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Edupreneurship implementation through teaching factory on mechanical engineering competence

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ABSTRACT

This study aims to (1) Describe how the edupreneurship implementation through Teaching Factory (TEFA) on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo; (2) Describe the factors supporting the successful implementation of edupreneurship through teaching factory on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo; and (3) Describes the contribution of the edupreneurship implementation through the teaching factory in fostering an entrepreneurial spirit in mechanical engineering students at SMK Muhammadiyah 1 Sukoharjo. This qualitative research used a descriptive approach. The data were collected by interview, observation, and documentation. The informants comprised principals, vice-principals of curriculum, heads of engineering expertise programs, productive teachers, and students. The data analysis technique employed interactive analysis techniques, starting from data collection and then the data were reduced; after being reduced, the data were presented, and the last was verification. The data validity was then tested by triangulation of sources. The findings in this study revealed that (1) In terms of planning, organizing, implementing, and monitoring/evaluating, the edupreneurship implementation through teaching factory on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo has been going very well by producing medical device products, especially patient beds that were produced and have been marketed to PKU Muhammadiyah Hospital in Central Java; (2) The factors driving the success of edupreneurship through technology factory comprised: quality educator resources, adequate infrastructure both in quantity and quality, standard operating procedures according to industry standards, quality products, and a well-established product marketing network; and (3) The edupreneurship implementation through the teaching factory contributes to fostering an entrepreneurial spirit by directly involving students in planning, production, and marketing.

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INTRODUCTION

Edupreneurship is an entrepreneurial activity in education to become a creative, innovative, and excellent school and can earn income from the activities carried out (Mulyatiningsih et al., 2014). Edupreneurship activities support the success of educational institutions to be excellent (Kuat & Santosa, 2020). An educational institution is declared excellent if it can empower educators and students to become successful people and contribute to the success of their institutions. The success of vocational education institutions, specifically, is judged by how much their graduates can be absorbed in the world of work or entrepreneurship (Dariansyah & Djuhartono, 2017; Mulyatiningsih et al., 2014).

To become an excellent institution, vocational high school is expected to prepare students to have work competencies according to the demands of the industrial world or provide various knowledge and skills to become entrepreneurs (Hynes & Richardson, 2007). In addition, the concept of edupreneurship is emphasized in the efforts made by the school creatively and innovatively to gain school excellence in the form of achievement and increase income (Suhartini et al., 2022). School achievement may not immediately lead to material gains, but excellent schools have more opportunities to receive better rewards, assistance, and student input. With this achievement capital, the school will gradually become an excellent one. Excellence may also have a small financial impact, but it does pave the way for a more successful future. After becoming an excellent school, opportunities to find additional income will also be easier to obtain.

The principal drives edupreneurship as a leader and manager in the school. Principals who become edupreneurs can organize and manage a school institution with full initiative, always innovate, and dare to take risks. According to the Oxford Project (2012) there are at least five behaviors of principals to become edupreneur principals: (1) acting as agents of change, (2) leading selflessly, (3) bringing a new culture, which is expected with full confidence, (4) supporting risk-taking and continuous learning, and (5) willing to invest and utilize existing resources; even when resources are scarce, leaders are willing to invest (Oxford Project, 2012). Further, teaching factory learning is the right thing for students to have competencies in the world and industry. Teaching factory learning brings learning closer to the actual situation regarding the curriculum, how it works, work culture, and work discipline, providing competencies as demanded by the world of industry and work (Li et al., 2019).

Edupreneurship through teaching factories is implemented using students carrying out learning activities similar or almost similar to those carried out in the business and industrial world (Kuat, 2018). A teaching factory is a learning concept in an actual situation to bridge the competency gap between the knowledge provided by the school and the needs of the industry. Hasbullah (2010) stated that the teaching factory is a learning approach based on the production process and learning in the world of work. Learning through the teaching factory aims to develop the characters and work ethics (discipline, responsibility, honesty, cooperation, leadership, and others) needed by the business world and industry and to improve the quality of learning outcomes by simply equipping competence (competency-based training) becoming learning that equips the ability to produce goods/services (production-based training) (Kuat, 2017).

