

Based on the results of the recapitulation of expert judgments and user responses, the average value of media experts is 80% in the "Decent" category, material experts 84% in the "Very Eligible" category, and 90% user responses in the "Very Eligible" category. The average value of the three media experts, material experts, and users obtained a total score of 85% with the "Very Eligible" category.

Research conducted by Anugrah and Alfian (2020) regarding augmented reality on the main components of a car engine produces an augmented reality application that projects a 3D object of a car engine component with an additional application feature, namely rotate. Different research was also carried out by Kurniawan and Masugino (2020), who discussed augmented reality in differential for SMK students. The research resulted in a differential competency augmented reality application for class XI SMK that can be operated on Android. Tests are carried out directly on material experts and material experts without testing the performance or functionality of the application first so that it can minimize the occurrence of hangs, crashes, or buttons that are not according to orders when the application is used.

From the previous studies above, this research has several advantages, including the content presented in the application being more complex and interesting, such as motion animation on 3D objects. In addition to buttons to rotate, there are also buttons to zoom in and out to see more details of differential and additional objects. Audio that explains each scene that is displayed. In addition, this research also conducted black box testing to determine the application's functionality.

CONCLUSION

The conclusions obtained in this study are as follows. First, the resulting product is an augmented reality book and a differential system competency application on the android platform. This application has main components, namely (1) The main menu page, which contains buttons to other pages; (2) The developer profile page contains profiles of developers and mentors in making the application; (3) The user manual page, which contains steps for using the application; (4) The material page contains an introduction to the material Differential System and its references; (5) The exercise page contains materials for evaluating student understanding d) The marker download page contains the marker file and AR Book; and (6) The AR scan page is the most important page in projecting differential 3D objects which consists of three scenes, namely introduction and how it works, component recognition and differential examination. Second, the functionality test results using black box testing with testing on five different devices show that all functions in the application can run as ordered, so it is said to be feasible to use. The feasibility level was obtained from the validation of media experts, with an average of 80% in the "appropriate" category, material experts, with an average of 84% in the "very appropriate " category, and the validation of user responses on average 90% with the "very appropriate " category used. Based on the average results of the three validation tests, the augmented reality application on the differential system competence is said to be "very appropriate" for use in vocational high schools. The results of this study have yet to reach the

stage of testing application performance efficiency and testing the effectiveness of learning media, so suggestions for further researchers can follow up on this in different competencies.

REFERENCES

Amin, M. M. (2017). *Strategi implementasi revitalisasi SMK: 10 langkah revitalisasi SMK*. Direktorat Jenderal Pendidikan Dasar dan Menengah.

Anugrah, K. W., & Alfian, A. N. (2020). Augmented reality sebagai media pembelajaran komponen utama mesin mobil berbasis Android. *Jurnal Mahasiswa Bina Insani*, *5*(1), 21–32. http://ejournal-binainsani.ac.id/index.php/JMBI/article/view/1370

Asyhar, R. (2011). *Kreatif mengembangkan media pembelajaran*. Gaung Persada Press.

Farman, I., Malik, M. N., & Lamada, M. (2018). Peran industri dalam meningkatkan mutu pendidikan melalui kelas industri di SMK. *Prosiding Seminar Nasional Fakultas Teknik UNM*. http://ocs.unm.ac.id/ft/semnasft2019/paper/viewFile/80/8

Hakim, L. (2018). Pengembangan media pembelajaran PAI berbasis augmented reality. *Lentera Pendidikan : Jurnal Ilmu Tarbiyah Dan Keguruan*, *21*(1), 59–72. https://doi.org/10.24252/lp.2018v21n1i6

Ismail, A., & Nasrulloh, I. (2020). Peningkatan kompetensi profesional guru fisika vokasi di Kabupaten Garut melalui pelatihan pengembangan bahan ajar berbasis augmented reality. *Prosiding Seminar Nasional Pengabdian Masyarakat (SENAM) 2020*, 429–439. https://ocs.machung.ac.id/index.php/senam/article/view/28

Junaedi, I. (2019). Proses pembelajaran yang efektif. *Journal of Information System, Applied, Management, Accounting and Research*, *3*(2), 19–25. http://journal.stmikjayakarta.ac.id/index.php/jisamar/article/view/86

Khurniawan, A. W. (2016). *Grand design pengembangan teaching factory dan technopark di SMK*. Direktorat Pembinaan Sekolah Menengah Kejuruan, Direktorat Jenderal Pendidikan Dasar dan Menengah, Kementerian Pendidikan dan Kebudayaan Republik Indonesia. https://repositori.kemdikbud.go.id/5045/1/DjzUYFjnZL1m58GaC5wH0pK4944YS2JWiOi 20Mag.pdf

Kiryakova, G., Angelova, N., & Yordanova, L. (2018). The potential of augmented reality to transform education into smart education. *TEM Journal*, *7*(3), 556–565. https://doi.org/10.18421/TEM73-11

Kurniawan, D., & Masugino, M. (2020). Pengembangan multimedia pembelajaran differential berbasis augmented reality untuk siswa kelas XI SMK. *Jurnal Pendidikan Teknik Mesin*, *20*(2), 66–69. https://doi.org/10.15294/jptm.v20i2.27935

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2019). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual Reality*, *23*(4), 425–436. https://doi.org/10.1007/s10055-018-0363-2

Putra, P. H., & Novelan, M. S. (2020). Perancangan aplikasi sistem informasi bimbingan konseling pada sekolah menangah kejuruan. *Jurnal Teknovasi : Jurnal Teknik Dan Inovasi Mesin Otomotif, Komputer, Industri Dan Elektronika*, *7*(1), 1–7. https://core.ac.uk/download/pdf/322500978.pdf

Putri, Y. E., Nuraina, E., & Styaningrum, F. (2019). Peningkatan kualitas hard skill dan soft skill melalui pengembangan program teaching factory (tefa) di SMK Model PGRI 1 Mejayan. *PROMOSI: Jurnal Program Studi Pendidikan Ekonomi*, *7*(2), 26–33. https://doi.org/10.24127/pro.v7i2.2511

Ramdani, S. D., El Islami, R. A. Z., Pratiwi, H., Fawaid, M., Abizar, H., & Maulani, I. (2021). Developing digital teaching material on basic electricity based on problem-based learning in

vocational education. *Jurnal Pendidikan Vokasi*, *11*(1), 78–91. https://doi.org/10.21831/jpv.v11i1.38894

Sari, A. K., Ningsih, P. R., Ramansyah, W., Kurniawati, A., Siradjuddin, I. A., & Sophan, M. K. (2020). Pengembangan kompetensi guru SMKN 1 Labang Bangkalan melalui pembuatan media pembelajaran augmented reality dengan Metaverse. *Panrita Abdi - Jurnal Pengabdian Pada Masyarakat*, *4*(1), 52–59. https://doi.org/10.20956/pa.v4i1.7620

Sari, R. M. M., & Priatna, N. (2020). Model-model pembelajaran di era revolusi industri 4.0 (e-learning, m-learning, AR-learning dan VR-learning). *Biormatika : Jurnal Ilmiah Fakultas Keguruan Dan Ilmu Pendidikan*, *6*(1), 107–115. http://ejournal.unsub.ac.id/index.php/FKIP/article/view/699

Sidiq, U., & Choiri, M. M. (2019). *Metode penelitian kualitatif di bidang pendidikan* (A. Mujahidin (ed.)). CV. Nata Karya. http://repository.iainponorogo.ac.id/484/1/METODE PENELITIAN KUALITATIF DI BIDANG PENDIDIKAN.pdf

Sugiyono, S. (2013). *Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R & D* (17th ed.). Alfabeta.

Sulistyoko, E., & Armanto, H. (2020). Pembelajaran menggunakan augmented reality pada alat-alat pekerjaan dasar teknik otomotif kelas X. *Prosiding Seminar Nasional Informatika Bela Negara*, *1*, 31–39. https://doi.org/10.33005/santika.v1i0.7

Utomo, M. (2020). Meningkatkan prestasi belajar siswa mapel produktif teknik kendaraan ringan dengan menggunakan media pembelajaran. *JIRA: Jurnal Inovasi Dan Riset Akademik*, *1*(4), 319–326. https://doi.org/10.47387/jira.v1i4.56

Wahono, R. S. (2006). *Aspek dan kriteria penilaian pembelajaran*. Romisatriawahono.Net. https://romisatriawahono.net/2006/06/21/aspek-dan-kriteria-penilaian-media-pembelajaran/

Yuliono, T., Sarwanto, S., & Rintayati, P. (2018). Keefektifan media pemelajaran augmented reality terhadap penguasaan konsep sistem pencernaan manusia. *Jurnal Pendidikan Dasar*, *9*(1), 65–84. https://doi.org/10.21009/10.21009/JPD.081

Management of dynamic curriculum in revitalizing vocational high school graduates

Lispiyatmini, Hermanto iD
Universitas Negeri Yogyakarta, Indonesia.
* Corresponding Author. Email: Lilis.g@jotun.com

ARTICLE INFO

ABSTRACT

This study aims to describe the management of dynamic curriculum implemented by Vocational High School (VHS) Mitra Industri MM2100 in revitalizing its graduates. It was conducted using the qualitative descriptive method at VHS Mitra Industri MM2100 and the object was how VHS Mitra Industri MM2100 implemented a dynamic curriculum. The data were obtained by using a questionnaire, through document studies and observation, and by interviewing principals, deputy principals, heads of departments, and productive teachers. The findings show that VHS Mitra Industri MM2100 implements a dynamic curriculum that always changes according to the development of science, technology, and the needs of graduate users so that the output is in accordance with the expectations and competencies required. The stages of implementing the dynamic curriculum include (1) establishing a learning flow in accordance with the school's vision and mission, (2) involving the industrial sector in curriculum preparation, (3) creating an industrial world ecosystem in the school, (4) adapting the curriculum to changes in the industrial sector and government policies, (5) involving parents in the teaching-learning process maximally, and (6) monitoring and evaluating the implementation of the curriculum on a regular basis by involving all relevant stakeholders. The implementation of a dynamic curriculum at VHS Mitra Industri MM2100 shows the results that match the expectations and competencies needed by the industrial sector, as evidenced by the 100% absorption of graduates for work specialization.

INTRODUCTION

Curriculum management as the core of education plays a very important role in determining the success of education. The curriculum developed in vocational high schools should adapt to the needs of the industry as users of Vocational High School (VHS) graduates. A dynamic curriculum is a curriculum that is able to adapt to current industrial developments by involving industry in the preparation of the curriculum. Revisions or changes to the curriculum are carried out periodically following the current technological and industrial developments. According to the explanation of Law of the Republic of Indonesia Number 20 the Year 2003, Article 15, vocational education is secondary education that prepares students especially to work in certain fields. Vocational education is directed at preparing students to enter the workforce.

This increase in human resources is more oriented to the learning experience of students, by providing knowledge and skills that can be applied to the world of work so that they are able to

compete competitively in the world of work. However, the current reality is that quite many VHS graduates are unemployed because they do not have competencies that match the needs of the world of work. This shows that the competence of job seekers does not yet link and match with the industry. The National Bureau of Statistics recorded unemployment in Indonesia in February 2021 as many as 8.75 million people. This number increased compared to that in February 2020, which was 6.93 million. The highest number of job seekers are vocational high school graduates, among the other schools' leavers, which is 11.45% (CNN Indonesia, 2020).

One of the reasons for the high unemployment rate of VHS graduates is the management the of VHS curriculum, which is not in accordance with the needs of the industry, as the graduates produced are not fully in accordance with the needs of the industry. This is in accordance with the results of Baiti and Munadi's (2014) research which reveals that the gap between the industrial sector and the world of education occurs because of differences in determining the quality. The world of education views high-quality graduates as graduates that have high grades and complete their study in a short time. Meanwhile, industry requires graduates with good technical skills and positive attitudes. Technical ability is better known as hard skills related to the scientific background and skills learned. Meanwhile, a positive attitude is better known as soft skills, namely abilities related to communication, creativity, critical thinking, collaboration, and agility in being adapted to changes.

In addition to these differences in perspective, the gap between the industrial sector and the world of education is at least caused by several factors, among others: (1) VHS graduates are not quite able to adapt to technological developments and to developing themselves in the workplace; (2) VHS graduates lack mental readiness to work; and (3) VHS graduates lack fighting power (Baiti & Munadi, 2014). Regarding these conditions, the President of the Republic of Indonesia instructed to revamp the education system and vocational training, through Presidential Instruction No. 9 of 2016. The President emphasized the need for the revitalization of vocational high schools to improve the quality of human resources. The instruction was assigned to the Ministry of Education and Culture.

The President of the Republic of Indonesia, through Presidential Instruction No. 9 of 2016 concerning the revitalization of vocational high schools, instructed ministers, governors, head of the Bureau of National Education Standard to take the necessary steps according to their respective duties, functions, and powers to revitalize vocational schools in order to improve the quality and competitiveness of Indonesian human resources. The President also instructed that a map of the workforce needs for VHS graduates be drawn up according to their respective duties, functions, and authorities based on the VHS development roadmap.

Especially to the Minister of Education and Culture, six instructions were given. The six instructions are: (1) creating a roadmap for VHS; (2) completing and aligning the VHS curriculum with competencies according to the needs of graduate users (link and match); (3) increasing the number and competence of vocational educators and education staff; (4) increasing collaboration with the ministry, institutions, local governments, business and industrial sectors; (5) improving access and certification of VHS graduates and VHS accreditation; and (6) forming a vocational development working group (The Minister of Education and Culture, 2020).

In particular, the revitalization of VHS is described in the revitalization master plan (RMP) guideline at the school level. In the guide, it is explained that the concept of the revitalization of VHS is a process of improving the performance of VHS which is carried out through: (1) refocusing the competency program; (2) redesigning the education component in VHS as a whole completely and thoroughly, so as to produce graduates who really have competence, good character, and work readiness and are competitive both at national and international levels (Directorate of Vocational Development, 2019).

The substance of vocational education must display the characteristics of vocational education which are reflected in the aspects that are closely related to curriculum planning, namely that the vocational education curriculum has been oriented to processes and results or graduates. However, the main success of the vocational education curriculum is measured not only by the educational success of students at school but also by their work performance in the world of work. Finch and Crunkilton (1979) suggest that the vocational education curriculum is oriented towards

processes (experiences and activities in the school environment) and outcomes (the effect of these experiences and activities on students) (Jatmoko, 2013).

The curriculum is a set of plans and arrangements regarding the objectives, content and teaching materials, and the methods used to achieve educational goals (President of the Republic of Indonesia, 2003). The curriculum is a process in teaching-learning activities that involve teachers, students, teaching materials, and learning media. The curriculum can also be interpreted as the maximum effort of the school to achieve the desired results inside and outside school (Guru Pendidikan, 2019). Viewed from the objectives of VHS as described above, the VHS curriculum is a set of systematic teaching-learning plans and arrangements to prepare students to become a character, skilled, creative workforce that is compiled through a process of alignment with the business and industrial sectors.

The curriculum is one of the components in the education system, where the curriculum will provide direction and be a guide in the implementation of the educational process, especially in formal educational institutions. Without a curriculum, the educational process will not run well. Even if we look at it from an extreme point of view, we can say that if there is no curriculum, there will be no educational process in schools. What determines the activities of the educational process in the form of teaching-learning activities is all determined in the curriculum, of course with a number of adaptations and variations.

Thus, we can understand and it is not an exaggeration if Beauchamp (1998) mentions that curriculum is the heart of education. The curriculum is the heart of education. The curriculum is the heart of education, so in its implementation it must be dynamic, meaning that it must follow changes according to the times, science and technology, the level of intelligence of students, culture, value systems, and community needs. Masykur (2019) writes the resulting curriculum can be dynamic, meaning that the curriculum must be able to answer any demands that arise needs according to a certain period of time. Thus curriculum changes do not have to wait a year or several years, but are very flexible according to changing conditions that require a change (Masykur, 2019).

Historically, the educational curriculum in Indonesia often changes every time there is a change in the Minister of Education, so the quality of Indonesian education has not yet met clear and steady quality standards. In the course of history since 1945, the national educational curriculum underwent changes in many periods, namely in 1947, 1952, 1968, 1975, 1984, 1994, 2004, 2006, 2013, and in 2021 the government introduced a prototype curriculum. These changes are a logical consequence of changes in the political, social, cultural, economic, and scientific systems in society (Wikipedia, 2022).

The current nationally available curriculum is the Revised Curriculum 2013. The competencies taught in this curriculum still do not meet the industry's needs optimally. This happens because the content of the existing curriculum tends to be static, while the needs in the industrial sector are always developing dynamically. Therefore, it requires the ability in dynamic curriculum management so as to be able to meet the changing needs of the industry.

Curriculum management is a system of managing curriculum, which is comprehensive and systematic aiming at realizing the achievement of curriculum objectives and how the curriculum is designed, implemented, and controlled by whom, when, and where. Curriculum management is also related to the policy of who is given the task, authority, and responsibility in designing, implementing, and controlling the curriculum (Syafaruddin & Amiruddin, 2017). From the expla-nation above, curriculum management can be concluded as a process of utilizing all curriculum resources, including planning, organizing, and supervising in order to achieve curriculum goals.

RESEARCH METHOD

This research was conducted at VHS Mitra Industri MM2100 Cikarang Barat, Bekasi Regency. The method used in this research is the descriptive qualitative method. The qualitative descriptive research is research that utilizes qualitative data that are described descriptively. This type of research is often used to analyze events, phenomena, or social conditions. The qualitative descriptive research aims to describe existing phenomena, both natural and human-engineered, which pay more attention to the characteristics, quality, and interrelationships among activities.

Qualitative descriptive research is a combination of descriptive and qualitative research. Descriptive research is research whose purpose is to present a complete picture of a social setting, or is intended to explore and clarify a phenomenon or social reality. It is conducted by describing a number of variables with respect to the problem and unit under study. Qualitative research is research that produces descriptive data in the form of written or spoken words from people or observed behavior (Sendari, 2019).

In this research, the data collection was carried out through interviews, a data collection technique by conducting direct dialogue with data sources, and carried out in an unstructured manner, where respondents had the freedom and opportunity to express their thoughts, views, and feelings naturally (Nugrahani, 2014). Interviews were conducted with stakeholders at VHS Mitra Industri MM2100. The stakeholders in question are (1) principals, (2) vice principals for curriculum, (3) representatives of productive teachers, and (4) representatives of normative teachers. To obtain a more comprehensive picture, the researchers carried out a documentation study through e-mail, school profiles, curriculum documents, and presentation of school program reports. The processed data were then described clearly in the preparation of the report.