However, teaching factory learning in vocational high schools still needs to follow the actual learning demands, so graduates are not accepted in the industrial world and the world of work. The phenomenon revealed that vocational high school graduates still need to gain high competence, so their competence still needs to be recognized by the business world and the industrial world (Hartanto et al., 2019; Torun & Tumen, 2019). This follows the results of Yunanto's (2017) research that implementing the teaching factory in the boutique fashion design skill program at SMKN 2 Gedangsari, Gunung Kidul could have gone better. The activities carried out have yet to be able to run optimally in a sustainable manner. In addition, the involvement of productive teachers and students needs to be maximized in teaching factory learning. As a result, the seven parameters of teaching factory management, workshop and laboratory management, training learning, communication media, products and services, teaching factory resources, and industrial relations have yet to be maximally achieved (Yunanto, 2017).

In this case, the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo has carried out teaching factory activities since receiving block grand teaching factory assistance from the government. At first, it could not develop because it was still doing early activities and experimenting. However, since becoming a center of excellence school, it has later become a center of excellence for teaching factory activities that developed rapidly and in harmony with the construction of a technopark. Thus, teaching factory activities can use a large area of land accompanied by the fulfillment of increased machine facilities by buying CNC machines and welding cutting machines. Teaching factory activities are also developing, especially after producing medical devices like patient beds, waiting chairs, etc (Liu et al., 2019).

On the other hand, growing students' entrepreneurial spirit is vital so that vocational school graduates are not unemployed. In this case, the policies made by the Indonesian government are to improve the quality of human resources through education, instill an entrepreneurial spirit at every level of education, and seek to expand employment opportunities. In schools, efforts to develop an entrepreneurial spirit are carried out with edupreneurship activities such as business centers and teaching factories. The growth of an entrepreneurial spirit through a business center is carried out through business practice activities by students (Kuat, 2015).

Meanwhile, the psychological aspects that characterize individuals are said to have an entrepreneurial spirit and attitude, according to Suryana (2008) are:

> *(1) Confidence in determining something, confidence in doing things, and confidence that they can overcome various risks faced are the basic factors that entrepreneurs must own. Someone with an entrepreneurial spirit feels confident that whatever he does will succeed despite facing various obstacles. He is also not always haunted by the fear of failure, making himself optimistic about keeping going; (2) Initiative (energetic and confident): in dealing with the dynamics of life full of changes and problems, an entrepreneur will always try to find a way out. They do not want their lives to depend on the environment, so they will continue trying to find a way out; (3) Having achievement motive: various targets to achieve success in life are usually and always designed by an entrepreneur. One by one, their targets continue to be achieved. When faced with a failed condition, they will continue to try to improve the failure they experienced. Success after success achieved by someone with an entrepreneurial spirit makes it a trigger to continue to achieve success in his life. For them, the future is success and beauty to be accomplished in life; (4) Having a leadership spirit (dare to be different and take calculated risks): leadership is a key factor in becoming a successful entrepreneur; and (5) Liking a challenge: people may often read or witness several cases of a manager or executive resigning from a company to become an entrepreneur.*

Based on the background of the problems that have been described, the problem formulations in this research are (1) How is the edupreneurship implementation through the teaching factory on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo?; (2) What are the supporting factors for implementing edupreneurship through teaching factories on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo?; and (3) How is the contribution of the edupreneurship implementation through the teaching factory in fostering the entrepreneurial spirit of students in the mechanical engineering expertise program at SMK Muhammadiyah 1 Sukoharjo?.

RESEARCH METHOD

The type of research used in this research is qualitative research. Qualitative research is used to understand a phenomenon or an event in the field related to what is experienced by the research subject. Qualitative research is used to understand certain situations, events, roles, groups, or social interactions (Creswell, 2016). This qualitative research uses a descriptive approach to describe or analyze a research result but is not used to make broader conclusions. The research was conducted with the mechanical engineering expertise of SMK Muhammadiyah 1 Sukoharjo. The informants for this research comprised principals, vice-principals of curriculum, heads of engineering expertise programs, productive teachers, and students. Collecting data in this study utilized interviews,

observation, and documentation. The data analysis technique used interactive techniques, starting from data collection regarding teaching factory learning. Then, data were reduced; after being reduced, the data were presented, and the last was verification (Miles & Huberman, 1992). To test the data validity, triangulation was performed. This study employed triangulation of sources by comparing information through observation, interviews, and documentation. From the results of these studies, evidence would be obtained following the phenomenon under study.

RESULT AND DISCUSSION

The Edupreneurship Implementation Through Teaching Factory on the Mechanical Engineering Expertise Competence at SMK Muhammadiyah 1 Sukoharjo

The implementation of edupreneurship through teaching factory competence in mechanical engineering skills at SMK Muhammadiyah 1 Sukoharjo is seen from planning, organizing, implementing, and monitoring/evaluating.

Planning

The planning of the Teaching Factory (TEFA) workshop on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo aimed to prepare the implementation to run well. The initial planning was carried out from making the stipulation and the teaching factory program. Planning began with the selection of human resources, aimed to determine the minimum competence of teachers according to the needs of the mechanical expertise teaching factory program. The required competencies conducted the recruitment of teachers with a minimum undergraduate qualification from the Faculty of Teacher Training and Education, Department of Mechanical Engineering. To improve the performance and productivity of teachers, competence was increased by being sent to Educational and Training Institutions (Diklat) or internships in the industry. According to Ismail et al. (2018), teachers need creativity and flexibility to create functional conditions for students during the learning process and create educational experiences which enable the development of creativity among their students.

Product planning also aimed to ensure that the product met the quality and market needs. The products included medical devices, such as patient beds, patient waiting chairs, patient dining tables, and first aid kits. Product planning was carried out on an ongoing basis to maintain product quality and good customer service. In this case, every product entry and exit was always recorded to make it easier for the teacher to check the product's condition. The data were used to determine what products were needed by consumers and improve quality following industry standards. Some of the proceeds from product sales were used to develop teaching factory facilities and infrastructure. Sudiyono (2020) states that program planning related to products/services to be generally produced still on the type of product based on orders, not yet on product innovation, the number of products to be produced, and product sustainability.

Furthermore, marketing planning at the TEFA workshop on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo used the marketing concept of STP (segmentation, targeting, positioning) with a marketing mix model of 7P (product, price, place, promotion, process, people, physical evidence). The marketing target segment is PKU Muhammadiyah Hospitals throughout Indonesia. In the initial stage, it is targeted to meet the needs of PKU Muhammadiyah hospitals in Central Java, Indonesia. In addition, aside from the use of social media as the main means of promotion, other forms of promotion also with affordable product prices, accompanied by product quality maintained and equipped with good service as the primary promotion.

Then, financial planning at the teaching factory workshop on mechanical engineering expertise competence aimed to protect the workshop finances from the impact of complex activities. Initial capital was used to develop capital (production). Finance came from assistance from the Ministry of Education and Culture of the Republic of Indonesia and capital from the school itself.

Organizing

The organization of the TEFA workshop on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo aimed to determine the division of personnel and each task and authority in carrying out their duties. The TEFA workshop has its management structure outside of the school management structure. The management structure helps facilitate the division of tasks in the organizational structure of the TEFA workshop. The division of tasks for the TEFA workshop unit at SMK Muhammadiyah 1 Sukoharjo were divided into responsible persons with the positions of director, stakeholder, implementation coordinator or chairman, head of the workshop of teaching factory production unit, secretary, treasurer, teachers, employees, and students. In the teaching factory at SMK Muhammadiyah 1 Sukoharjo, the person in charge also served as the director of TEFA.

In addition, the preparation of the organizational structure made detailed job descriptions, so there was no overlap and could coordinate well. This follows research conducted by Sanatang (2020), who states that the organization is carried out through establishing the TEFA organizational structure, job descriptions, and standard operating procedures for each department's activities. However, the implementation of each department's activities has not been well documented. The human resources involved in the organizational structure are all internal to the school. There is no participation from the relevant government

In organizing production, the production schedule was written after the teaching factory workshop received orders from consumers. It made it easier to determine work and anticipate a student work system that used a rolling system so that students were not burdened with learning hours. In addition, product sales data were used to determine the number of products sold and where the products were sold.