RESULT AND DISCUSSION

Vocational high schools as educational institutions that develop vocational fields in Indonesia play an important role in improving human resources (HR). Employment opportunities for vocational school graduates are actually quite many. There are many opportunities that can be utilized if the school is able to accommodate the competencies needed in the world of work. Many VHSs still do not link and match with the world of work in providing learning experiences to students in terms of the selection of teaching materials, learning resources, activities, and practicum equipment used.

This phenomenon shows that VHS as an educational unit has not been optimal in preparing students and graduates to have competencies according to the demands of the world of work, especially in the business and industrial sectors, which will become users of graduates. This phenomenon can be illustrated in the Figure 1.
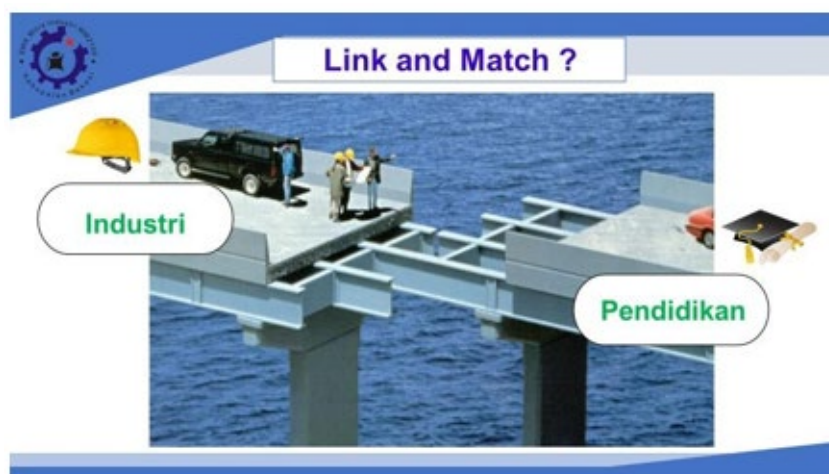
Figure 1. Illustration of the Missing Link and Match Between the Educational Sector and Industrial Sector

Based on this phenomenon, VHS Mitra Industri MM2100 runs a flow process of teaching and learning that focuses on a dynamic curriculum in order to carry out its vision and mission, so that it can revitalize its graduates according to the needs and competencies of the industrial sector. The vision and mission of VHS Mitra Industri MM2100 are as follows: Vision, VHS Mitra Industri MM2100 is an education and development center that produces students according to industry needs and entrepreneurial spirit, and Mission, (1) Building the character of students to behave positively;

(2) Equiping students with knowledge and skills according to the needs of industries; and (3) Building a strong entrepreneurial spirit.

To strengthen the achievement of its vision and mission, VHS Mitra Industri MM2100 imposes five values (honesty, responsibility, discipline, cooperation, caring) and 6-S: *senyum* (smile), *sapa* (greeting), *salam* (salaam), *sopan* (politeness), *santun* (courtesy), *semangat* (enthusiasm) that must be carried out by all teachers and students and supported by parents in a committed and consistent manner. This is made possible by the availability of an industrial ecosystem and adequate facilities and infrastructure.

The Steps to Implement Dynamic Curriculum Management

Establishing the Teaching-Learning Flow in Accordance with the School's Vision and Mission

In carrying out the teaching-learning process, VHS Mitra Industri MM2100 refers to the school's vision and mission and is adjusted to the developments and changes in education policy and the industrial sector. Vision and mission are a strong guideline in determining school targets, and thus the process flow always undergoes appropriate and necessary changes. Figure 2 is the flow of the teaching and learning process at VHS Mitra Industri MM2100 before the pandemic (in normal situations).
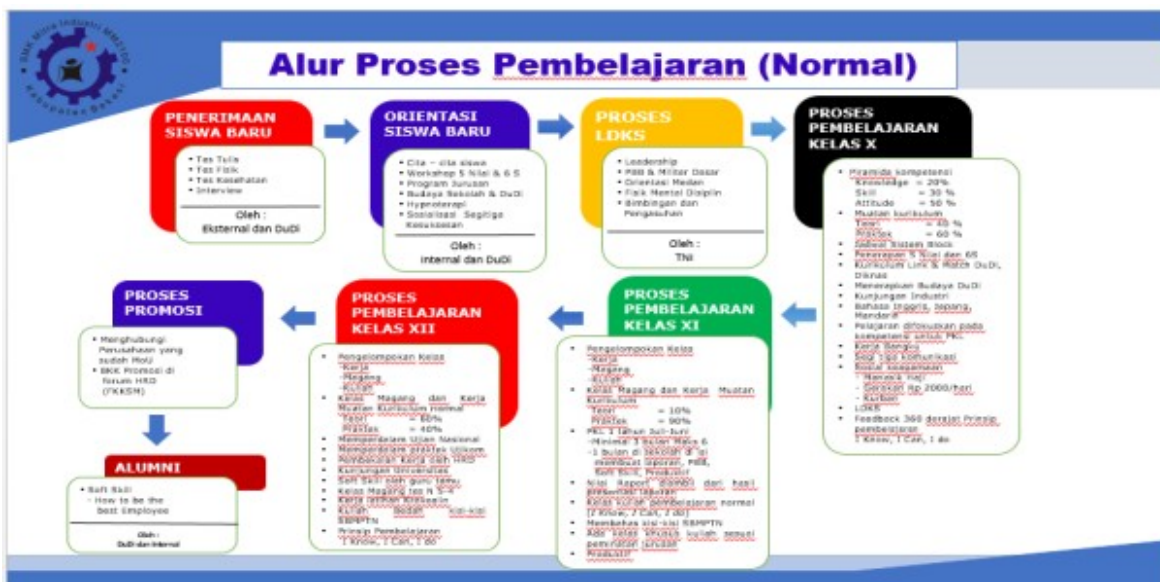
Figure 2. Process of Teaching Before Covid-19 Pandemic – Normal Situation

The flow of the teaching-learning process in normal situations is as follows, (1) Admission of new students involves the industrial sector and military personnel in the selection process. The selection process consists of written, physical, and health tests and an interview, and the process is adjusted to the recruitment process in the industry; (2) New student orientation is focused on building industrial character by means of workshops with the five values (honesty, responsibility, discipline, cooperation, and caring) and 6-S (smile, greeting, salaam, politeness, courtesy, enthusiasm), strengthening students' ideals, major programs, school culture, business and industrial sectors, hypnotherapy, and socialization of the triangle of success;

(3) Process of new students' basic leadership training involves the military personnel in its implementation, focusing on training in basic military and marching rules, physical mental and discipline, guidance, and parenting; and (4) The teaching-learning process of class X focuses on strengthening the character of preparedness for entering the industrial sector (fieldwork) so that the theoretical content (40%) and the major practical work (60%), carry out the teaching process in class using a competency pyramid where 20% is theory, 30% is skill, and 50% is character building in the division of teaching hours in each subject.

The competency pyramid is a learning concept at VHS Mitra Industri MM2100, which consists of the dimensions of knowledge, skills, and attitude. In teaching and learning activities, each of these dimensions is applied in different percentages. The carrying out of the competency pyramid can be explained as follows. To develop knowledge, the teacher spends 20% of the allocated time in the teaching-learning process on giving explanations of the theory in general. As much as 30% of the allocated time for the teaching-learning process is spent on providing students with practice according to each department, group work, presentations, and self-confidence training. For the attitude, 50% of the allocated time of the teaching-learning process is spent by the teacher to observe students following the teaching and learning process whether they carry out the five school values according to predetermined rules or not, for example being proactive in groups, being on time in carrying out assignments, and working together in completing group assignments.

The subjects are adapted to the needs of the industrial sector by referring to the national curriculum. The introduction to industrial culture is taught in class X by inviting industry experts or silver experts. The point is that the subject matter taught is in accordance with the required and expected competencies. In the first semester of class X, an evaluation is carried out using a parent questionnaire to ensure that the school has implemented a quality teaching-learning process.

(5) Class XI learning process, class XI must choose the path of specialization. Every student must choose one of the alternatives: to work, to continue their study to college, or to be an entrepreneur and plus an internship to Japan or Germany. Class XI is prepared for field work practicum with different periods according to the chosen interests. The fieldwork period is a minimum of six months and a maximum of one year or more, depending on the company's request. The curriculum is tailored to each specialization; (6) Class XII teaching-learning process, class XII teaching-learning process is in accordance with the specialization that has been chosen in class XI. The students who are interested in working start to be promoted to companies that have MoUs with the school with a bonded system. The students who are to continue their studies are prepared with a deepening of material to enter college. The students who are interested in internships in Japan and Germany are prepared to strengthen their language according to the requirements of the country of destination for the internship. Meanwhile, the interest in entrepreneurship has not been maximally carried out because it is not in accordance with the quota, but is carried out in their respective production units; and (7) Alumni. The alumni who have worked in the industry have a share and care program to strengthen their soft skills on how to be the best employees.
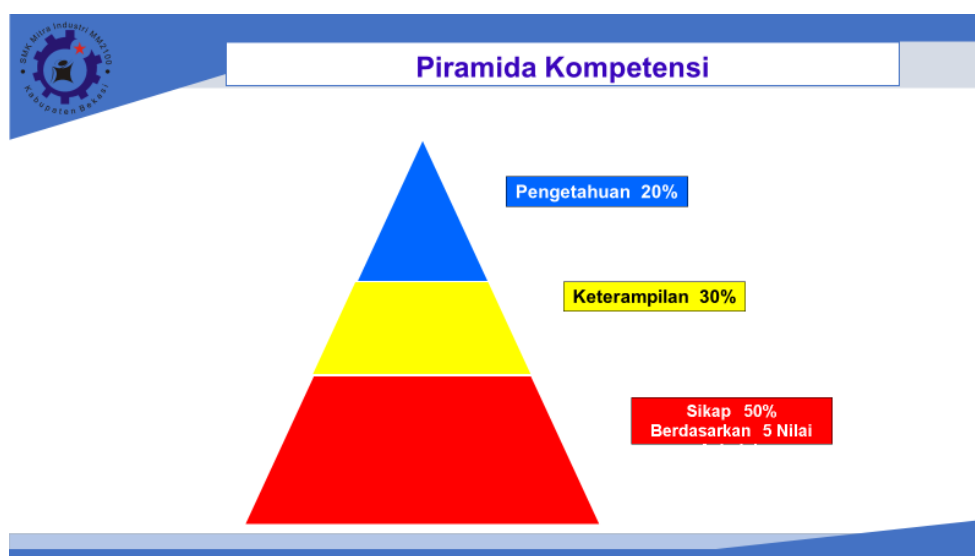

Figure 3. Competency Pyramid in Process of Teaching at VHS Mitra Industri MM2100

In general, all flows of the teaching-learning process during new normal and normal situations are still running, but there are changes in their implementation. The basic difference is in the implementation system. All processes are adapted to the existing conditions. For example, in the

process of accepting new students, orientation, LDKS, and other learning processes are carried out in a hybrid way. From the description of the flow of the learning process at VHS Mitra Industri MM2100 above, it is clear that curriculum management is applied dynamically and always adapts to the situation, policies, and current conditions.

Involving the industrial sector in Curriculum Preparation

In preparing its curriculum, VHS Mitra Industri MM2100 always involves the industrial sector to ensure the teaching and learning process is in accordance with industrial needs. The involvement of industries in curriculum preparation is carried out through forum group discussions (FGD) and curriculum validation which is carried out every year. Figure 4 is the concept of the curriculum as a result of the FGD with industries in general. While the implementation is adjusted to each department, especially for the content related to the product.

Figure 4. Competencies Needed by Industries Based on KSA

The curriculum that is run at VHS Mitra Industri MM2100 is in accordance with the curriculum expected by the Directorate of Vocational Training. The Director of Vocational Training on his official website explains that there are five conditions for creating a link and match between vocation and the industrial sector.

The requirements for creating a link and match between vocation and the industrial sector are as follows: (1) joint curriculum development must be synchronized and approved annually, (2) the industrial sector is required to provide guest teachers to teach for at least 50 hours per semester, (3) student internships are designed for at least one semester jointly between the school and the industrial sector, (4) competency certification is carried out by industry, (5) the industrial sector is committed to absorbing graduates. In addition to these five conditions, the director also states the development of teaching factories is included in the VHS curriculum (Director General of Primary and Secondary Education Ministry, 2018).

The dynamic curriculum implemented at VHS Mitra Industri MM2100 is in line with the government's policy regarding center-of-excellence schools which are currently being run by selected vocational schools and receive assistance from centers of excellence. The characteristics of this new paradigm curriculum are as follows: (1) The world of work can be involved in improving teaching and learning; (2) The curriculum structure is simpler, with two groups of subjects, namely general and vocational, with the percentage of the vocational group being 70% of the total lesson hours; (3) The implementation of project-based learning is by integrating related subjects; (4) Field-work practicum is at least 6 months; (5) Students can choose the subjects outside their expertise program; and (6) There is a specific time allocation for strengthening projects of Pancasila student profile (Sakarinto, 2021).

Creating an Industrial World Ecosystem in Schools

In carrying out the teaching-learning process, VHS Mitra Industri MM2100 creates an industrial nuanced ecosystem and builds industrial culture in schools. School infrastructure and facilities, green lanes for roads, and determination of uniforms are adapted to the industrial sector, for example, the students majoring in industry wear safety shoes are provided with safety driving training and other industrial cultures.

The availability of an industrial world ecosystem at this school is in line with the results of the research conducted by Christensen et al. (2016) on work culture. In his research report, it is stated that VHS is one of the suppliers of industrial workers so that VHS graduates can follow the existing work system. Kaizen as a gradual approach in a systematic, sustainable manner is in accordance with the achievement of goals. One of the tools for continuous improvement is the concept of 5 S: seiri (brief), seiton (tidy), seiso (dress), seiketsu (care), and seshitsuke (diligent) (Nusannas, 2018).

In essence, the creation of an ecosystem that supports the implementation of a dynamic curriculum must be provided optimally and have a strategy that is in accordance with industrial needs or apply industrial culture to schools. According to Ismara et al. (2020) in the strategy book for implementing industrial acculturation in vocational education, he explains the stages of cultivating work in the vocational education environment as follows: (1) analysis of industrial needs; (2) developing values that are in line with industrial needs, 3) the process of convincing and committing to the importance of industrial values; 4) compiling behavioral guidelines for students, teachers and parents; 5) compiling mechanisms for habituation of behavior and character; 6) devising regular monitoring and evaluation mechanisms; 7) devising mechanisms for continuous improvement of rules and regulations; 8) equipping infrastructure and supporting equipment; 9) repetition of the process of cultivating cyclically and continuously (Ismara et al., 2020).

Adjusting the Curriculum to Changes in Industrial Sectors and Government Policies

To ensure that the curriculum implemented at VHS Mitra Industri MM2100 is in accordance with the needs of the industry, every year it is always validated with the industry through focus group discussions. This is also in accordance with the government's policy for the center-of-excellence schools, known as the 8 plus 1 Program.

The 8 plus 1 Program is translated into the learning process carried out at VHS Mitra Industri MM2100. The 8 plus 1 Program is currently run by the government consisting of eight program activities plus one activity to improve the program. The 8 plus 1 Program is as follows. (1) The curriculum is prepared together with the business sector and industrial sector (BS&IS) standards (strengthening aspects of soft skills and work character); (2) Project-based learning (PJBL) from BS&IS from the start (ensuring hard skills will be accompanied by soft skills and work readiness characters; (3) The number and participation of teachers from the expert industry of BS&IS is significantly increased (up to a minimum of 50 hours/semester); (4) Internship/industrial work practice (prakerin) is a minimum of one semester;

(5) Certification of graduates' and teachers' competence is in accordance with BS&IS standards and needs; (6) Teachers regularly get updates and training from BS&IS; (7) Applied research starts from a case or real need from BS&IS and the community (as a basis for teaching industry/teaching factory, collaborating with BS&IS and stakeholders; (8) Commitment to graduate absorption by BS&IS; and (9) Making available scholarships and donations in the form of laboratory equipment or other equipment for vocational education (Sakarinto, 2021).

The 8 plus 1 Program carried out at VHS Mitra Industri MM2100 can be seen in Table 1. Recently the government also issued Curriculum 2022 known as the prototype curriculum and VHS Mitra Industri MM2100 started studying and running programs (Mulyana, 2022).

Table 1. Implementation of the 8 + I Program at VHS Mitra Industri MM2100 for the 2020-2021 Academic Year

No.	Aspects of 8 + 1	Implementation
1	The curriculum is prepared together with the business sector and industrial sector (BS&IS) standards to strengthen aspects of soft skills and work characteristics.)	1. Implementing industrial culture and strengthening industrial character by applying the Five Values and Six Ss 2. Curriculum validation for all majors 3. Vocational competence according to SKKNI
2	Project-Based Learning (PJBL) from BS&IS from the start, ensuring hard skills will be accompanied by soft skills and work readiness characters	1. Collaborating with the industry to implement project-based learning (PJBL). Products made by each department include: (a) Elind : Electric sink; (b) Electricity: Electrical Installation; (c) TKR : Car repair; and (d) Machine: Backlift, Garbage bank. 2. Implementing industrial class with PT. Posmi. 3. Implementing teaching factory with PT. Asahi Base Best
3	The number and participation of teachers from the EXPERT industry of BS&IS is significantly increased (up to a minimum of 50 hours/semester)	Inviting guest teachers to teach 32 hours per semester per department.
4	Internship/industrial work practice (Prakerin) at a minimum of one semester	1. Work interest: at least 1 year. 2. College and internship interest: 6 months
5	Competency certification according to BS&IS standards and needs for graduates and teachers	
6	Teachers regularly get updated and training from BS&IS	Routine job training for teachers in industries.
7	Applied research that starts from a case or real need from BS&IS and the community (as a basis for teaching). Industry/teaching factory collaborating with BS&IS and stakeholders	ODC (October Digital Creative) program regularly every year by involving the industry as mentors and judges
8	Commitment to graduate absorption by BS&IS	100% graduate absorption for graduates interested in work
9	Scholarships or apprentice from BS&IS for students as well as donations in the form of laboratory equipment or other equipment for vocational education	MoUs with 215 companies whose scopes include: 1. Validation of fieldwork curriculum and syllabus 2. Guest teacher 3. On-the-job training 4. Industrial visit 5. Street vendors 6. Graduate recruitment 7. Internship program 8. Industrial class 9. Teaching factory 10. CRS program 11. *Ujikom* 12. Scholarships 13. Support worksheets

(Source: Directorate of VHS, 2019)

Involving Parents Maximally in the Teaching-Learning Process

To ensure success in carrying out the learning process at VHS Mitra Industri MM2100, parental involvement is very important so that from the initial process of starting teaching, parents must carry out their respective duties to the best in accordance with the rules that have been determined and agreed upon in the orientation and socialization process of the school program at the orientation stage of new students.