Implementing

The implementation of teaching factory learning on the mechanical engineering expertise competence involved students, i.e., students of class XI and XII, on the mechanical engineering expertise competence. The learning process with the teaching factory implementation on the mechanical engineering expertise competence began with planning the approach application of the teaching factory learning model, carried out by applying an industrial culture approach, setting up school practice laboratories adapted to conditions in the industry, and applying the block system learning hours.

The implementation of learning strategies and systems was prepared by adjusting the industry-based curriculum, selecting and implementing learning strategies appropriate to the learning conditions, and utilizing the production unit as a place and a good learning environment. In addition, the making of learning job sheets followed the needs of the industry. The management of practical learning facilities and infrastructure was also added by constructing a teaching factory building with equipment facilities following industry standards and separate from the school building. Management was also carried out by applying industrial environmental management standards, such as spatial planning, equipment, and waste management.

Moreover, implementing teaching factory learning at SMK Muhammadiyah 1 Sukoharjo began with an introduction to practical learning, starting from preparing to wear practical clothes and Personal Protective Equipment (PPE). Prior learning was done by opening, praying, checking student attendance by the teacher or instructor, and continuing with the division of work or practical jobs. Especially for class XI and XII, who had their turn rolling, they would practice in the production building of the TEFA workshop. Implementing the practice also began with an explanation and direction to the job, work safety, and the purpose of the practice carried out by the teacher or instructor. Implementation of the practice was following the job given and directed. Students learned to analyze, solve problems, and make reports or records of the work. The teacher or instructor also monitored and guided the practicum process.

Products in medical devices resulted from the practicum carried out in the TEFA workshop in the form of medical devices, especially patient beds, that have been produced and marketed to PKU Muhammadiyah hospitals in Central Java. Standard Operational Procedure (SOP) was used in carrying out all types of work. Related to this, students need to be trained for emergency conditions

and limited tools, which are expected to grow and develop their creativity (Efendi & Sudarwanto, 2018). Then, sales of service products were carried out by employees with the help of students as implementers. Proceeds from product sales were used as production funding, divided into operational costs, employee salaries, and school income funds. It confirms that the TEFA workshop became income for schools by the TEFA concept.

The implementation of teaching factory learning on the mechanical engineering expertise competence has been proven to involve students, namely students of class XI and XII, in the mechanical engineering expertise competence.

Monitoring and Evaluating

Supervision activities are needed to record the progress of the teaching factory, monitor the process and progress of implementing policies continuously, identify problems and deviations that arise, formulate problem-solving, and make progress reports regularly in a short period. Evaluation is an effort to assess something technically and economically for the possibility of implementing development. In the teaching factory implementation, evaluation means an assessment of the learning model that has been implemented to make continuous improvements. Through the evaluation process, the institution could consider the strengths and weaknesses of the elements influencing the teaching factory implementation at SMK Muhammadiyah 1 Sukoharjo and get an idea to improve the quality and quality to support the successful implementation of the teaching factory.

The research results in support by Putra (2022), stated that the research results showed that planning, organizing, implementing, and supervising were following the teaching factory concept on the motorcycle engineering and business expertise competence at SMK Ma'arif 1 Wates was carried out well but not optimal. In addition, in their study, 65% of students had been involved in organizing and implementing, while for planning, organizing, and evaluating, 100% were carried out by the management team of the teaching factory unit on the motorcycle engineering and business expertise competence at SMK Ma'arif 1 Wates.

Based on the data obtained, the implementation of edupreneurship through teaching factory competence in mechanical engineering skills at SMK Muhammadiyah 1 Sukoharjo, seen from planning, organizing, implementing, and monitoring/evaluating, has gone very well, by producing medical equipment products, especially patient beds that have been produced and marketed to the PKU Muhammadiyah Hospital in Central Java, Indonesia.