Communication is the most important factor to realize the success of students so that at VHS Mitra Industri Mm2100 it strengthens the golden triangle of communication. This means that parents and students must carry out the tasks that are their best responsibilities, and must not beat each other. They must support each other and find the best way if there are things that are obstacles to success and they should not complain, but provide input and solutions.

Running the communication triangle among parents, schools, and students itself is a form of implementation of Law No. 20 of 2003 concerning the National Education System, Article 7 paragraphs 1 and 2 of the law reads: (1) parents have the right to participate in choosing schools and obtain information about their children's educational development, and (2) parents of children of compulsory school age are obliged to provide their children with basic education.

This is also supported by research by Nurtanto and Sofyan (2015), which cites several opinions about the effect and involvement of parents on student achievement. In his research, Yulianto found that parental involvement is all forms of parental attention and activities aimed at the success of their children's education. Teachers and parents have the same desire for the success of their children. These desires include: (1) being open to teachers, (2) cooperating in disciplining children, (3) helping monitor children's homework, and (4) attending parent meetings. In this study, it was stated that parental support in learning was quite influential on student achievement.

Monitoring and Evaluating Curriculum Implementation Periodically by Involving All Relevant Stakeholders

To ensure the graduates are qualified, competent, and in line with the expectations of the industrial sector, the monitoring and evaluation process is carried out regularly. Monitoring is a data collection process that is carried out routinely (Novitasari, 2022). In principle, monitoring is carried out during ongoing activities to ensure whether or not the suitability of processes and achievements is planned. If deviations or delays are found, they are immediately addressed so that activities can run according to plans and targets. The results of monitoring become input for the benefit of the next process (Ministry of Health Human Resources Development and Empowerment Agency, 2017).

To ensure the curriculum management can run well, VHS Mitra Industri MM2100 periodically carry out evaluation. The evaluation is done in several ways. The monitoring and evaluation process at VHS Mitra Industri MM2100 is illustrated in Table 2.

Table 2. Forms of Evaluation and Monitoring of Curriculum Implementation at VHS Mitra Industri MM2100

No.	Evaluation Form	Duration
1	FGD on curriculum and industries	Annually
2	Questionnaire to parents	Biannually
3	Student e-Sugestion	Monthly
4	Input from industries	Setiap monitoring PKL
5	Other inputs	Every time there is a visitor to the school

Evaluation is a process that determines to what extent the goals that have been set can be achieved. In general, evaluation can be defined as a systematic process of gathering information in the forms of number, verbal description, analysis, and interpretation of information to make decisions on the quality of a product or outcom (Masykur, 2019).

The evaluation process of VHS Mitra Industri MM2100 with the graduate users to see whether the output of its graduates is in line with their expectations is conducted through interviews during visits to companies to monitor students doing field work by asking the following questions: (1) What is the quality of graduates of VHS Mitra Industri MM2100 like when they are working in your company?; and (2) What is your advice to VHS Mitar Industri MM2100 in order that it can maintain the quality of its graduates and even improve according to expectations?

In the evaluation process, it is also seen demands from companies that use graduate output. From the results of the search for graduates of Class 7, who passed the 2020-2021 academic year, the data on the employability of graduates is as can be seen in Table 3.

Table 3. Employability of Batch 7 Graduates of VHS Mitra Industri MM2100 Academic Year 2020-2021

No.	Company name	Department							Total
		TITL	ELIN D	TBSM	TKRO	Machine	AK	AP	
1	PT Roki Indonesia	8	24	13	9	15	16	7	92
2	PT Yamaha Music		4	2	2	3	3	1	15
3	PT Denso Indonesia	6	6	12	6	5	7	3	45
4	PT Posmi Steel		4	4	2	9	2		21
5	PT Sugity Creatives	9	8	20	15	11			63
6	PT ADVANEX		1						1
7	PT TOKAI RIKA		4	1	4		2		11
8	PT PANASONIC	1	9	5	2	4	3		24
9	PT Autoplastic Indonesia	4	5	17	7	12			45
10	PT Hamaden Indonesia						3		3
11	PT ABBI			2	3		9		14
12	PT OAJ CARTON BOX	2	1	2	2				7
13	PT TRINITAN	2	4	9	2	6	2	5	30
14	ASUKA HOTEL							6	6
15	PT AKS	1		1		1	1		4
16	PT LG	4	9	18	19	8	2		60
17	PT NUTRIFOOD				4				4
18	PT Indomatsumoto	2	2	12	3	9			28
19	PT JFE Galavanizing Indonesia						2		2
20	PT Jotun Indonesia	3	2	2	3	6	1		17
21	PT IML Technologi			1	1		1		3
22	PT Diamond Electric		4	1	2	3	3		13
23	PT SINSEI DENSI	3	1				1		5
24	PT JFE Logistic			1		2			3
25	PT Sanden Indonesia		1	5	1				7
26	PT YUTAKA			2					2
27	PT KAYABA		1						1
28	PT Sari Roti		3	5	5	1		1	15
29	PT FUKUSUKE				1	1	1		3
30	PT Tri Centrum Fortuna	1		3	3	2			9
31	PT AHM					1			1
	Total	46	96	138	96	99	59	23	557

The Table 3 shows that the employability of the graduates that choose to work in the industrial sector is 100%. The key to the success of the management of the dynamic curriculum is the willingness and agility to change according to technological developments, policies, and the needs of the industrial sector quickly and accurately.

CONCLUSION

The dynamic curriculum management that is run at VHS Mitra Industri MM2100 is the management of the curriculum that follows the developments of industries as users of its graduates. The implementation of the dynamic curriculum from planning to evaluating always involves industries, parents, and all elements of education. The curriculum will be changed if the current curriculum does not meet the needs of industries. Changes in the curriculum, which do not change the whole system, can be executed immediately, such as adding materials to certain competencies. While the changes that are comprehensive in nature and affect the entire system are made at the beginning of the school year. This comprehensive curriculum change is carried out through a curriculum validation process with the industry. In carrying out the dynamic curriculum, VHS Mitra Industri MM2100 takes several activity steps. The steps for implementing a dynamic curriculum are: (1) establishing the learning flow in accordance with the school's vision and mission, (2) involving the industrial sector in curriculum preparation, (3) creating an industrial world ecosystem in schools, 4) adjusting the curriculum with changes that occur in industries and government policies, (5)

involving parents in the learning process to the fullest, and (6) monitoring and evaluating the implementation of the curriculum on a regular basis by involving all relevant stakeholders. Dynamic curriculum management that is run at VHS Mitra Industri Mm2100 can revitalize VHS graduates as evidenced by the employability of 100% of graduates. The management of the VHS curriculum must be carried out dynamically to produce graduates who are ready to work and are needed in the industrial sector. Sensitive and agile to changes that are so fast and willing to change to keep up with developments.

REFERENCES

Badan Pengembangan dan Pemberdayaan Sumber Daya Manusia Kesehatan Kementerian Kesehatan. (2017). *Pedoman Monitoring dan Evaluasi Pembelajaran*. Badan Pengembangan dan Pemberdayaan SDM Kesehatan Pusat Pendidikan SDM Kesehatan Kementerian Kesehatan RI. http://202.70.136.161:8107/65/1/PEDOMAN-MONEV_-2017.1.pdf

Baiti, A. A., & Munadi, S. (2014). Pengaruh pengalaman praktik, prestasi belajar dasar kejuruan dan dukungan orang tua terhadap kesiapan kerja siswa SMK. *Jurnal Pendidikan Vokasi*, *4*(2), 164–180. https://doi.org/10.21831/jpv.v4i2.2543

Beauchamp, G. (1998). The effect of group size on mean food intake rate in birds. *Biological Reviews of the Cambridge Philosophical Society*, *73*(4), S0006323198005246. https://doi.org/10.1017/S0006323198005246

Christensen, T., Danielsen, O. A., Laegreid, P., & Rykkja, L. H. (2016). Comparing coordination structures for crisis management in six countries. *Public Administration*, *94*(2), 316–332. https://doi.org/10.1111/padm.12186

CNN Indonesia. (2020, December 11). Menaker ungkap sebab lulusan SMK dominasi pengangguran di RI. *CNN Indonesia*. https://www.cnnindonesia.com/ekonomi/20201211140123-92-580934/menaker-ungkap-sebab-lulusan-smk-dominasi-pengangguran-di-ri

Direktorat Pembinaan Sekolah Menengah Kejuruan. (2019). *Panduan penyusunan Rencana Induk Revitalisasi (RIR) SMK tingkat sekolah*. Kementerian Pendidikan dan Kebudayaan Direktorat Jendral Pendidikan Dasar dan Menengah Direktorat Pembinaan Sekolah Menengah Kejuruan.

Direktur Jendral Pendidikan Dasar dan Menengah Kementerian. (2018). *Peraturan Direktur Jendral Pendidikan Dasar dan Menengah Kementerian Pendidikan dan Kebudayaan Nomor: 07/D.D5/KK/2018 tentang Struktur Kurikulum Sekolah Menengah Kejuruan (SMK)/Madrasah Aliyah Kejuruan (MAK)*. Direktur Jendral Pendidikan Dasar dan Menengah Kementerian. https://kurikulum.kemdikbud.go.id/wp-content/unduhan/Struktur_SMK_2018.pdf

Finch, C. R., & Crunkilton, J. R. (1979). *Curriculum development in vocational and technical education: Planning, content, and implementation* (5th ed.). Allyn and Bacon.

Guru Pendidikan. (2019). *Pengertian kurikulum menurut para ahli*. Seputarilmu. https://seputarilmu.com/2019/11/pengertian-kurikulum-menurut-para-ahli.html

Ismara, K. I., Pramono, H. S., Nugroho, N., Dwijonagoro, S., & Kuncoro, I. H. (2020). *Strategi penerapan budaya kerja industri di pendidikan vokasi dengan selamat dan sehat*. UNY Press. http://staffnew.uny.ac.id/upload/131873963/pendidikan/4 Buku Strategi Budaya Kerja.pdf

Jatmoko, D. (2013). Relevansi kurikulum SMK kompetensi keahlian teknik kendaraan ringan terhadap kebutuhan dunia industri di Kabupaten Sleman. *Jurnal Pendidikan Vokasi*, *3*(1), 1–13. https://doi.org/10.21831/jpv.v3i1.1572

Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2020). *Penyesuaian Keputusan Bersama Empat Menteri tentang panduan pembelajaran di masa pandemi COVID-19*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia. https://www.kemdikbud.go.id/main/blog/2020/08/penyesuaian-keputusan-bersama-empat-menteri-tentang-panduan-pembelajaran-di-masa-pandemi-covid19

Masykur, R. (2019). *Teori dan telaah: Pengembangan kurikulum*. Aura Publisher. http://repository.radenintan.ac.id/12468/1/TEORI DAN TELAAH PENGEMBANGAN KURIKULUM KIRIM.pdf

Mulyana, M. (2022). *Mengenal kurikulum prototipe 2022 (Kurikulum Merdeka)*. Ainamulyana. https://www.ainamulyana.com/2021/12/mengenal-kurikulum-prototipe-2022.html

Novitasari, C. (2022). *Monitoring: Pengertian, tujuan, contoh dan tahapan*. Pelajarindo. https://pelajarindo.com/pengertian-monitoring

Nugrahani, F. (2014). *Metode penelitian kualitatif dalam penelitian pendidikan bahasa*. Cakra Books. https://library.stiba.ac.id/uploaded_files/temporary/DigitalCollection/ZTDNEpUTHQoQU JMHLrErGJyHg89uy71MyuHyOTYzZDg3YWUxYjdjNA==.pdf

Nurtanto, M., & Sofyan, H. (2015). Implementasi problem-based learning untuk meningkatkan hasil belajar kognitif, psikomotor, dan afektif siswa di SMK. *Jurnal Pendidikan Vokasi*, *5*(3), 352–364. https://doi.org/10.21831/jpv.v5i3.6489

Nusannas, I. S. (2018). Implementasi konsep budaya 5R (Ringkas, Rapi, Resik, Rawat dan Rajin) sebagai upaya meningkatkan kinerja perusahaan dari sisi non keuangan. *Eqien: Jurnal Ekonomi Dan Bisnis*, *3*(2), 93–106. https://doi.org/10.34308/eqien.v3i2.31

Presiden Republik Indonesia. (2003). *Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional*. Presiden Republik Indonesia. http://simkeu.kemdikbud.go.id/index.php/peraturan1/8-uu-undang-undang/12-uu-no-20-tahun-2003-tentang-sistem-pendidikan-nasional

Presiden Republik Indonesia. (2016). *Instruksi Presiden Republik Indonesia Nomor 9 Tahun 2016 tentang Revitalisasi Sekolah Menengah Kejuruan dalam Rangka Peningkatan Kualitas dan Daya Saing Sumber Daya Manusia Indonesia*. Presiden Republik Indonesia. https://www.kemdikbud.go.id/main/index.php/files/download/e451d9ec3a04121

Sakarinto, W. (2021). *Kebijakan revitalisasi SMK melalui program SMK Pusat Keunggulan tahun 2021*. Direktorat Jendral Pendidikan Vokasi Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. https://docplayer.info/215664340-Kebijakan-revitalisasi-smk-melalui-program-smk-pusat-keunggulan-tahun-2021.html

Sendari, A. A. (2019, August 8). Mengenal jenis penelitian deskriptif kualitatif pada sebuah tulisan ilmiah. *Liputan6*. https://hot.liputan6.com/read/4032771/mengenal-jenis-penelitian-deskriptif-kualitatif-pada-sebuah-tulisan-ilmiah

Syafaruddin, S., & Amiruddin, A. (2017). *Manajemen kurikulum*. Perdana Publishing. http://repository.uinsu.ac.id/3492/1/MANAJ KURIKULUM.pdf

Wikipedia. (2022). *Kurikulum di Indonesia*. Wikipedia. https://id.wikipedia.org/wiki/Kurikulum_di_Indonesia#:~:text=Secara berurut%2C kurikulum Indonesia ditetapkan,yang berkembang di dalam masyarakat

Strengthening teacher pedagogical literacy after the Covid-19 pandemic in vocational secondary education in Banten Province

Sintha Wahjusaputri * [1] (iD) **, Wati Sukmawati [1]** (iD) **, Tashia Indah Nastiti [2], Via Noorlatipah [1]**

[1] Universitas Muhammadiyah Prof. Dr. HAMKA, Indonesia.

[2] Universitas Indonesia, Indonesia.

* Corresponding Author. Email: sinthaw@uhamka.ac.id

ARTICLE INFO

ABSTRACT

The purpose of this study is to improve the pedagogic competence of teachers in implementing literacy in learning through lesson study, namely: socialization, training, self-evaluation, reflective pedagogical paradigm, exploration, simulation, documentation, group discussion, mapping, and practice at SMK Negeri 3 Tangerang Selatan, Banten Province, Indonesia. This type of action research consists of two cycles, each carried out in four meetings. The research procedure includes (1) planning, (2) implementing actions, (3) observing, and (4) reflection. The subjects in the study were productive teachers and normative teachers at SMK Negeri 3 Tangerang Selatan, opening 15 people. The results showed that the teacher's pedagogic competence in implementing literacy in pre-action learning was 37%, the first cycle increased by 83%, and the second increased significantly by 100%. Classically the percentage has increased by 63%. Based on these results, lesson study can improve the pedagogic competence of teachers in implementing literacy in learning at SMK Negeri 3 Tangerang Selatan, Banten Province, Indonesia.

INTRODUCTION

Vocational Secondary Education (SMK) is an important part of the national education system, which has a strategic position to realize quality students with active involvement from the industrial world and the world of work (IDUKA). Since the beginning of 2020, Vocational Secondary Education (SMK) has entered a new situation due to the impact of the Covid-19 pandemic that has disrupted learning and learning activities (Futra et al., 2021). The situation invites various policies to deal with the impact of the increasingly severe Covid-19 pandemic. The debriefing can be poured into the learning plan. Teachers as educators have a crucial role in determining learners' success so that it becomes a determinant of improving the quality of education in schools (Syauqi et al., 2020).

President of the Republic of Indonesia, Joko Widodo's directive on "Acceleration of Superior Human Resource Development 2020-2024" is "Improving the qualification pyramid of labor to become a trained, skilled workforce to absorb everything into industries" for Vocational Secondary Education (SMK) in areas connected with Industries and the World of Work (IDUKA) so

that graduates are following needs, and ready for new things. The Ministry of Education and Culture of the Republic of Indonesia published a guide to the National Literacy Movement, saying that the government promotes six national lethargy cultures: literacy, numeracy literacy, science literacy, digital literacy, financial literacy, and citizenship literacy (Atmazaki et al., 2017).

Therefore, the role of teachers in Education is realized in the Law of the Republic of Indonesia Number 14 of 2005 concerning teachers and lecturers who mandate the development and development of the teaching profession as the actualization of the educator profession. According to Law No.20/2003 on Sistem Pendidikan Nasional, teachers must have competence, one of which is pedagogical competence. Pedagogical competence is the best way to support the students learning and the best way to support learners' learning by ensuring the quality of teachers in the field of disciplines and learners taught by teachers professionally (Maclellan, 2008). Ryegård et al. (2010) explained that pedagogical competence is teachers' ability to learn and transform knowledge, attitude, and skills (skills) in the teaching and learning process for learners.