The Driving Factor for the Successful Implementation of Edupreneurship Through Teaching Factory on the Mechanical Engineering Expertise Competence at SMK Muhammadiyah 1 Sukoharjo

The successful implementation of edupreneurship was supported by several factors. First, human resources had high competence because the number of teachers in the mechanical expertise program was five, all of whom had undergraduate backgrounds. Improving teacher competence was also carried out by involving productive teachers in education and training activities held by the government. Thus, all teachers attended education and training. Another effort was to attend industrial internships; all five productive teachers had taken industrial internships. From these data, it can be concluded that human resources, especially productive teachers related to the teaching factory learning implementation, all had an undergraduate background and had attended education, training, and internships.

Second, the facilities and infrastructure owned were a four-story building with sufficient classrooms; there was air conditioning, Wi-Fi facilities, and LCD in each class. The teaching factory laboratory had facilities for CNC machines, lathes, cutting machines, welding tools, and painting tools. In addition, there was room for painting the product in the context of finishing the product. Third, work operational standards refer to work standards in the industry in terms of work culture, production work standards, and work safety standards under the guidance of experienced supervisors.

Fourth, the products produced in the teaching factory had high quality because each product had passed the quality test in collaboration with the university's engineering faculty laboratory. The product results were medical devices, including patient beds, patient waiting chairs, push tables for

patients eating, tools for placing infusions, first aid kits, and modifying ambulance cars. Fifth, the product marketing network had been well established by holding an MOU with PKU Muhammadiyah Hospitals in Central Java, so that the need for hospital beds could be met from the teaching factory of SMK Muhammadiyah 1 Sukoharjo. PKU hospitals that have purchased patient beds are PKU Sukoharjo, PKU Surakarta, PKU Gombong, PKU Karanganyar, PKU Tegal, and others. Meanwhile, modifying ambulance cars from the community was also quite a lot.

The driving factor for the successful implementation of edupreneurship through the teaching factory is supported by the Sanatang (2020) research results, revealing that: (1) the TEFA implementation in the TKJ expertise program at SMK Negeri 5 Makassar was going well because it applied management principles, i.e., planning, organizing, implementing, and controlling, supported by TEFA components: human resources, administration, and finance, equipment, curriculum, learning, products, and marketing; (2) The TEFA implementation in the TKJ expertise program at SMK Negeri 5 Makassar was also running due to supporting factors, including (a) principals who had an entrepreneurial spirit and enthusiasm to develop TEFA, (b) some TEFA managers and instructors (teachers and employees) had attended industry training, (c) adequate equipment facilities, (d) support from students who were always enthusiastic in the TEFA learning process, and (e) there was support from the business and the partner industry world, although the number of participating industries was still lacking.

Also in line with research conducted by Sudiyatno et al. (2013) which states that the supporting factors for implementing the teaching factory at SMK St. Mikael Surakarta are a good culture or culture, competent human resources in their field, and adequate equipment facilities. Also supported by the results of Muhitasari and Purnami (2022), the supporting factors in teaching factory learning are infrastructure facilities according to industry standards and competent teachers, and also in line with the results of Sari's et al. (2022) research, which states that the supporting factors include: competent teachers, supporting facilities and infrastructure, enthusiastic students, toolman, block system practicum schedule, and collaboration with Industrial World Business Internship Program (DUDI), the inhibiting factor is less than optimal time, marketing and a less strategic place. Casmudi et al. (2022) The supporting factors for the curriculum, teacher human resources, facilities and infrastructure, support from DUDI partners, and the management of TEFA products show good and very good categories; and (3) Obstacles and implementation solutions are identified and resolved through a consensus meeting at SMKN 4 Balikpapan.

The Edupreneurship Implementation Through the Teaching Factory Contributes to Fostering an Entrepreneurial Spirit

Teaching factory activities could increase the students' entrepreneurial spirit if the activities follow the learned competencies. At SMK Muhammadiyah 1 Sukoharjo, the edupreneurship implementation through teaching factory activities was carried out following competence in engineering expertise. In addition, the activities done will contribute more positively if they involve students, starting from planning and production to marketing processes.

The involvement of students in the planning, production, to marketing processes is also needed to provide students with direct experience in entrepreneurship. What was done at SMK Muhammmadiyah 1 Sukoharjo, students were involved since receiving orders, and then orders were analyzed between the supervising teacher and students. Then, it was drawn, and the students worked out the order from the base of the picture. The supervising teacher controlled the quality of the work, and to ensure the continuity of the product and to maintain quality in product testing, collaboration with universities was conducted.