Pedagogical competence focuses on five sub-competitive teacher pedagogical competencies that are commonly implemented to improve learners' learning outcomes, namely: (1) The ability to understand learners; (2) The ability to create POAC is planning (planning), arrangement (organizing), implementation (actuating), and control (controlling); (3) The ability to carry out learning; (4) The ability to evaluate learning outcomes; (5) The ability to develop learners to actualize various potentials (Budiyono & Santosa, 2018; Johnson & Johnson, 2009; Uerz et al., 2018). According to Barley and Diamon (2010), pedagogical competence is the practice of a teaching framework and is delivered through structured knowledge. This knowledge includes experience, evidence, understanding moral goals, and spreading transparent values (Susanto et al., 2019).

Susanto et al. (2019) explained that pedagogical competence is the ability of teachers to create an atmosphere and learning experiences that vary in the management of learners according to the curriculum. Aimah et al. (2018) explained that as a standard to measure the professionalism of teachers in fulfilling their role in the teaching profession. The teacher is one of the components of Education that has an important role in achieving the success of the literacy program (Marti et al., 2018). This is because the teacher is a person who interacts directly with students in carrying out literacy in learning. Without a teacher, students cannot receive knowledge properly (Papert, 2005).

SMK Negeri 3 Tangerang Selatan is a reference in the Community Activity Program (PKM) because the school is an outstanding school with a center of excellence in animation. Location of SMK Negeri 3 Tangerang Selatan on Jl. Raya Puspiptek, Puri Serpong 1 Housing, Setu District, South Tangerang City, Banten Province, Indonesia. The vision of SMK Negeri 3 Tangerang Selatan is that educating competent students requires creative teachers and pedagogical literacy. One of the answers is to develop teachers' competence as educators through training and mentoring of school literacy movements, especially pin pedagogical literacy fields (Susanto et al., 2019). School literacy movement with a focus on pedagogical literacy is the foundation of the way of thinking and rationalizing the need for literacy movements to be implemented by all school residents consistently, continuously, and measurable (Piirto, 2011).

Therefore the pedagogical literacy movement needs to be understood and carried out with expository learning methods, including socialization, planning, implementation, and continuous evaluation (Susanto et al., 2019). Responsibility for the school literacy movement becomes a shared responsibility between the government, schools (management and educators), learners, parents of learners, and the community. The pedagogical literacy movement became a fundamental part when understood and implemented modernly, covering all dimensions and aspects related to school as a system (Gustine, 2018). Pedagogical literacy movement conducted in a planned and consistent manner in the implementation and evaluation, and follow-up of programs by all teachers who are focused on students and parental assistance facilitates human pillars that grow and develop as lifelong learners, with the principles of learning to know, learn to do, remember to be, learn to live together and learn to see (Wahjusaputri, 2015).

Improving the pedagogical literacy of teachers at SMK Negeri 3 Tangerang Selatan, Banten Province, according to Rivai and Sudjana (2011) by (1) Mapping pedagogic literacy, where teachers must have mastery of lessons to improve the quality of learning; (2) Mapping of teacher characteristics, where teachers must have teaching skills, teacher attitudes, teaching experience,

teaching methods, assessment methods, willingness, and develop their profession; (3) Development of pedagogic literacy, where a teacher has communication skills, personality, willingness and ability to provide assistance and guidance to students; and (4) Measurement and evaluation of pedagogic literacy programs, where a teacher has relationships with students and colleagues, self-appearance as well as other required skills. This research was conducted on 15 teachers, both productive teachers and normative teachers.

Based on the pre-test analysis of the teacher's pedagogic competence in implementing literacy in learning at SMK Negeri 3 Tangerang Selatan, Banten Province, it has yet to achieve the desired criteria. The results of teacher pedagogic competence based on interviews, observations, and questionnaires show that the average score classically is 63, with a percentage reaching 37%, or seven teachers are already competent. In comparison, those who are not qualified reach 63%, or there are eight teachers. This shows that there are several obstacles faced by teachers in implementing literacy in learning, including teachers do not understand the concepts, objectives, principles, and stages of implementing literacy in schools, teachers do not understand the indicators or focus of activities that develop literacy in learning for students, and teachers have not made maximum use of the literacy support infrastructure in the classroom.

The interviews showed that most teachers had yet to receive material related to literacy, either from training or the like. The learning so far only prioritizes knowledge, attitudes, and skills related to the subjects being taught. Some teachers have received literacy material but have yet to apply it thoughtfully. This is due to the absence of continuous teacher competency development through supervision, lesson study, and sharing of experiences between teachers.

Based on the problems described above, the author and his collaborator partners, namely teachers at SMK Negeri 3 Tangerang Selatan, Banten Province, took the initiative to determine alternative actions to improve the pedagogic competence of teachers in implementing literacy in learning. Alternative problem-solving is selected through the Lesson Study method. In order to create a learning community field, lesson study is a methodology for promoting the teaching profession through cooperative and long-lasting learning assessments (Cajkler & Wood, 2016). Through a series of lesson study activities, there will be a learning process between fellow lesson study members so that directly or indirectly, it will be able to improve the quality of the learning process and, at the same time, increase the teacher's pedagogic competence (Cajkler & Wood, 2016).

The advantages obtained from the implementation of lesson study, according to Gunn and King (2015), include: (1) Teachers are more careful about the objectives of certain materials that will be taught to students; (2) Teachers have in-depth thoughts about learning objectives for the future interests of students; (3) Teachers can examine the best things that can be used in learning through learning from other teachers (participants or participants of lesson study); (4) Teachers learn about the content or subject matter from other teachers so that they can increase knowledge about what should be given to students; (5) Teachers can develop skills in teaching, when planning lessons and during learning activities; (6) Teachers can build abilities through collegial learning, in the sense that teachers can learn from each other about what they feel is still lacking, both about knowledge and skills in teaching students; (7) Teachers can develop the eyes to see students, in the sense of presenting.

In lesson study activities, teachers can solve problems faced in class, especially regarding implementing literacy in learning. This research aims to mobilize a group of teachers collaboratively through lesson study activities in planning, implementing, and reflecting on literacy activities in classroom learning. By conducting lesson study, it is hoped that the pedagogic competence of teachers in implementing literacy in learning can increase. This study aims to improve teachers' pedagogic competence in implementing literacy in each lesson through Lesson Study at SMK Negeri 3 Tangerang Selatan, Banten Province, Indonesia.

RESEARCH METHOD

This study used the School Action Research (PTS) design. According to Creswell and Creswell (2017), school action research is research conducted by school management as an educational organization to improve institutional performance, processes, and productivity. The author chose the school action research design model due to the problem of teacher pedagogic competence in carrying out literacy in every lesson at SMK Negeri 3 Tangerang Selatan, Banten Province, which still needs to reach the desired criteria.

Therefore, alternative actions were chosen to solve the problem through lesson study. This research action was carried out in two cycles. The classroom action research model describes the four steps and their repeaters: planning, implementing, observing, and reflecting (Sugiyono, 2006). The research subjects used in this study are productive and normative teachers, totaling 15 teachers consisting of 4 male teachers and 11 female teachers in the 2020-2021 academic year. The research location is at SMK Negeri 3 Tangerang Selatan on Jl. Raya Puspiptek, Puri Serpong 1 Housing, Setu District, South Tangerang City, Banten Province, Indonesia. This research was conducted from September to December 2021.

The data collection techniques in this study used the techniques of tests, observation, interviews, documentation, and field notes to determine the pedagogic competence of teachers in implementing literacy in learning through lesson study in each cycle. Techniques for data analysis were used on both a quantitative and qualitative level. Quantitative techniques are carried out to analyze the pedagogic competence of teachers in implementing literacy in learning through lesson study in each cycle.

Data analysis was carried out in four steps (McNally, 2007): (1) Review and calculate the score of the results of filling in the observation instrument based on the guidelines for the instrument filled in with Formula 1; (2) Recapitulate the scores of the results of filling in the observation instruments that have been calculated in the table provided; (3) Categorize the scores of the results of filling in the observation instruments with predetermined criteria; and (4) Calculate the percentage of the results of filling in the observation instrument with the Formula 2.

$$NA = \frac{\sum X}{M} \qquad (1)$$

Information:
NA = Final Score
$\sum X$ = Total Score
M = Total maximum score

$$SP = \frac{SK}{R} \; x \; 100\% \qquad (2)$$

Information:
SP = Precentage score
SK = Cummulative Score
R = Total Respondents

After analyzing the observations of the teacher's pedagogic competence in implementing literacy in learning, the percentage results are categorized according to the guidelines as in Table 1.

Table 1. Category Percentage of Observation Results

Criteria	Score Range
A = Very Good	86% - 100%
B = Good	70% - 85%
C = Fair	55% - 69%
D = Kurang	Under 55%

Quantitative data was obtained from observations, interviews, field notes, and documentation analysis. Qualitative data analysis in this study was carried out through three main activities, namely data reduction, data display, and conclusion drawing/verification (Sugiyono, 2006). Collecting qualitative data is likely easier to describe the increase in teacher pedagogic competence in implementing literacy in learning through lesson study.

RESULT AND DISCUSSION

Before the lesson study was applied, it showed that the pedagogic competence of teachers in implementing literacy in learning at SMK Negeri 3 Tangerang Selatan, Banten Province obtained an average score of 63, which was included in enough category, which was in the score range of 55-70, with a percentage reaching 37% or there were eight there are already competent teachers, while those who are not competent reach 63% or there are seven teachers. The teacher's pedagogic competence has yet to be achieved in implementing literacy in learning because teachers need to understand the concepts, objectives, principles, and stages of implementing literacy in schools.

Teachers also need to understand the indicators or focus of activities that develop literacy in learning for students. Teachers have yet to make maximum use of literacy support facilities in the classroom. The interviews showed that most teachers had yet to receive material related to literacy, either from training or the like. The learning teachers have carried out at SMK Negeri 3 Tangerang Selatan, Banten Province, only prioritizes knowledge, attitudes, and skills related to the subjects they teach. Several productive and normative teachers have received literacy materials but have yet to apply them thoughtfully. This is due to the absence of continuous teacher competency development through supervision, lesson study, and various experiences between teachers.

After the Lesson Study was applied in the first cycle, it showed that the teacher's pedagogic competence in implementing literacy in learning at SMK Negeri 3 Tangsel Banten Province had increased with an average score of 82 good compared to pre-action only 63 or enough category. Classically, the percentage of teacher pedagogic competence in pre-action was 37% and increased in the first cycle by 83%. It is proven that there is an increase in the percentage of teachers' pedagogic competence by 17%. Improving the results of teacher pedagogic competence between pre-action and cycle I can be seen in Table 2.

Table 2. Improving Teacher Pedagogic Competence in Pre-action and Cycle I

Observed aspects	Pre Action	Cycle I
Average Teacher Pedagogic Competence	63	82
Percentage of Teacher Pedagogic Competence	37%	83%

The research results in the first cycle are good but have not reached the percentage of classical teacher pedagogic competence of 85%. This is because there are still four teachers with pedagogical competence in implementing literacy in learning with enough category, even though the desired competence individually is at least good. Weaknesses that arise include there are still teachers who have not responded to enrichment books during literacy lesson hours, teachers have not responded to reading through varied reading strategies, teachers have not responded to reading in the form of oral, written, artistic, craft activities according to students' literacy skills, and there are still teachers who have not prepared a class reading corner.

The principal has not been maximal in carrying out lesson study activities because the principal has not been optimal in guiding teachers, there is no collaboration between high-competency teachers and low-competence teachers, and there is no response, providing comments and feedback on problems that arise in the implementation of teaching literacy. After being re-applied lesson study in cycle II showed that the pedagogic competence of teachers in implementing literacy in learning at SMK Negeri 3 Tangerang Selatan, Banten Province experienced a significant increase with an average score of 92 or the very good category compared to the first cycle of only 80 or the good category, and pre-action of 63 or category enough.

Classically, the percentage of teacher pedagogic competence in pre-action was 37%, increased in the first cycle by 83%, and increased significantly in the second cycle by 100%. It is proven that there is an increase in the percentage of teacher competence by 63%. The increase in the results of teacher pedagogic competence between pre-action to cycle II can be seen in Table 3.

Table 3. Improving Teacher Pedagogic Competence through Lesson Study in Cycle I and Cycle II

Observed Aspects	Cycle I	Cycle II
Average Teacher Pedagogic Competence	80	92
Percentage of Teacher Pedagogic Competence	83%	100%

The research results in cycle II are very good, exceeding the desired individual competence by at least Good and already exceeding the percentage of classical teacher competence by 85%. An increase in teacher pedagogic competence in carrying out literacy in classical learning is caused by teachers having implemented literacy in classroom learning very well, including teachers who have responded to enrichment books during literacy lesson hours, teachers who have responded to reading through varied reading strategies, teachers have responded to readings in the form of oral, written, artistic and craft activities following the literacy skills of students, and the teacher has prepared reading corners and reading materials in each class.

The principal has been maximal in carrying out lesson study activities. It is proven that the principal has been optimal in guiding teachers, the collaboration between high-competence teachers and low-competence teachers is very good, and there are responses, comments, and feedback on problems that arise in the implementation of literacy. Thus the implementation of lesson study has an impact on increasing the pedagogic competence of teachers in implementing literacy in learning at SMK Negeri 3 Tangsel, Banten Province. This follows the opinion of Nash et al. (2021), which states that through a series of lesson study activities, there will be a learning process between fellow teacher members of the lesson study so that directly or indirectly, it will be able to improve the quality of the learning process and at the same time can improve the teacher's pedagogic competence.

Furthermore, Regulation of the Ministry of National Education of the Republic of Indonesia Number 13 of 2007 concerning School Principal Standards explains that when it comes to effectively using school resources, the principal can manage schools, manage change and develop schools towards effective learning organizations, managing teachers and staff in the context of resource utilization. The explanation above shows that applying lesson study improves teachers' pedagogic competence in implementing literacy in learning at SMK Negeri 3 Tangerang Selatan, Banten Province. This activity is likely to be successful. This is based on data collection and analysis results showing a significant increase and exceeding the desired criteria.

Factors supporting the literacy of teacher-literate competence include: (1) Mastering the characteristics of students from physical, moral, spiritual, social, cultural, emotional, and intellectual aspects; (2) Mastering learning theory and educational learning principles; (3) Developing a curriculum that is in a way with the subjects that are mastered; (4) Organize educational learning; (5) Utilizing information and communication technology for learning purposes; (6) Conduct assessment and evaluation of learning processes and outcomes; (7) communicate effectively, empathically and politely with students; (8) Perform reflective actions to improve the quality of learning (Hendriani, 2018). In addition, teachers are accompanied to train themselves in the development of deeper reflective abilities, namely the ability of mental processes, reasoning skills, problem-solving skills, and the ability to listen and interpret values (Pellegrino & Hilton, 2012).

The efforts made include four steps taken, namely: (1) The teacher is invited to feel and determine what difficulties are fundamentally experienced from direct experience, then the teacher is asked to make the first note experienced; (2) Determine the location and limits of difficulties, after understanding the problem, then participants are accompanied through activities to sharpen the root of the problem to solve the problem; (3) Alternative problem solving, teachers are invited to discuss with other teachers; and (4) The development of reasoning, this activity is a continuation of alternative problem-solving activities, and in small groups, it is carried out the development of reason

aimed at sharpening the power of reason to produce the best problem-solving solution of existing ideas as a solution to problem-solving.

CONCLUSION

Based on the results and discussion above, lesson study can improve teachers' pedagogic competence in implementing literacy in learning at SMK Negeri 3 Tangerang Selatan, Banten Province. This can be seen from the average score in the pre-action category of 63 or enough category, an increase in the first cycle of 80 or the good category, and a significant increase in the second cycle of 92 or the very good category. It is proven that there is an increase in the average score of 28. Classically, the percentage of teacher pedagogic competence in pre-action was 37%, increased in cycle I by 83%, and increased significantly in cycle II by 100%. It is proven that there is an increase in the classical percentage of 63%.

ACKNOWLEDGMENTS

REFERENCES

Aimah, S., Purwanto, B., Santoso, H. D., & Ifadah, M. (2018). Lesson study: Engaging collaborative learning to promote teachers' pedagogical competence. *2nd English Language and Literature International Conference (ELLiC) Proceedings*, *2*, 334–337. https://jurnal.unimus.ac.id/index.php/ELLIC/article/view/3550

Atmazaki, A., Ali, N. B. V., Muldian, W., Miftahussururi, M., Hanifah, N., Nento, M. N., & Akbari, Q. S. (2017). *Panduan Gerakan Literasi Nasional*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia. https://gln.kemdikbud.go.id/glnsite/wp-content/uploads/2017/08/panduan-gln.pdf

Barley, K., & Diamon, I. (2010). *Profesionalism and pedagogy*. University of London.

Budiyono, S., & Santosa, G. B. (2018). Language education and education challenges in the mondial era. *Proceedings of the Fourth Prasasti International Seminar on Linguistics (Prasasti 2018)*, 302–306. https://doi.org/10.2991/prasasti-18.2018.57

Cajkler, W., & Wood, P. (2016). Lesson study and pedagogic literacy in initial teacher education: Challenging reductive models. *British Journal of Educational Studies*, *64*(4), 503–521. https://doi.org/10.1080/00071005.2016.1164295

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publication.

Futra, D., Primahardani, I., Putra, R. A., & Albeta, S. W. (2021). Pembelajaran online selama pandemi Covid-19 oleh mahasiswa pendidikan kimia: Bentuk, implementasi dan harapan. *Jurnal Pendidikan Sains Indonesia*, *9*(2), 266–279. https://doi.org/10.24815/jpsi.v9i2.18810

Gunn, A. A., & King, J. R. (2015). Using empathic identification as a literacy tool for building culturally responsive pedagogy with preservice teachers. *Teacher Development*, *19*(2), 168–186. https://doi.org/10.1080/13664530.2014.998371

Gustine, G. G. (2018). A survey on critical literacy as a pedagogical approach to teaching English in Indonesia. *Indonesian Journal of Applied Linguistics*, *7*(3), 531–537. https://doi.org/10.17509/ijal.v7i3.9798

Hendriani, A. (2018). Pedagogik literasi kritis; Sejarah, filsafat dan perkembangannya di dunia pendidikan. *PEDAGOGIA*, *16*(1), 44. https://doi.org/10.17509/pdgia.v16i1.10811

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher*, *38*(5), 365–379. https://doi.org/10.3102/0013189X09339057

Maclellan, E. (2008). Pedagogical literacy: What it means and what it allows. *Teaching and Teacher Education*, *24*(8), 1986–1992. https://doi.org/10.1016/j.tate.2008.05.009

Marti, M., Merz, E. C., Repka, K. R., Landers, C., Noble, K. G., & Duch, H. (2018). Parent involvement in the getting ready for school intervention is associated with changes in school readiness skills. *Frontiers in Psychology*, *9*, 1–16. https://doi.org/10.3389/fpsyg.2018.00759

McNally, M. G. (2007). The four-step model. In D. A. Hensher & K. J. Button (Eds.), *Handbook of Transport Modelling* (pp. 35–53). Emerald Group Publishing Limited. https://doi.org/10.1108/9780857245670-003

Nash, B., Wetzel, M. M., Dunham, H., & Murdter-Atkinson, J. A. (2021). Ways of being in bommunity: Centering preservice teachers' culturally sustaining pedagogies in field-based literacy teacher education. *Literacy Research: Theory, Method, and Practice*, *70*(1), 408–427. https://doi.org/10.1177/23813377211026640

Papert, S. (2005). Teaching children thinking. *Contemporary Issues in Technology and Teacher Education*, *5*(3), 353–365. https://www.learntechlib.org/p/21844

Pellegrino, J. W., & Hilton, M. L. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. The National Academies Press.

Piirto, J. (2011). *Creativity for 21st century skills: How to embed creativity into the classroom*. Sense Publishers. https://www.researchgate.net/publication/263374102_Creativity_for_21st_Century_Skills_How_to_Embed_Creativity_Into_the_Classroom

Rivai, A., & Sudjana, N. (2011). *Media pengajaran*. Sinar Baru Algesindo.

Ryegård, Å., Apelgren, K., & Olsson, T. (2010). *A Swedish perspective on pedagogical competence* (R. Eriksson (trans.)). Uppsala University. https://mp.uu.se/documents/432512/1163536/NSHU+Eng_inlaga%5B1%5D.pdf/353a7746-fd1a-678a-f0f9-8cffe89036ad

Sugiyono, S. (2006). *Statistika untuk penelitian* (A. Nuryanto (ed.)). Alfabeta.

Susanto, R., Rozali, Y. A., & Agustina, N. (2019). Development of pedagogical competency models for elementary school teachers: Pedagogical knowledge, reflective ability, emotional intelligence and instructional communication pattern. *Universal Journal of Educational Research*, *7*(10), 2124–2132. https://doi.org/10.13189/ujer.2019.071010

Syauqi, K., Munadi, S., & Triyono, M. B. (2020). Students' perceptions toward vocational education on online learning during the COVID-19 Pandemic. *International Journal of Evaluation and Research in Education*, *9*(4), 881–886. https://doi.org/10.11591/ijere.v9i4.20766

Uerz, D., Volman, M., & Kral, M. (2018). Teacher educators' competences in fostering student teachers' proficiency in teaching and learning with technology: An overview of relevant research literature. *Teaching and Teacher Education*, *70*, 12–23. https://doi.org/10.1016/j.tate.2017.11.005

Wahjusaputri, S. (2015). Pengaruh kepemimpinan kepala madrasah, pengembangan, budaya kerja dan self learning terhadap kompetensi pedagogik guru Madrasah Aliyah Negeri (MAN) di Kawasan Pesisir Pantai Utara Jakarta. *Edukasi Islami : Jurnal Pendidikan Islam*, *4*(8), 1175–1183. https://doi.org/10.30868/ei.v4i08.84

Internal factors that are influencing in determining the selection of expertise programs in vocational high school

Dwi Rahdiyanta , **Khusni Syauqi** * , **Achmad Arifin**
Universitas Negeri Yogyakarta, Indonesia.
* Corresponding Author. Email: khusnisyauqi@uny.ac.id

ARTICLE INFO

ABSTRACT

This study aims to examine the effect of students' internal factors (information literacy, self-understanding, and attitude) on their decision to enroll in a vocational high school mechanical engineering program. It is ex-post facto correlation research using a sample of 300 out of 1,086 students. The sample was established using the proportional random sampling technique using the Krejcie and Morgan formula. The data were collected using questionnaires, observation sheets, and documents. The findings reveal that (1) there is a significant and positive correlation between the internal factors and the student's decision to enroll in the mechanical engineering program of vocational high school (VHS); (2) all internal factors have a significant effect on both directly and indirectly on the student's preference for mechanical engineering program of VHS.

INTRODUCTION

Based on the National Education System in Indonesia, after students graduate from Junior High School (JHS), they are offered two alternatives to continue to secondary education, namely general secondary education in the form of senior high school (SHS) and vocational secondary education in the form of vocational high school (VHS). SHS prepares students to be able to continue on to higher education, while VHS prepares graduates to be ready to work according to their field of expertise (Minister of National Education Regulation Number 22 the Year 2006 on Standard of Contents).

Junior high school graduates who will continue to VHS need to get serious attention and guidance from parents and teachers so that everything runs smoothly in determining the selection of expertise programs in VHS. This is especially important due to the extensive fields of vocational programs offered in VHS. Based on the vocational program spectrum of secondary vocational education in Indonesia, there are currently nine vocational fields, 46 vocational programs, and 142 vocational competencies (Decree of the Director General of Elementary and Secondary Education, Ministry of Education and Culture, Republic of Indonesia Number: 4678/D/Kep/2016 on 2 September 2016, on Vocational Spectrum of Secondary Vocational Education).

When students are selecting schools for their secondary education, parents and teachers, as well as the students themselves, must pay serious attention to prevent uncertainty among students in

terms of their choice of secondary education. This uncertainty may be caused by: (1) students' inability to decide between the available alternatives, (2) students' lack of interest, and (3) students' lack of confidence (Crites, 1969; Wicaksono et al., 2018). Choosing the wrong secondary education and not by their interests can cause learning activities and school experiences to be unpleasant and stressful for students. Purnamawati et al. (2019) shows that students' lack of interest in this type of education affects their academic performance and behavior to the point that they will skip classes and even drop out of school.

Making choices combines needs, hopes, personal resources, and economic necessities (Robershaw et al., 2022; Vroom & Jago, 1978). Furthermore, that vocational choice is a combination of interests, abilities, values, opportunities, hopes, and realities (Perry & Wallace, 2015). Therefore, JHS should provide the students with sufficient information regarding vocational fields, vocational programs, and vocational competencies offered by VHS. Detailed information on VHS, such as its vision, missions, goals, and available vocational programs, helps parents and students choose the right program they desire (Herrick, 1996).

Wu (2020) asserts that making choices is a complex issue in the vocational development stages. Furthermore, the process of making vocational choices is influenced by the types of personalities. One's personality development is a mental process that results from one's involvement in one's community, both in similarities and differences. London (1973) uses the term "ego identity" to describe one's personality about one's community. Self-identity is constructed through the interaction of biological, psychological, and sociocultural conditions in which a person lives. Therefore, one's vocational choice always considers the clash between life patterns and vocational development structure.

Isaacson (1977) contends that the process of choosing a career or vocational program has four interrelated variables: reality factors, educational process, emotional factors, and personal values. Reality factors are related to one's response toward one's environment, which forces one to decide on one's career. The educational process is associated with the educational quality and quantity that one achieves, enabling one to gain insight into choosing a career. Emotional factors are about personality aspects. Finally, personal values are value aspects attached to a person that influences his or her career choice. Vocational choices are individual psychological awareness of the objective world about the self (Morris & American Heritage, 1982). Moreover, one's vocational development is essentially an interaction between individual behaviors, attitudes, ambitions, values, and social factors in one's surroundings (Heinz, 2009). Thus, vocational choices are one's psychological process to find the right attitude toward a particular object.

One's character or personality influences one in facing various vocational and career choices offered in one's communities (Holland, 1997). It means that one will choose a career based on one's personality. According to Holland's theory, people will be inward-looking (self-understanding) to assess whether a particular career suits their personality. Thus, self-knowledge is one of the most influential factors in vocational choices. Meanwhile, Vroom and Jago (1978) says that people will make particular vocational choices if they are sure and hopeful that their chosen career will make them successful. Therefore, they will put more effort into achieving the career they desire.

In choosing a vocational program in VHS, JHS graduates encounter some problems. For example, (1) they do not fully understand the details of each program offered in VHS, (2) they lack sufficient understanding of the world of work associated with those programs, (3) they do not know the requirements they have to fulfill for each program, both the cognitive and physical ones, (4) most JHS students have insufficient access to information technology, so they have problems in keeping up with the development of technology and employment related to those vocational programs, and (5) their self-understanding is not good enough to be able to choose the right program for them.

Given the wide spectrum of vocational programs available in VHS, this research focuses on JHS students' preference for the mechanical engineering program at VHS. The determinant factors in this preference are limited to the students' internal factors, namely information literacy, self-understanding, and attitudes toward the mechanical engineering program. Information literacy, self-understanding, and attitudes play an important role in determining the choice of areas of expertise in VHS for junior high school graduates. Therefore, junior high school students must always be

encouraged to increase their capacity, especially those related to developing information literacy, self-understanding, and a positive attitude toward VHS.

This research examines: (1) the description of psychological factors (self-understanding, information literacy, and attitude) regarding the decision of JHS students in Indonesia, especially in the Yogyakarta Special Region, to enroll in the mechanical engineering program in VHS, and (2) the effects of their internal factors of self-understanding, information literacy, and attitude on their preference for a mechanical engineering program in VHS.

RESEARCH METHOD

This correlation research aimed to formulate factors influencing JHS graduates in Yogyakarta Special Region to enroll in the mechanical engineering program at VHS. The research population comprised 1,086 JHS graduates who recently enrolled at VHS, majoring in mechanical engineering in Yogyakarta Special Region, Indonesia. Using Krejcie and Morgan's sampling formula (Isaacson, 1977), i.e., a 5% margin of error is acceptable, a sample of 285 students was established using the proportional random sampling technique. To anticipate any questionnaires and data that could not be processed, the number of samples was added by 5%. Thus, the minimum sample used in this study was as many as: 285 + (5% x 285) = 300 students.

The data were collected using surveys, questionnaires, observation sheets, and documents. The validity of the instruments was measured through expert judgment using the Delphi technique (content validity) and confirmatory factor analysis (construct validity) to find out whether the instrument items were suitable for estimating the components involved in the designated constructs (Ary et al., 2010). Meanwhile, the instrument reliability was calculated using Cronbach's alpha (Fernandes, 1984). The results of the instrument reliability test for information literacy, self-knowledge, attitudes, and the decision to enroll in the mechanical engineering program were 0.88, 0.79, 0.91, and 0.93, respectively. Thus, the proposed research instruments could be used for data collection.

The data were then analyzed using descriptive and inferential analyses (hypothesis tests), including correlation analysis, regression, and path analysis by testing the statistical assumptions (normality, linearity, homoscedasticity, and multi-collinearity). The data analysis requirements test results can be seen in Table 1, Table 2, Table 3, and Table 4.

Table 1. Normality Test Results

| No. | Variables | Score Distribution | | Skewness |
		Histogram	Normal Probability Plot	
1	X_1			0,30
2	X_2	Close to normal curve	Allow the direction of the diagonal line	-0,185
3	X_3			-0,360
4	X_4			-0,120

Based on Table 1, it can be concluded that the residual distribution of all variables in this study meets the normality requirements.

Table 2. Linearity Test Results

| Variable | Linearity | | | | Dev. Fro Linearity | | | |
	$F_{calculation}$	F_{table}	p	Conclusion	$F_{calculation}$	F_{table}	p	Conclusion
X_1-Y	24,125	3,88	0,00	Significant	0,955	1,50	0,543	Linear
X_2-Y	47,566	3,88	0,00	Significant	0,940	1,44	0,580	Linear
X_3-Y	122,331	3,88	0,00	Significant	0,724	1,50	0,863	Linear
X_1-X_3	16,763	3,88	0,00	Significant	1,010	1,50	0,458	Linear
X_2-X_3	58,333	3,88	0,00	Significant	1,153	1,44	0,254	Linear

Table 3. Homoscedasticity Test Results

Regression Pairs		Scatterplot		Test Park		
Independent Variable	Dependent Variable	Score Distribution	Conclusion	F	*Sig.*	Conclusion
LnX$_1$, LnX$_2$,	LnRES^{2}X$_3$	Does not form a specific pattern (spread randomly around the zeros on the Y axis)	Homoscedasticity	0,940	0,421	Homoscedasticity
LnX$_1$, LnX$_2$, LnX$_3$	LnRES^{2}Y		Homoscedasticity	1,207	0,307	Homoscedasticity

Based on Table 3, the regression equations specified in this study meet the requirements of homoscedasticity.

Table 4. Multicolinearity Test Results

r product moment between independent variables		Regression Pair		*Tolerance*		*VIF*	
Lowest	Highest	Independent variables	Dependent variables	Lowest	Highest	Lowest	Highest
0,231	0,636	X$_1$,X$_2$	X$_3$	0,759	0,897	1,115	1,317
		X$_1$,X$_2$,X$_3$	Y	0,759	0,897	1,115	1,317

Based on Table 4, it can be concluded that there is no evidence of serious multicollinearity between the independent variables. The inter-variable correlation of this study is presented in the Figure 1.
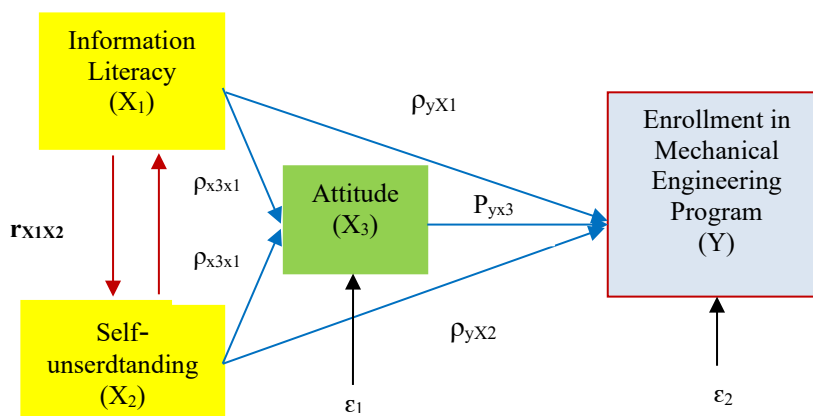
Figure 1. Inter-Variable Correlation

RESULT AND DISCUSSION

Result

The data in this study are summarized in the presentations of frequency distribution, central tendencies (mean, mode, median), as well as measures of dispersion (standard deviation), and the descriptive interpretation of four variables, namely information literacy (X$_1$), self-understanding (X$_2$), attitude (X$_3$), and decision to enroll in the mechanical engineering program at VHS (Y). The analysis result is presented in Table 5. The descriptive analysis reveals that the empirical mean value (M) is higher than the criteria mean value (Mi). Table 5 also shows that the gained value for all variables is above 70%. Thus, it can be generally said that all variables in this study are classified in the "high" category.

Table 5. Descriptive Analysis Result

Var.	SD.	Mi	M	Me	Mo	M : Mi	Value (%)	Category
X1	9.67	78	95.66	95.00	96.00	Higher	73.5	High
X2	5.41	33	44.03	44.00	44.00	Higher	80.3	High
X3	7.16	54	75.29	75.00	72.00	Higher	83.6	High
Y	6.92	51	69.22	69.00	70.00	Higher	81.0	High

Inter-Variable Correlation

The correlation or relationship among variables can be explained by testing the hypothesis: There is a significant relationship among all variables, namely information literacy (X_1), self-understanding (X_2), attitude (X_3), and preference for the mechanical engineering program at VHS (Y). A null correlation analysis with Pearson's product moment was conducted to test the hypothesis. The test results, as seen in Table 6, confirm that the hypothesis is accepted at the significance level of 0.05.

Table 6. The Inter-Variables' Null Correlation Analysis

		X_1	X_2	X_3	Y
X_1	Pearson Correlation	1	.582	.448	.545
	Sig.	.000	.000	.000	.000
X_2	Pearson Correlation	.582	1	.535	.515
	Sig.	.000	.000	.000	.000
X_3	Pearson Correlation	.448	.535	1	.651
	Sig.	.000	.000	.000	.000
Y	Pearson Correlation	.545	.515	.651	1
	Sig.	.000	.000	.000	.000

The Effect of Information Literacy (X_1) and Self-understanding (X_2) on Students' Attitude Toward VHS (X_3)

The effect of information literacy and self-understanding on students' attitudes toward VHS can be determined by testing the hypothesis: There is a significant effect of information literacy (X_1) and self-understanding (X_2) on students' attitudes toward VHS (X_3). The multiple regression analysis was used to test the hypothesis, where X_3 was the dependent variable, while X_1 and X_2 were the independent variables. The analysis result is presented in Table 7.

Table 7. The Multiple Regression Analysis Result of X3 on X1 and X2

Variable Dependent	Independent	B	Beta	r_{par}	Det. Parsial (r^2_{par})	T_{table}	Sig. t
X_3	X_1	0.225	0.305	0.267	0.071	4.743	0.000
R = 0.695							
R^2 = 0.483							
F = 55.000	X_2	0.572	0.433	0.423	0.179	4.994	0.000
P < 0.05							
C = 25.13							

The result of the multiple regression analysis (Table 7) shows that Fcal = 55.00 and p < 0.05; thus, the correlation coefficient (R) of 0.695 is significant at the significance level of 0.05. This affirms that the hypothesis that there is a significant effect of information literacy (X_1) and self-understanding (X_2) on students' attitudes toward VHS (X_3) is accepted. The coefficient of determination (R^2) of 0.483 shows that the contribution of the two variables is 48.3%.

The Effect of Information Literacy (X1), Self-understanding (X2), and Students' Attitude Toward VHS (X3) on Their Preference for Mechanical Engineering Program at VHS (Y)

The tested hypothesis is There is a significant effect of information literacy (X_1), self-understanding (X_2), and students' attitude toward VHS (X_3) on their preference for the mechanical

engineering program at VHS (Y). Multiple regression analysis was used to test the hypothesis, where Y was the dependent variable, while X_1, X_2, and X_3 were the independent variables. The summary of the multiple regression analysis result is presented in Table 8.