After the product was finished, it was handed over to the customer. In marketing activities, students were also involved in printing product catalogs and advertising through existing social media. In other words, after getting an order, students design the product to be made, carry out production, and determine the price consumers must pay. In one activity, students could gain experience in planning, producing, marketing, and managing finances.

Based on the experience of successful schools in implementing teaching factories and contributing to the improvement of students' entrepreneurial spirit, the strategy that must be carried out is to involve students directly in the entire business process. It needs to be emphasized because,

in general, schools still involve students in teaching factory activities, limited to production activities. As a result, students need to learn whether the resulting product sells well, how much it costs, and how much profit it will make. It is supported by Siswanto (2011) research results, stating that teaching factories can improve students' entrepreneurial spirit by involving students directly in the entire business process from planning, production, and marketing. This is also in line with the results of Habiba et al. (2020) which states that the product of the teaching factory program provides positive results in creating an industrial culture that can increase productive competencies and foster students' entrepreneurial spirit, as well as produce products/services that have added value with absorbable quality and are accepted by society.

CONCLUSION

Judging from planning, organizing, implementing, and monitoring/evaluating, the edupreneurship implementation through teaching factory on the mechanical engineering expertise competence at SMK Muhammadiyah 1 Sukoharjo has gone very well by producing medical device products, especially patient beds that have been produced and marketed to PKU Muhammadiyah Hospitals in Central Java. Factors driving the success of edupreneurship through factory teaching include (1) quality educator resources, (2) adequate infrastructure, both in quantity and quality, (3) standard operating procedures work according to industry standards, (4) quality products, and (5) well-developed product marketing network. The edupreneurship implementation through the teaching factory fosters an entrepreneurial spirit by directly involving students in planning, production, and marketing.

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REFERENCES

Casmudi, C., Sugianto, S., & Maulida, D. T. (2022). Implementation of teaching factory vocational school of center of excellence (PK)(Case study of learning aspects of the culinary and clothing expertise program at SMK Negeri 4 Balikpapan). *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, *5*(2), 11033–11045. https://bircu-journal.com/index.php/birci/article/view/4921

Creswell, J. W. (2016). *Research design: Pendekatan kualitatif, kuantitatif, dan campuran* (R. K. Pancasari (trans.); 4th ed.). Pustaka Pelajar.

Dariansyah, D., & Djuhartono, T. (2017). *Evaluasi efektifitas bussines plan training untuk guru dalam rangka meningkatkan edupreunership di SMK Bisnis dan Teknologi Bekasi* (pp. 171–180). Mercu Buana. http://digilib.mercubuana.ac.id/manager/t!@file_artikel_abstrak/Isi_Artikel_815675957890.pdf

Efendi, Y., & Sudarwanto, S. (2018). Penguatan karakter mandiri, disiplin, kerjasama dan kreatif ("marikerja kreatif") melalui lesson study pada pembelajaran teknologi sepeda motor. *Jurnal Pendidikan Vokasi Otomotif*, *1*(1), 89–99. https://doi.org/10.21831/jpvo.v1i1.21786

Habiba, P. G. S., Sujanto, B., & Karnati, N. (2020). Evaluation of implementation of teaching factory programs in state vocational school, South Jakarta. *International Journal of Education and Research*, *8*(1), 157–164. https://www.ijern.com/journal/2020/January-2020/13.pdf

Hartanto, S., Ratnasari, S. L., & Arifin, Z. (2019). Work skills factor for mechanical engineering students of vocational high school. In N. H. Noh@Seth, N. M. Noor, M. Arsat, D. F. Ali, A. N. M. Nasir, N. H. A. Wahid, & Y. Kamin (Eds.), *TVET Towards Industrial Revolution 4.0* (pp. 70–79). Taylor & Francis. https://doi.org/10.18502/kss.v3i15.4349

Hasbullah, H. (2010). Implementasi pabrik pengajaran (teaching factory) untuk meningkatkan kompetensi siswa SMK. In *Konvensi Nasional V Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia 2010* (pp. 395–402). https://ejournal.undiksha.ac.id/index.php/APTEKINDO/article/view/78