Table 8. The Multiple Regression Analysis Result of Y on X_1, X_2, and X_3

Variable Dependent	Variable Independent	B	Beta	r_{par}	Det. Parsial (r^2_{par})	t_{cal}	Sig. t
Y	X_1	0.019	0.057	0.075	0.006	0.722	0.026
R = 0.733 R²= 0.538	X_2	0.284	0.222	0.223	0.050	3.992	0.000
F = 56.816 P < 0.05 C = 12.199	X_3	0.366	0.378	0.371	0.138	6.844	0.000

The results of the multiple regression analysis, as shown in Table 8, show that F_{cal}= 56.815 and $p < 0.05$, indicating that the correlation value (R) of 0.538 is significant at the significance level of 0.05. Based on the results of the research, the research hypothesis, which states that information literacy (X_1), self-understanding (X_2), and attitudes toward VHS (X_3) significantly affect their choice of mechanical engineering program in VHS (Y), is accepted. Furthermore, the coefficient of determination value (R^2) of 0.538 shows that X_1, X_2, and X_3 contribute 53.8% of the variation in Y.

In detail, information literacy (X_1) has a significant effect on the student's preference for a mechanical engineering program in VHS with $\beta = 0.057$ and $p > 0.05$, so does self-understanding (X_2) with $\beta = 0.222$ and $p < 0.05$ and attitudes towards VHS (X_3) with $\beta = 0.378$ and $p < 0.05$. Based on the coefficient of partial determination, students' attitude toward VHS is the most influential factor affecting their choice of mechanical engineering program in VHS (13.8%), followed by self-understanding (5%) and information literacy (0.6%). Therefore, an attitude has a more dominant role in enrolling in the mechanical engineering program at VHS.

Based on the predictor value and the constant of multiple regression results, the multiple regression equation is $Y = 12.199 + 0.019 X_1 + 0.284X_2 + 0.366X_3$. This equation indicates that the average value of Y (the students' decision to enroll in the mechanical engineering program in VHS) will increase or decrease by 0.019, 0.284, and 0.366 for each increase or decrease in information literacy (X_1), self-understanding (X_2), and attitude toward VHS (X_3) respectively by one unit. An empirical causal relationship model containing the regression coefficient (β) or path coefficient is presented in Figure 2.
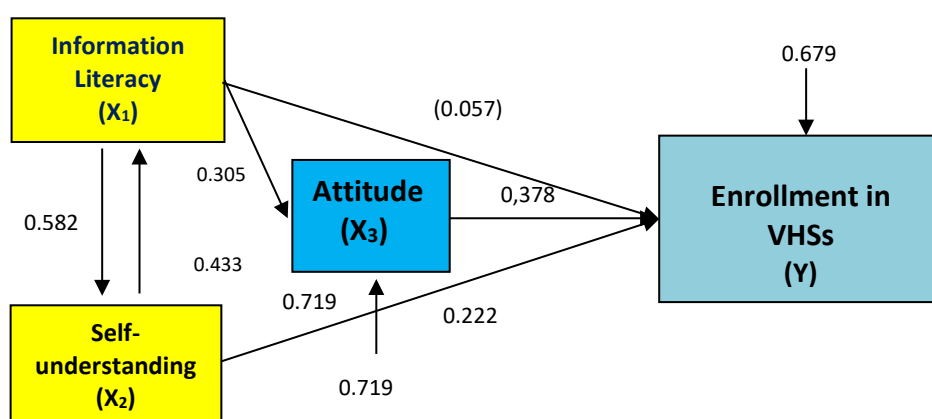
Figure 2. An Empirical Casual Relationship Model

Path Analysis (Direct and Indirect Effects)

The direct and indirect effects are examined by testing the significance of the path coefficient based on the empirical causal relationship model. A coefficient of less than 0.05 is insignificant and excluded from the model. The direct effect can be determined from the beta coefficients of two regression analyses using the stepwise methods, namely (1) a multiple regression of X_3 on X_1 and X_2

and (2) a multiple regression of Y on X_1, X_2, and X_3. However, the indirect effects are calculated manually based on the direct path coefficient in the causal relationship model. The summary of the direct, indirect, and non-causal relationships of the above causal relationship model is presented in Table 9.

Table 9. Path Analysis Results

Variable		Direct Effect	Direct Effect on X_3	Total Effect	Non-Casual Effect	Correlation
Dependent	Independent					
X_3	X1	0,305	-	0,305	0,124	0,448
	X2	0,433	-	0,433	0,206	0,535
Y	X1	0,057	0,040	0,040	0,234	0,545
	X2	0,225	0,162	0,162	0,210	0,515
	X3	0,378	-	0,378	0,409	0,651

Based on the results of the direct and indirect effect analysis, the data show the following: (1) The direct effect of the students' information literacy on their preference for the mechanical engineering program in VHS is significant, and so is the indirect effect of the students' attitudes; and (2) The direct effect of the students' self-understanding on their preference for mechanical engineering programs in VHS is significant, and the indirect effect of the students' attitudes. Based on the path analysis results above, it can be concluded that the student's information literacy, self-understanding, and attitude toward VHS play a significant role in their choice of mechanical engineering as their major in VHS.

Discussion

This study successfully reveals that the relationship among the researched variables is in "moderately strong" criteria. The lowest correlation value is on the relationship between information literacy and the students' attitudes (r = 0.448). Meanwhile, the highest one is on the relationship between the student's attitude and their preference for the mechanical engineering program (r = 0.651), indicating that their attitude strongly affects their enrollment in the mechanical engineering program at VHS. This is consistent with the research findings of Zirkle (2004), affirming that there is a positive relationship between attitudes, motivation, and the choice of vocational programs. Therefore, positive attitudes toward VHS must be developed by improving the quality of the VHS learning process, output, and outcome to promote VHS's positive image.

The multiple regression analysis results show that information literacy, self-knowledge, and the students' attitude positively and significantly affect their preference for the mechanical engineering program at VHS. Furthermore, each aspect significantly impacts the students' choice to major in mechanical engineering. The significant effects of information literacy on the program the students prefer to show that the findings of this research are correspondingly similar with that of Parkinson et al. (1998), confirming that information literacy on sciences and technologies affects one's orientation regarding their preferred vocational program.

Furthermore, this study's results are from the previous study carried out by Perry and Wallace (2015), who found that information literacy on employment contributes 74.4% to third-grade students' interest in enrolling in VHS. Similarly, Rahdiyanta et al. (2020) and Ali dan Asrori (2006) suggested that information literacy, self-understanding, and attitude influence and determine one's decision on what vocational program to choose. JHS graduates' lack of insight into the world of work affects their choice of secondary school. Accordingly, Munadi (2005) confirmed that JHS graduates' lack of perception and poor attitudes toward VHS results from their self-understanding inadequacy which eventually will influence their accuracy in deciding what vocational program to enroll in.

The path analysis results show that the direct effect of information literacy on preference for mechanical engineering programs in VHS is significant, and so is the indirect effect of the students' attitudes. This result indicates that the student's attitude plays a role in explaining the effect of information literacy on the vocational program they choose. Furthermore, it is in line with the

findings of Hirschi (2011), showing that the JHS students' information literacy regarding VHS will affect their perception and attitude toward VHS, which eventually will significantly affect their vocational decision.

Therefore, information literacy is a crucial factor influencing the decision-making process. In other words, JHS graduates who are information literate will have better and more accurate considerations in choosing the vocational program that fits them well. At the same time, information literacy is influenced by some situational factors from school, family, and society. If the situational factor is good, how will the students' information literacy be? This will eventually shape a better insight into VHS, science and technology development, and the world of work associated with the mechanical engineering program.

Besides, the result of the path analysis shows that the direct effect of the students' self-understanding on their preference for the mechanical engineering program in VHS is significant, and likewise, the indirect effect of the students' attitudes. This implies that students' attitude is crucial in explaining the effect of self-knowledge on the students' vocational decision-making. It agrees with Mifflen and Mifflen (1986) that self-concept or self-understanding has a dominant role in developing children's characteristics and behavior. Thus, self-knowledge is an essential psychological activity in taking action. Those who know their potential well have better orientation in deciding what vocational program or career they want to pursue. It is very reasonable since every vocational program or career has specific characteristics and requirements and intrinsic and extrinsic impacts.

In addition, the results of the path analysis revealed that students' attitude toward VHS significantly and strongly affects their preferred vocational program. This is in line with the previous study by Bello et al. (2017) and Rahdiyanta et al. (2020), who claimed that attitude is one of the psychological aspects of individuals, which is crucial because a person tends to behave so that it will affect a lot of one's behaviors. Attitude is a tendency to react to people, institutions, or events either positively or negatively.

Furthermore, according to the theory of determinism, human attitudes are derived or influenced by genetic determinism, psychic determinism, and environmental determinism. Genetic determinism holds that an individual's attitude is affected by that of his/her grandparents. Psychic determinism claims that one's behavior is affected by his/her parents' treatment, parenting, or education. Environmental determinism assumes that the development of a person's attitude is strongly affected by the environment in which the individual lives and how the environment treats him/her. Similarly, according to Thompson (1973), a person's vocational program is affected by either internal or psychological aspects.

The findings of this study show that all parties, including the students themselves, parents, and teachers, must pay serious attention when deciding on the right type of secondary school. It is particularly important to ensure that their targeted secondary school program is clear. These uncertainties may be attributed to (1) the inability to choose one of the alternatives, (2) a lack of interest and talent, and (3) hesitation due to the lack of self-confidence (Crites, 1969). Failure to choose a secondary school that fits one's ability and interest may have detrimental impacts. For example, this wrong choice may create an unpleasant, torturous, and stressful condition in teaching and learning.

CONCLUSION

There is a positive and significant relationship between information literacy, self-understanding, and student attitudes toward the determination of the field of mechanical engineering expertise in VHS. The relationship between these variables is categorized as "strong." The lowest correlation coefficient is found in the relationship between the family environment and attitude ($r = 0.448$; $p < 0.05$). While the highest correlation coefficient is found in the relationship between attitudes and participation in the mechanical engineering study program at VHS ($r = 0.651$). Information literacy, self-understanding, and attitude positively and significantly impact the students' decision to enroll in the mechanical engineering program at VHS (53.8%). Based on the coefficient of partial determination, the student's attitude is the most influential variable affecting their choice

of the mechanical engineering program in VHS (13.8%), followed by self-understanding (5%) and information literacy (4.6%).

Information literacy, self-understanding, and attitude have a positive and significant effect either directly or indirectly on their decision to enroll in the mechanical engineering program at VHS. Information literacy, self-understanding, and attitudes play an important role in determining the choice of areas of expertise in VHS for junior high school graduates. Therefore, junior high school students must always be encouraged to increase their capacity, especially those related to the development of information literacy, self-understanding, and a positive attitude toward SMK. Junior high school teachers must provide various media access to information about SMK and provide more intensive vocational training as early as possible to their students..

REFERENCES

Ali, M., & Asrori, M. (2006). *Psikologi remaja : Perkembangan peserta didik*. Bumi Aksara.

Ary, D., Jacobs, L. C., Sorensen, C., & Razavieh, A. (2010). *Introduction to research in education*. Cengage Learning. http://repository.unmas.ac.id/medias/journal/EBK-00124.pdf

Bello, D. A., Afolaranmi, T. O., Hassan, Z. I., Ogbonna, F. C., Inedu, P. G., Ejiga, C., & Chirdan, O. O. (2017). Knowledge and use of oral rehydration solution in the home management of diarrhea among mothers of under fives in Jos, Plateau State. *International Journal of Biomedical Research*, *8*(1), 33–37. https://doi.org/10.7439/ijbr.v8i1.3781

Crites, J. O. (1969). *Vocational psychology: The study of vocational behavior and development*. McGraw-Hill.

Heinz, W. R. (2009). Vocational identity and flexible work: A contradicting or constructive relation? In F. Rauner (Ed.), *Innovative Apprenticeships: Promoting Successful School-to-work Transitions* (pp. 33–46). LIT Verlag Münster.

Herrick, M. J. (1996). Assessment of student achievement and learning, what would Dewey say? a "recent" interview with John Dewey. *Journal of Vocational and Technical Education*, *13*(1), 17–29. https://files.eric.ed.gov/fulltext/EJ535227.pdf

Hirschi, A. (2011). Relation of vocational identity statuses to interest structure among Swiss adolescents. *Journal of Career Development*, *38*(5), 390–407. https://doi.org/10.1177/0894845310378665

Holland, J. L. (1997). *Making vocational choices: a theory of vocational personalities and work environments* (3rd ed.). Psychological Assessment Resources.

Isaacson, L. E. (1977). *Career information in counseling and teaching*. Allyn and Bacon.

London, H. H. (1973). *Principles and techniques of vocational guidance*. Charles E. Merrill Publishing.

Mifflen, F. J., & Mifflen, S. C. (1986). *Sosiologi pendidikan* (J. Kullit (trans.)). Tarsito.

Morris, W., & American Heritage. (1982). *The American heritage dictionary: Second collage edition*. Houghton Mifflin.

Munadi, S. (2005). *Memahami orientasi pilihan bidang keahlian siswa SMP*. UNY Press.

Parkinson, J., Hendley, D., Tanner, H., & Stables, A. (1998). Pupils' attitudes to science in key stage 3 of the national curriculum: a study of pupils in South Wales. *Research in Science & Technological Education*, *16*(2), 165–176. https://doi.org/10.1080/0263514980160206

Perry, J. C., & Wallace, E. W. (2015). Children and adolescents. In *APA handbook of career intervention, Volume 1: Foundations.* (pp. 189–207). American Psychological Association. https://doi.org/10.1037/14438-011

Purnamawati, P., Arfandi, A., & Nurfaeda, N. (2019). The level of use of information and communication technology at vocational high school. *Jurnal Pendidikan Vokasi*, *9*(3), 249–257. https://doi.org/10.21831/jpv.v9i3.27117

Rahdiyanta, D., Anggoro, Y., Wijanarka, B. S., & Sasongko, B. T. (2020). The development of interactive learning media by manufacturing helical gear using milling machine. *Journal of Physics: Conference Series*, *1446*(1), 1–7. https://doi.org/10.1088/1742-6596/1446/1/012012

Robershaw, K. L., Bradley, K. D., & Waddington, R. J. (2022). Parents' awareness and perspectives of school choice scale: Psychometric evidence using Rasch modelling. *Journal of School Choice*, *16*(2), 275–305. https://doi.org/10.1080/15582159.2021.2004493

Thompson, J. F. (1973). *Foundations of vocational education: Social and philosophical concepts*. Prentice-Hall.

Vroom, V. H., & Jago, A. G. (1978). On the validity of the Vroom-Yetton model. *Journal of Applied Psychology*, *63*(2), 151–162. https://doi.org/10.1037/0021-9010.63.2.151

Wicaksono, W., Sparrow, R. A., & Van Bergeijk, P. (2018). The impact of parents' education and attending vocational high school to college entrance. *Jurnal Pendidikan Vokasi*, *8*(1), 12–23. https://doi.org/10.21831/jpv.v8i1.17938

Wu, M.-J. (2020). Predicting outcomes of school-choice policies using district characteristics: Empirical evidence from Hong Kong. *Journal of School Choice*, *14*(4), 633–654. https://doi.org/10.1080/15582159.2020.1773742

Zirkle, C. (2004). Distance education programming barriers in career and technical teacher education in Ohio. *Journal of Vocational Education Research*, *29*(3), 157–179. https://doi.org/10.5328/JVER29.3.157

The role of the heutagogy approach in advanced adult education as rebuilding the vocational self-concept in the industrial era 4.0 and society 5.0

Titi Sumarni *, Putu Sudira (iD)
Universitas Negeri Yogyakarta, Indonesia.
* Corresponding Author. Email: titisumarni100@gmail.com

ARTICLE INFO

ABSTRACT

Technical and Vocational Education and Training (TVET) is established by UNESCO and ILO as education and training beneficial for the community. The community will be able to develop when they can use their leadership skill properly. This is what makes adult vocational education very important in building the nation. One example of the role of adult vocational education is reducing unemployment through a heutagogy approach. The heutagogy approach centered on individual participants, where the individual has full autonomy in creating their learning. The heutagogy approach is also helpful for developing an individual's self-capacity and vocational self-concept. The individual vocational self-concept through the heutagogy approach can help students, graduates, alumni, and the community develop skills (re-skills, up-skills) and prepare to enter the world of work. The skill development can be done by forming (re-establishing) the individual's vocational self-concept. In the development of the industrial revolution 4.0 and society 5.0, the role of self-concept with a heutagogy approach in advanced adult education is to build vocational self-concepts so that they can be independent in learning, prepare work skills and utilize technology well as lifelong learning, and make an individual as a digital transformation society. Besides that, the heutagogy approach has a triple-loop learning process that aims to make the right decision on the learning power of vocational self-concept. With the preparation of work skills, the self-concept of vocational maturity means that the higher the self-concept, the higher the maturity in the industrial era 4.0 career and Society 5.0 or with the existence of vocational self-concept in the future can make mature decisions.

INTRODUCTION

Human capital can be interpreted as a knowledge-based economy. That is, well-educated and well-trained personnel is the main capital to improve the welfare of life. In addition to Human Capital as the main capital of knowledge-based economic development, the skills of workers and experiences there are social capital can be social capital related to the values of shared and social culture, environment, and social tissue. This allows individuals or groups to trust each other and work together.

The review of this issue is supported by research on human capital development in migrant workers, where the goal is to examine the regulation of human capital of rural migrant workers to consider social capital as an increase in productivity. So that migrant workers do not view their human capital that is valued by companies (Sha & Taylor, 2019). Human capital in migrant workers who learn to reject management rules by relying on social capital networks (Sha & Taylor, 2019). Besides the problems that often occur in humans when one's identity is not correctly known. The impact of self-identity on unknown interests and talents can cause a weak vocational self-concept in individuals.

At the same time, the weakness of individual vocational self-concept causes increasing unemployment rates among graduates and others. This is because graduates who are not ready to work due to talent in person need to be developed into a skill or competence. Based on the problem of vocational self-concept (VSC) is important, since according to Rosenberg (1989) self-concept is the totality of thoughts and feelings that refer to ourselves and objects. As a reduction in the unemployment rate, the more important thing is to build human resources to become competent human beings as long as you find a vocational self-concept for survival.

Therefore, the importance of the vocational self-concept in vocational learning is to produce superior human resources. Based on these objectives and problems, this article reveals that adult education through a heutagogy approach plays an important role in rebuilding the vocational self-concept, as well as reducing unemployment among the community (graduates, adults, and the community), where human capital and social capital are the capital in education. Advanced adults because adult vocational education applies throughout life (life long learning). Therefore, this article contains the important role of the heutagogy approach to adult and continuing education in rebuilding the vocational self-concept in the Industrial Revolution 4.0 and Society 5.0.

The heutagogy approach is learning towards the maturity of students (Sudira, 2017). This is supported by research that heutagogy is a form of self-determined learning with practices and principles rooted in andragogy (Blaschke, 2012). Similarly, this approach has a main priority, i.e., the independence of students in learning achievement, determining their learning strategies, and developing their teaching materials autonomously (Sumarsono, 2019). Therefore, the heutagogy approach is appropriate for further adult education. This is supported by research that the perception of further education is very important for the success of a career or life (Triyono et al., 2018). The following supports and explains the elements of the heutagogy approach.
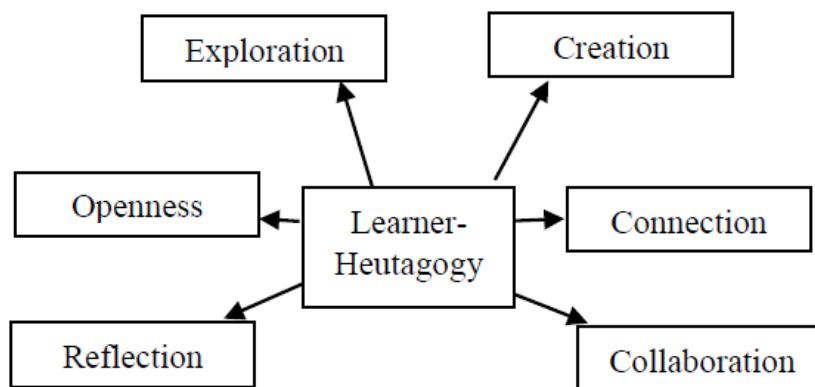

Figure 1. Heutagogy Design Elements

Based on Figure 1 about element heutagogy (Blaschke & Hase, 2016), the following is an explanation of each element: (1) Exploration; students will be allowed to explore the path of knowledge sources, be able to ask and answer questions and be able to develop and test hypotheses; (2) Creation; students will be given the to create something learned; (3) Collaboration; learners should be encouraged to collaborate in problem-solving, help each other in their learning, and be allowed to progress together. (4) Connections; students should be encouraged to connect with others in their discipline using available media, namely Twitter, LinkedIn, etc.; (5) Sharing; students should be allowed to share their knowledge and resources with friends; and (6) Reflection; students will be given enough time to write reflections on learning to increase the level of higher cognitive activities such as analysis and synthesis.

The heutagogy approach is very important. In addition to self-learning, this approach is useful when students use multimedia and online learning. Where learners do invaluable work for themselves through discovery and reflection (Parslow, 2010). Similarly, research supports that heutagogy learners learn from each other and do self-reflection (Dick, 2013). Learners are involved in what processes and how to learn worldwide (Hase & Kenyon, 2000). In addition, heutagogy is humanism and constructivism (Blaschke & Hase, 2015). At the same time, the starting point for learning in Heutagogy is a student (Jones et al., 2019). The heutagogy curriculum must be flexible considering the background of students and the results of students' learning. In contrast, the role of the teacher in the approach of heutagogy as the supervisor of students provides formative feedback according to their own learning needs. In addition, their learning environment provides opportunities for students to explore and understand what they are learning (Blaschke & Hase, 2015).

Vocational self-concept can be interpreted as personal views of themselves. Self-view can be interpreted as an assessment of self-assessment, self-evaluation, and self-characteristics, which can even include confidence in yourself. The purpose of forming a self-concept is so that an individual has a self-identity and knows himself. The formation of a vocational self-concept does not only apply to students or vocational school graduates, but also to the general public who have long graduated from school or those who have not yet found a job. It raises an understanding of the state of oneself and self-experience associated with awareness of the world of work which will form the individual's vocational self-concept (Ingarianti & Purwaningrum, 2018). The research support for vocational self-concept is the effect of career exploration intervention (CEI) on career maturity and self-concept in high school students in Malaysia (Lau et al., 2021). In other studies, self-concept will increase when there is an increase in social skills training as an increase in adolescent self-concept in Kibera (Okore et al., 2021).

In the development of the Industrial Revolution 4.0 and society 5.0, the role of self-concept with a heutagogy approach in advanced adult education to build vocational self-concepts so that they can be independent in learning, prepare work skills and utilize technology as lifelong learning and make an individual a digital transformation society. The Industrial Revolution 4.0 provides creative and systematic space for production processes and super-fast, accurate, effective, and efficient services. Meanwhile, society 5.0 can be described as a community life that lives a healthy life free from pollution of the physical and social environment, advanced, prosperous, happy, safe, peaceful, harmonious, and social justice for all with the support of industrial 4.0 technology and adequate science (Sudira, 2019).

Meanwhile, implementing industry 4.0 in education requires high readiness (Jamaludin et al., 2020). Society 5.0 balances Industry 4.0, where responsible economic development and solving individual social problems and changes in the social environment (Potočan et al., 2021). Similarly, the support of other research on discoveries demands socio-economic fusion to prepare a system (knowledge-based economy) as the basis and construction of social bridges (Konno & Schillaci, 2021).

Meanwhile, society 5.0 in the era of society 5.0 must go through the level of merging between virtual and physical worlds to balance economic progress and solve social problems by providing goods and services (Deguchi et al., 2020). Likewise, the benefits of society 5.0 deepen individual relationships, and technology encourages improvement in the quality of life and as a guide for development at the community level in terms of quality of life and sustainability (Ferreira & Serpa, 2018). As for the State of Japan, society 5.0 will seek to create a sustainable society for human

security and well-being through a cyber-physical system or as a collaborative ecosystem activity (Shiroishi et al., 2018). It is the same in Indonesia that Society 5.0 plays a role in increasing the competence of human resources.

RESEARCH METHOD

The preparation of this article used a literature review approach and a collaborative virtual learning system. This article is a type of research that used a descriptive, collaborative, multidisciplinary quality approach, a mindset, and a foresight approach. The object of research was the author herself. The purpose of this research collection is to describe in quality to the author herself the concept of individual vocational self-concept with a heutagogy approach. This approach helps individuals to reskill or up-skilling their abilities. This article used a collection of literature reviews from ScienceDirect sites (https://www.sciencedirect.com/), emerald (https://www.emerald.com/insight/), and Google Scholar. The keywords used in this article are heutagogy, further adult education, vocational self-concept, Industrial Revolution 4.0, and Society 5.0.

RESULT AND DISCUSSION

Result

The results of the role of the heutagogy approach in further vocational adult education. One example is the determination with the heutagogy approach, i.e., the virtual collaborative learning model (virtual collaboration learning). The virtual collaboration learning model is a collaboration model to increase collaboration competence and improve social culture (Hasler, 2011). It describes collaborating in the interests of either project, solving problems, learning, or virtual job training.

The skills that support the virtual collaborative learning model include collaboration skills, digital learning skills (Bower, 2017), sustainable professional skills (Cervai et al., 2013), interdisciplinary collaboration skills (Matias & Aguilar-González, 2017), technological skills, problem-solving skills, verbal and virtual communication skills, personal and interpersonal skills (employability skills) (Mitchell & Watstein, 2007), organizational skills (leadership) (Shah, 2016). In this case, aspects of vocational learning in the form of collaborative learning support the heutagogy approach in the implementation.

Lisa Marie Blaschke from Oldenburg University and University of Maryland University College (UMUC) explains that the concepts in heutagogy are double-loop learning and self-reflection (Hase & Kenyon, 2000). Double-loop learning occurs when the individual/student "questions and tests personal values (student reflections on improving learning how to learn" (Hase & Kenyon, 2000). Eberle and Childress (2009) explain that double-loop learning is when students consider the problem, action, and the resulting outcome. The following is Figure 2 about the role of heutagogy in advanced adult education in rebuilding individual vocational self-concepts in the design of single-loop learning and double-loop learning.
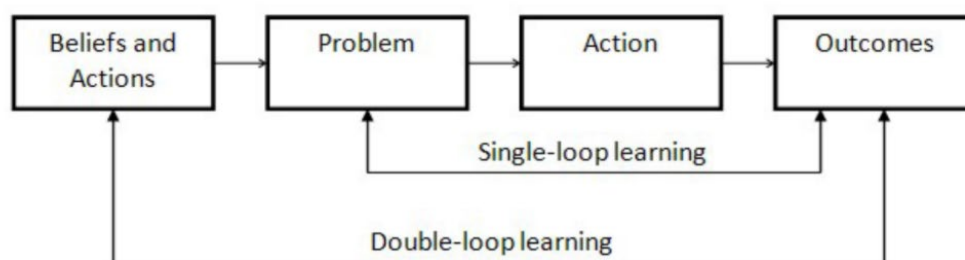

Figure 2. Double-Loop Learning Process

Based on Figure 2 about the double-loop learning process, the process greatly influences beliefs, actions, and problem-solving. One form of implementation is the role of heutagogy in adult vocational education. Therefore, it is necessary to design/principle of heutagogy for further adult education. Based on Figure 2, the key to heutagogy, namely double loop training, assumes that there is a role for heutagogy in adult vocational education to rebuild vocational self-concept in individuals in further adult education. Besides that, Figure 2 explains how the role of the heutagogy approach affects the individual's vocational self-concept, which explains physical and individual development, observations made by individuals on the field and work models, understanding of the work of adults, and general environmental influences and experiences in the workplace to get individuals through double-loop learning.

Implementation as a form of vocational self-concept through a heutagogy approach has a learning experience, one of which is the application of mobile heutagogy. The following is the design of the mobile heutagogy framework as a personalization dimension. Examples of serendipity results as heutagogy can be seen in Figure 4. The results of the role of heutagogy in further adult education as a rebuilding of the vocational self-concept are presented in Figure 5.
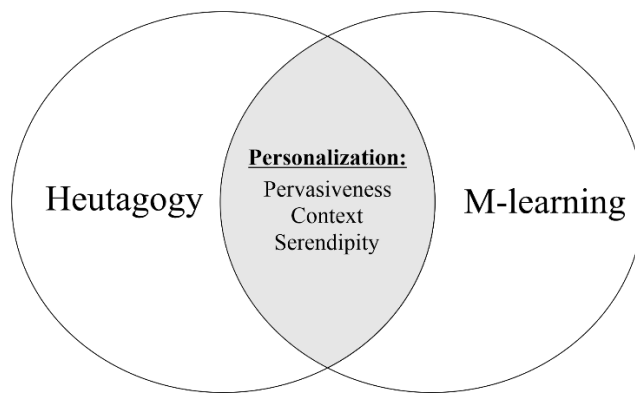

Figure 3. Mobile Heutagogy Framework Design as a Personalization Dimension
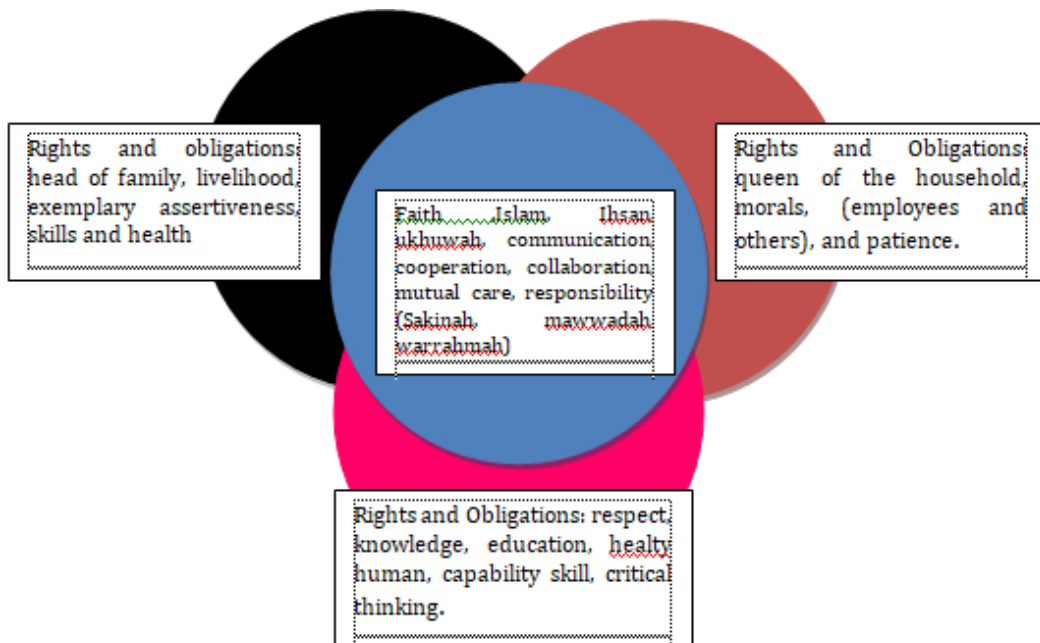

Figure 4. Family Life Shaping

Table 1. Results of the Literature Review of related research in the period 2015-2019

No.	Title	Journal	Author (Year)	Review
1	Transforming urban water governance through social (triple-loop) learning	Environmental Policy and Governance	Johannessen et al. (2019)	There is a need to design a more proactive governance structure for triple-loop learning that takes into account the barriers and supporting principles.
2	A systemic approach to processes of power in learning organizations: part1-literature, theory, and methodology of triple-loop learning	The Learning Organization	Flood and Romm (2018)	This power is in being responsible for making decisions and connecting the realities of existing life.
3	Using Triple loop learning to identify adaptive behavior of resilient supply Chain	Transpot Economic and Logistics	Świerczek (2018)	The triple loop provides the benefit of being able to present the basic components of an organization
4	Conceptualizing the lessons learned process in project management: towards a triple loop learning framework	International Journal of Project Manajement	McClory et al. (2017)	This research will enable future development of processes to leverage lessons learned around the world as well as project life cycles and organizations.
5	Managing Diversity Trough Triple Loop Learning: a Call for a paradigm shift	Human Resource Development	Kwon and Nicolaides (2017)	Triple loop benefits result in transformations in individual and organizational capacities for curiosity, compassion, and courage, which transcend the cognitive dimensions of double-loop learning.
6	Abstracting Technology-Enhanced Learning Design Principles	Design of Technology Enhanced Learning	Bower (2017)	Web 2.0-based learning produces different user procedures, including social networks, mobile learning, and the virtual world.
7	Measuring Supply Chain Knowledge Management performance based on double/ triple loop learning principle	International Journal of Productivity and Performance Management	Ramish and Aslam (2016)	Triple loop learning is concerned with the reflective and integrative aspects of learning and considering the goals of the organization concerning the vision and goals of the organization as a whole
8	The blind leading the blind Imprmptu leaderships are influenced by awareness in collaborative search	Aslib Journal of information management	Shah (2016)	Investigate aspects of collaboration by in a leadership style with organizational skills
9	Higher educational institutes as learning organizations for employer branding	Industrial and Commercial Training	Lenka and Chawla (2015)	Reflecting the conceptual framework of learning organizations, integrating variables at the individual, organizational, and team levels through communication skills and learning skills.

Table 2. Results of the Literature Review of related research in the period 2002-2014

| No.	Title	Journal	Author (Year)	Review
1	Towards a theoretical mobile heutagogy framework	Proceedings of ASCILITE 2014 - Annual Conference of the Australian Society for Computers in Tertiary Education	Narayan and Herrington (2014)	Heutagogy is a new learning and teaching framework. This heutagogy advocates student learning and teaching strategies where learning is directed and determined by the learner. Besides that, students and learning make use of technology, time, and geographical continuum as well as possible, the dimensions of personalization include pervasiveness context, and serendipity.
2	Assessing the quality of the learning outcome in vocational education: The Expero model	Journal of Workplace Learning	Cervai et al. (2013)	Evaluating the quality of learning outcomes in vocational education and training using continuous professional skills.
3	Preparing students to collaborate in the virtual work world	Higher Education, Skill, and Work-based Learning	Long and Meglich (2013)	Builders of virtual collaboration skills to prepare students in a virtual work environment.
4	Heutagogy and lifelong learning: A review of Heutagogical practice and self-determined learning	International Review of Research in Open and Distance Learning	Blaschke and Hase (2015)	Heutagogy is a form of self-determined learning with principles rooted in andragogy. The heutagogy approach to the pursuit and learning of students is very autonomous and self-determined to produce students who are ready for the workplace.
5	Intercultural collaborative learning in virtual worlds	Cutting-Edge Technologies in Higher Education	Hasler (2011)	The importance of intercultural collaborative learning as a basis for exploring cross-cultural differences and learning work skills in the form of cross-cultural competencies.
6	Developing generic competencies in online virtual education programs at the University of Deusto	Campus-wide information systems	Gvaramadze (2011)	How to equip graduates with generic competencies that are appropriate for the world of work and citizenship through learning.
7	The places where students and scholars work, collaborate, share and plan	Reference services review	Mitchell and Watstein (2007)	Technological skills are problem-solving skills where there are verbal or virtual communication skills, personal and interpersonal skills as an important role in the learning environment and means of work.
8	Double Loop Learning: A concept and Process for Leadership Educator	Journal of Leadership Educator	Cartwright (2002)	Double-loop learning is an educational concept and process that involves teaching people to think more deeply about their assumptions and beliefs.
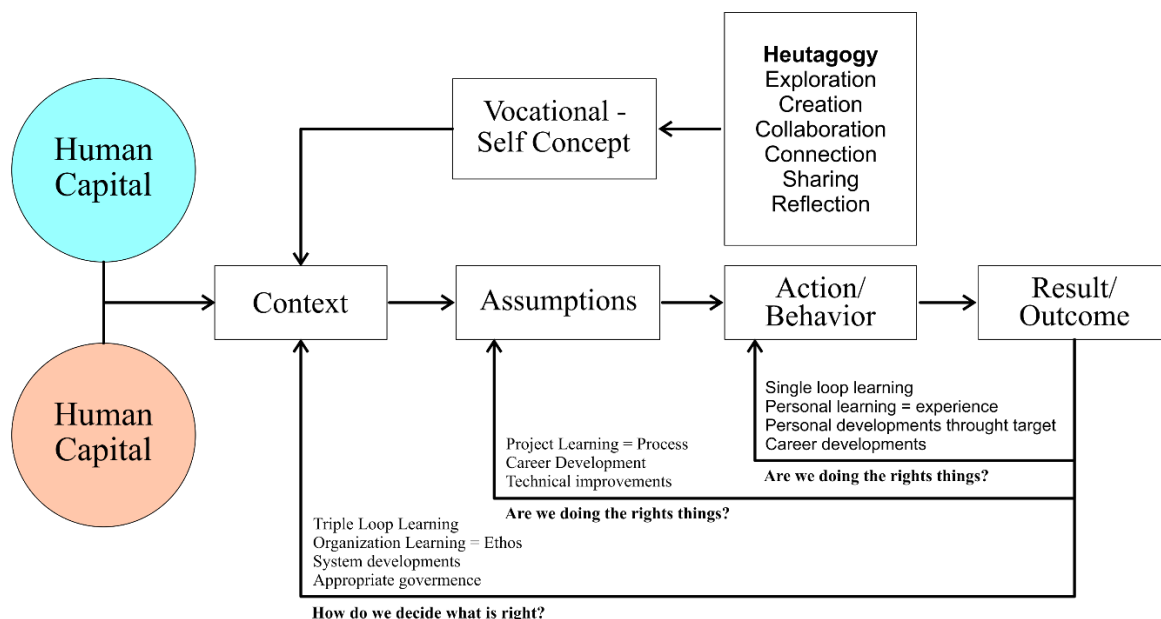
Figure 5. Single-Double and Triple-loop learning (Thorsten's Wiki) on Vocational Self-Concept in Advanced Adult Education

Discussion

The importance of self-concept in vocational learning with a heutagogy approach to produce superior human resources. In the heutagogy approach, self-concept is the determination of the direction of one's future. Anticipatory to meet self-needs and proactive to change (Sudira, 2017). Based on the principle of the heutagogy approach to self-concept produces findings, including the role of heutagogy in advanced adult education in rebuilding vocational self-concept in the design of Figure 2 with the support of research on vocational double-round learning (Hase & Kenyon, 2000). This quote results in the finding of a collaboration between the heutagogy approach to the vocational self-concept. Another finding is a serendipity of vocational self-concept in the heutagogy approach with the theme of family life-shaping.