Hynes, B., & Richardson, I. (2007). Entrepreneurship education. *Education + Training*, *49*(8/9), 732–744. https://doi.org/10.1108/00400910710834120

Ismail, M. E., Utami, P., Ismail, I. M., Khairudin, M., Amiruddin, M. H., Lastariwati, B., & Maneetien, N. (2018). The effect of an augmented reality teaching kit on visualization, cognitive load and teaching styles. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *24*(2), 178–184. https://doi.org/10.21831/jptk.v24i2.20031

Kuat, T. (2015). Penumbuhan jiwa kewirausahaan melalui praktik bisnis di business center (studi kasus: SMK Muhammadiyah 2 Surakarta). *Jurnal Pendidikan Ilmu Sosial*, *25*(1), 155–168. https://doi.org/10.2317/jpis.v25i1.827

Kuat, T. (2018). Implementation of edupreneurship through the teaching factory in vocational high school of hotel accommodation: Case study at SMK N 6 Yogyakarta. *Journal of Vocational Education Studies*, *1*(1), 7–12. https://doi.org/10.12928/joves.v1i1.590

Kuat, T. (2017). Penumbuhkan jiwa kewirausahaan melalui implementasi edupreneurship di sekolah menengah kejuruan. *Prosiding SNP (Seminar Nasional Pendidikan) Prodi Pendidikan Akuntansi FKIP Universitas Muhammadiyah Surakarta*, 130–143. https://publikasiilmiah.ums.ac.id/xmlui/bitstream/handle/11617/8881/11.1 Menumbuhkan Jiwa Wirausaha Melalui implementasi edupreneurship.pdf?sequence=1&isAllowed=y

Kuat, T., & Santosa, B. (2020). Edupreneurship through teaching factory in vocational school of hospitality expertise. *International Journal of Scientific & Technology Research*, *9*(4), 3115–3118. http://www.ijstrorg.wwwsg1-ss17.a2hosted.com/final-print/apr2020/Edupreneurship-Through-Teaching-Factory-In-Vocational-School-Of-Hospitality-Expertise.pdf

Li, F., Yang, J., Wang, J., Li, S., & Zheng, L. (2019). Integration of digitization trends in learning factories. *Procedia Manufacturing*, *31*, 343–348. https://doi.org/10.1016/j.promfg.2019.03.054

Liu, Y., Zhang, L., Yang, Y., Zhou, L., Ren, L., Wang, F., Liu, R., Pang, Z., & Deen, M. J. (2019). A novel cloud-based framework for the elderly healthcare services using digital twin. *IEEE Access*, *7*, 49088–49101. https://doi.org/10.1109/ACCESS.2019.2909828

Miles, M. B., & Huberman, A. M. (1992). *Analisis data kualitatif : Buku sumber tentang metode-metode baru* (T. Rohendi (trans.)). UI Press.

Muhitasari, R., & Purnami, A. S. (2022). Manajemen pembelajaran teaching factory dalam mewujudkan jiwa kewirausahaan pada siswa. *Media Manajemen Pendidikan*, *4*(2), 194–202. https://doi.org/10.30738/mmp.v4i2.8206

Mulyatiningsih, E., Sugiyono, S., & Purwanti, S. (2014). *Pengembangan edupreneurship sekolah kejuruan*. Fakultas Teknik Universitas Negeri Yogyakarta. http://staffnew.uny.ac.id/upload/131808329/pendidikan/edupreneurship.pdf

Oxford Project. (2012). *Leading through edupreneurship*. Oxford Community School.