The importance of serendipity as an unintentional discovery significantly impacts science learning, affecting the mindset and scientific reasoning (Amsad, 2019). The theory of self-concept, heutagogy, and dimensions of personalization support these findings. The vocational self-concept theory, according to Super and Forrest (1972), argues that self-concept is a self-image concerning the work to be carried out and the position he holds (vocational self-concept), which is part of the overall picture of oneself. Super and Forrest (1972) states that self-concept theory is an implication of an individual's self-concept on the career selection process or vocational self-concept. There is four formations of vocational self-concept, according to Super and Forrest (1972), including: (1) Physical and mental development; (2) Observations made on various fields and work models; (3) Understanding the work of adults; (4) Environmental influences in general.

Physical and Mental Development

The existence of physical and mental growth and development with the formation of attitudes and behavioral mechanisms then becomes important in self-concept. This is supported by research that self-concept is a person's description of himself, both physically and psychologically (social, emotional, moral, and cognitive) (Reski, 2018). Besides, physical and mental growth and development with a heutagogy approach can foster mental health and maturity.

Observations Made on Various Fields and Work Models

In this process, there is a prevocational or job introduction from an individual to his self-concept. This starts when the individual realizes that work is an aspect of human life.

Understanding the Work of Adults

In this phase, an individual begins to try a job as an experience. If the individual gets a positive experience from a job, the individual includes the choice of the job as an aspect of his self-concept for job decisions. This is the best opportunity to get job satisfaction. This is suitable in the establishment stage as a stage of individual development.

Environmental Influences in General

The existence of environmental influences causes the individual's self-concept to be able to play roles and fantasize about life. At the same time, the theory of heutagogy is that the teaching and learning of students are very autonomous and self-determined (Blaschke, 2012). Another theory about the personalization dimension in overlapping heutagogy and m-learning relates to learners with learning anywhere and equates technology, time, and geographic continuums (Narayan & Herrington, 2014).

Based on the theory and findings, there is a form of a concept of the important role of heutagogy in advanced adult education in rebuilding vocational self-concepts with superior human capital and social capital where having a vocational self-concept with a heutagogy approach can rebuild vocational self-concept through skills owned in the future.

In the era of industry 4.0 and society 5.0, the vocational self-concept can develop into the future with a heutagogy approach and future skills that apply in the 21st century, such as making mature decisions. This is supported by research on an individual having a positive self-concept, so he will think maturely in making decisions (Wutsqo et al., 2020). This is evidenced by using the triple-loop learning approach as organizational learning, one of which can make organizational decisions. Triple-loop learning is composed of single-loop learning and double-loop learning, but it starts from a context and then continues with assumptions, actions, and outcomes. There is a self-concept influencing factor during the process with a heutagogy approach.

The vocational self-concept also plays a role in world education, helping to give a picture of the future when an individual knows his/her self-concept. The vocational self-concept also plays a role in world education, helping to give a picture of the future when an individual knows his/her self-concept.

Education for Occupation

Education prepares an individual to be ready to enter the world of work (Billett, 2011). Education for work is closely related to vocational education and self-concept. This means that when someone knows about their self-concept through vocational education with a hautagogy approach, they can prepare for future occupation skills.

Education for career development

Career development is closely related to individual development and education for work, meaning that career development in education affects one's work performance in the nearest or future (Pangestuti, 2019).

Education for professional development

Education for professional development plays a role in improving the quality of adult education and is very important in improving the quality of educational services, encouraging innovation, and facilitating change. Professional development should promote active learning and promote meaningful change to data-driven job vacancies and assess changes in participants' knowledge, skills, and practices.

CONCLUSION

Single–double and triple-loop learning (Thorsten's Wiki) on vocational self-concept in further adult education is learning with a heutagogy approach starting from what we do right, whether we do something right and how we decide what is right. The starting point of the heutagogy approach

is the student, where students carry out self-determined learning. The approach used in this learning uses virtual collaboration learning in the world of advanced adult education and training. Meanwhile, based on the purpose of the role of the heutagogy approach in nation-building in the industrial revolution 4.0 and society 5.0. The main capital of human capital and social capital is through a context that is collaborated by elements of design heutagogy and then assumed through belief and action, action, and getting the outcome of the vocational self-concept. This is processed with a foresight approach to producing a correct decision. The purpose of the single-double and triple-loop learning process is to make the right decision. Personalization which consists of pervasiveness, context, and serendipity as a slice of the heutagogy and m-learning approach in industry 4.0 and society 5.0 with a virtual collaboration approach and cross-culture competence, can bring benefits between preparing future work skills through education and training, human resources competent, advanced adult education and development of a nation both in terms of economy, culture, and social.

REFERENCES

Amsad, L. N. (2019). Tinjauan penalaran ilmiah pada penemuan-penemuan sains yang tak disengaja (serendipity). *Jurnal Filsafat Indonesia*, *2*(1), 12–19. https://doi.org/10.23887/jfi.v2i1.17546

Billett, S. (2011). *Vocational education: Purposes, traditions and prospects*. Springer Science & Business Media.

Blaschke, L. M. (2012). Heutagogy and lifelong learning: A review of heutagogical practice and self-determined learning. *The International Review of Research in Open and Distributed Learning*, *13*(1), 56–71. https://doi.org/10.19173/irrodl.v13i1.1076

Blaschke, L. M., & Hase, S. (2015). Heutagogy, technology, and lifelong learning for professional and part-time learners. In A. Dailey-Hebert & K. S. Dennis (Eds.), *Transformative Perspectives and Processes in Higher Education* (pp. 75–94). Springer International Publishing. https://doi.org/10.1007/978-3-319-09247-8_5

Blaschke, L. M., & Hase, S. (2016). Heutagogy: A holistic framework for creating twenty-first-century self-determined learners. In B. Gros, K. Kinshuk, & M. Maina (Eds.), *The Future of Ubiquitous Learning* (pp. 25–40). Springer. https://doi.org/10.1007/978-3662-47724-3_2

Bower, M. (2017). Abstracting technology-enhanced learning design principles. In M. Bower (Ed.), *Design of Technology-Enhanced Learning* (pp. 365–403). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78714-182-720171013

Cartwright, S. (2002). Double-loop learning. *Journal of Leadership Education*, *1*(1), 68–71. https://doi.org/10.12806/V1/I1/TF1

Cervai, S., Cian, L., Berlanga, A., Borelli, M., & Kekäle, T. (2013). Assessing the quality of the learning outcome in vocational education: the Expero model. *Journal of Workplace Learning*, *25*(3), 198–210. https://doi.org/10.1108/13665621311306565

Deguchi, A., Hirai, C., Matsuoka, H., Nakano, T., Oshima, K., Tai, M., & Tani, S. (2020). What is society 5.0? In *Society 5.0: A People-centric Super-smart Society* (pp. 1–23). Springer Singapore. https://doi.org/10.1007/978-981-15-2989-4_1

Dick, B. (2013). Crafting learner-centred processes using action research and action learning. In S. Hase & C. Kenyon (Eds.), *Self-Determined Learning: Heutagogy in Action* (pp. 39–54). A&C Black.

Eberle, J., & Childress, M. (2009). Using heutagogy to address the needs of online learners. In P. L. Rogers, G. A. Berg, J. V. Boettcher, C. Howard, L. Justice, & K. D. Schenk (Eds.), *Encyclopedia of Distance Learning* (2nd ed., pp. 1945–1951). Information Science Reference. https://doi.org/10.4018/978-1-60566-198-8

Ferreira, C. M., & Serpa, S. (2018). Society 5.0 and social development: Contributions to a discussion. *Management and Organizational Studies*, *5*(4), 26–31. https://doi.org/10.5430/mos.v5n4p26

Flood, R. L., & Romm, N. R. A. (2018). A systemic approach to processes of power in learning organizations. *The Learning Organization*, *25*(4), 260–272. https://doi.org/10.1108/TLO-10-2017-0101

Gvaramadze, I. (2011). Developing generic competences in online virtual education programmes at the University of Deusto. *Campus-Wide Information Systems*, *29*(1), 4–20. https://doi.org/10.1108/10650741211192028

Hase, S., & Kenyon, C. (2000). *From andragogy to heutagogy*. UltiBASE. https://webarchive.nla.gov.au/awa/20010220130000/http://ultibase.rmit.edu.au/Articles/dec00/hase2.htm

Hasler, B. S. (2011). Intercultural collaborative learning in virtual worlds. In R. Hinrichs & C. Wankel (Eds.), *Transforming Virtual World Learning* (pp. 265–304). Emerald Group Publishing Limited. https://doi.org/10.1108/S2044-968(2011)0000004015

Ingarianti, T. M., & Purwaningrum, R. (2018). *Teori dan praktik konseling karier integratif* (N. F. Atif (ed.)). Refika Aditama.

Jamaludin, R., McKay, E., & Ledger, S. (2020). Are we ready for Education 4.0 within ASEAN higher education institutions? Thriving for knowledge, industry and humanity in a dynamic higher education ecosystem? *Journal of Applied Research in Higher Education*, *12*(5), 1161–1173. https://doi.org/10.1108/JARHE-06-2019-0144

Johannessen, Å., Gerger Swartling, Å., Wamsler, C., Andersson, K., Arran, J. T., Hernández Vivas, D. I., & Stenström, T. A. (2019). Transforming urban water governance through social (triple-loop) learning. *Environmental Policy and Governance*, *29*(2), 144–154. https://doi.org/10.1002/eet.1843

Jones, C., Penaluna, K., & Penaluna, A. (2019). The promise of andragogy, heutagogy and academagogy to enterprise and entrepreneurship education pedagogy. *Education + Training*, *61*(9), 1170–1186. https://doi.org/10.1108/ET-10-2018-0211

Konno, N., & Schillaci, C. E. (2021). Intellectual capital in Society 5.0 by the lens of the knowledge creation theory. *Journal of Intellectual Capital*, *22*(3), 478–505. https://doi.org/10.1108/JIC-02-2020-0060

Kwon, C., & Nicolaides, A. (2017). Managing diversity through triple-loop learning. *Human Resource Development Review*, *16*(1), 85–99. https://doi.org/10.1177/1534484317690053

Lau, P. L., Chung, Y. B., & Wang, L. (2021). Effects of a career exploration intervention on students' career maturity and self-concept. *Journal of Career Development*, *48*(4), 311–324. https://doi.org/10.1177/0894845319853385

Lenka, U., & Chawla, S. (2015). Higher educational institutes as learning organizations for employer branding. *Industrial and Commercial Training*, *47*(5), 265–276. https://doi.org/10.1108/ICT-01-2015-0001

Long, L. K., & Meglich, P. A. (2013). Preparing students to collaborate in the virtual work world. *Higher Education, Skills and Work-Based Learning*, *3*(1), 6–16. https://doi.org/10.1108/20423891311294948

Matias, A., & Aguilar-González, A. (2017). What do geology and it have in common? The case of an international collaboration through experiential learning. In A. Lee & R. D. Williams (Eds.), *Engaging Dissonance: Developing Mindful Global Citizenship in Higher Education* (pp. 107–127). Emerald Publishing Limited. https://doi.org/10.1108/S2055-3641270000009006

McClory, S., Read, M., & Labib, A. (2017). Conceptualising the lessons-learned process in project management: Towards a triple-loop learning framework. *International Journal of Project Management*, *35*(7), 1322–1335. https://doi.org/10.1016/j.ijproman.2017.05.006

Mitchell, E., & Watstein, S. B. (2007). The places where students and scholars work, collaborate, share and plan: endless possibilities for us! *Reference Services Review*, *35*(4), 521–524. https://doi.org/10.1108/00907320710838345

Narayan, V., & Herrington, J. (2014). Towards a theoretical mobile heutagogy framework. *Proceedings ASCILITE 2014 - Rhetoric and Reality*, 150–160. https://ascilite.org/conferences/dunedin2014/files/fullpapers/138-Narayan.pdf

Okore, C., Asatsa, S., & Ntarangwe, M. (2021). The effect of social skills training on self concept of teenage mothers at St. Charles Lwanga Vocational Training College in Kibera Nairobi-County, Kenya. *International Journal of Social Sciences and Economic Review*, *3*(1), 1–9. https://doi.org/10.36923/ijsser.v3i2.102

Pangestuti, D. C. (2019). Analisis pengalaman kerja, kompetensi, pendidikan dan pelatihan terhadap pengembangan karir dengan intervening prestasi kerja. *Jurnal Riset Manajemen Dan Bisnis (JRMB) Fakultas Ekonomi UNIAT*, *4*(1), 57–68. https://www.researchgate.net/profile/Dewi-Pangestuti-2/publication/335105947_ANALISIS_PENGALAMAN_KERJA_KOMPETENSI_PENDIDIKAN_DAN_PELATIHAN_TERHADAP_PENGEMBANGAN_KARIR_DENGAN_INTERVENING_PRESTASI_KERJA/links/5ef6aff9a6fdcc4ca4339d2e/ANALISIS-PENGALAMAN-KER

Parslow, G. R. (2010). Commentary: Heutagogy, the practice of self-learning. *Biochemistry and Molecular Biology Education*, *38*(2), 121–121. https://doi.org/10.1002/bmb.20394

Potočan, V., Mulej, M., & Nedelko, Z. (2021). Society 5.0: balancing of Industry 4.0, economic advancement and social problems. *Kybernetes*, *50*(3), 794–811. https://doi.org/10.1108/K-12-2019-0858

Ramish, A., & Aslam, H. (2016). Measuring supply chain knowledge management (SCKM) performance based on double/triple loop learning principle. *International Journal of Productivity and Performance Management*, *65*(5), 704–722. https://doi.org/10.1108/IJPPM-01-2015-0003

Reski, Y. Y. I. (2018). The correlational study between students interest and the students reading comprehension. *IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature*, *6*(1). https://doi.org/10.24256/ideas.v6i1.17

Rosenberg, M. (1989). Self-concept research: A historical overview. *Social Forces*, *68*(1), 34–44. https://doi.org/10.1093/sf/68.1.34

Sha, X., & Taylor, B. (2019). Problems of human capital development when employing migrant workers. *Journal of Chinese Human Resource Management*, *10*(1/2), 35–48. https://doi.org/10.1108/JCHRM-07-2017-0016

Shah, C. (2016). The blind leading the blind. *Aslib Journal of Information Management*, *68*(2), 212–226. https://doi.org/10.1108/AJIM-08-2015-0125

Shiroishi, Y., Uchiyama, K., & Suzuki, N. (2018). Society 5.0: For human security and well-being. *Computer*, *51*(7), 91–95. https://doi.org/10.1109/MC.2018.3011041

Sudira, P. (2017). *TVET Abad XXI: Filosofi, teori, konsep, dan strategi pembelajaran vokasional* (Hartono (ed.); 2nd ed.). UNY Press. http://staffnew.uny.ac.id/upload/131655274/penelitian/DOC C 3 Buku Referensi TVET ABAD 21 Filosofi, Teori, Konsep, dan Strategi Pembelajaran Vokasional.pdf

Sudira, P. (2019). *Pendekatan pembelajaran vokasional dalam revolusi industry 4.0 dan society 5.0 diantara pedagogy, andragogy dan heutagogy*. UNY Press.

Sumarsono, S. (2019). The paradigms of heutagogy and cybergogy in the transdisciplinary perspective. *Jurnal Pendidikan Dan Pengajaran*, *52*(3), 172–182. https://doi.org/10.23887/jpp.v52i3.22882

Super, D. E., & Forrest, D. J. (1972). *Career development inventory, form I: Preliminary manual*. Teachers College, Columbia University.

Świerczek, A. (2018). Using triple-loop learning to identify adaptive behaviour of resilient supply chain. *Transport Economics and Logistics*, *78*, 7–17. https://doi.org/10.26881/etil.2018.78.01

Triyono, M. B., Trianingsih, L., & Nurhadi, D. (2018). Students' employability skills for construction drawing engineering in Indonesia. *World Transactions on Engineering and Technology Education*, *16*(1), 29–35. http://www.wiete.com.au/journals/WTE&TE/Pages/Vol.16, No.1 (2018)/05-Nurhadi-D.pdf

Wutsqo, B. U., Rizky, D. M., & Hidayat, D. R. (2020). Hubungan konsep diri dengan kematangan vokasional pada siswa SMK. *Jurnal Ilmiah Bimbingan Konseling Undiksha*, *11*(1), 54–60. https://doi.org/10.23887/jibk.v10i2