Putra, N. M. (2022). Implementasi teaching factory kompetensi keahlian teknik dan bisnis sepeda motor di SMK Ma'arif 1 Wates. *Jurnal Pendidikan Vokasi Otomotif*, *4*(1), 57–68. https://doi.org/10.21831/jpvo.v4i1.46153

Sanatang, S. (2020). Implementasi teaching factory pada program keahlian teknik komputer dan jaringan SMK Negeri 5 Makassar Sulawesi Selatan. *Jurnal MediaTIK*, *3*(3), 19–24. https://doi.org/10.26858/jmtik.v3i3.15175

Sari, A. K., Giatman, M., & Ernawati, E. (2022). Manajemen pembelajaran teaching factory dalam meningkatkan kompetensi keahlian siswa jurusan tata kecantikan di sekolah menengah kejuruan. *JRTI (Jurnal Riset Tindakan Indonesia)*, *7*(2), 148–155. https://doi.org/10.29210/30031696000

Siswanto, I. (2011). Pelaksanaan teaching factory untuk meningkatkan kompetensi dan jiwa kewirausahaan siswa sekolah menengah kejuruan. *Prosiding Seminar Nasional Pendidikan Teknik Boga Dan Busana*, *6*(1), 1–13. https://journal.uny.ac.id/index.php/ptbb/article/view/30889

Sudiyatno, S., Sampurna, Y., & Siswanto, I. (2013). Pabrik pengajaran di SMK ST Mikael Surakarta. *Jurnal Taman Vokasi*, *1*(1). https://doi.org/10.30738/jtv.v1i1.134

Sudiyono, S. S. (2020). Teaching factory sebagai upaya peningkatan mutu lulusan di SMK. *Jurnal Penelitian Kebijakan Pendidikan*, *12*(2), 159–181. https://doi.org/10.24832/jpkp.v12i2.271

Suhartini, Y., Muchlas, M., & Kuat, T. (2022). Kompetensi kewirausahaan kepala sekolah dalam mengembangkan edupreneurship di sekolah menengah kejuruan. *Jurnal Pendidikan Dan Konseling (JPDK)*, *4*(5), 4833–4849. https://doi.org/10.31004/jpdk.v4i5.7395

Suryana, S. (2008). *Kewirausahaan pedoman praktis: Kiat dan proses menuju sukses*. Salemba Empat.

Torun, H., & Tumen, S. (2019). Do vocational high school graduates have better employment outcomes than general high school graduates? *International Journal of Manpower*, *40*(8), 1364–1388. https://doi.org/10.1108/IJM-11-2017-0314

Yunanto, D. (2017). Implementasi teaching factory di SMKN 2 Gedangsari Gunungkidul. *Vidya Karya*, *31*(1), 29–36. https://doi.org/10.20527/jvk.v31i1.3971

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Development of Integrated Project-based (PjBL-T) model to improve work readiness of vocational high school students

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ABSTRACT

The unemployed from vocational high schools (SMK) is still high. Several factors, including the low job readiness of vocational students and the small availability of jobs, cause the high unemployment rate for vocational schools. This study aims to develop a learning model of Integrated Project Based Learning (PjBL-T) and test the effectiveness of the PjBL-T model in preparing vocational students' job readiness. The design of this study adopted the Richey and Klein model stages. This research was carried out in three stages: model development, internal validation, and external validation. This study used research subjects consisting of 10 vocational teachers, ten industrial practitioners, and 54 Automotive Engineering SMK Muhammadiyah 2 Tempel students. The research objects used were SMK Muhammadiyah 2 Tempel, Jogjakarta Automotive Center (OJC) Auto Service, Barokah Auto Service, Astra Daihatsu Armada, and Gadjah Mada Auto Service. The data collection techniques used were focus group discussions (FGD), questionnaires, and practice assessment sheets. Data were analyzed descriptively. The PjBL-T model is feasible and can be applied according to the learning objectives. The effectiveness of increasing student work readiness tested limited and expanded and improved very well with a score of 3.27.

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INTRODUCTION

Vocational High School (SMK) is a secondary education provider whose role is to form skilled and ready-to-work human resources (Maghfiroh et al., 2019; Setiaji et al., 2020). Vocational High Schools prepare their students to become competent and productive individuals so that when they graduate, they are expected to be able to compete for work or fill job vacancies in the industry and become independent entrepreneurs following their competencies (Fathoni et al., 2019; Sudarsono, 2022). However, the Central Statistics Agency of the Republic of Indonesia (BPS RI) released data that the workforce of Vocational High School Graduates (SMK) occupied the highest open unemployment rate (TPT) in February 2022, which was 10.38%.

The high training rate for SMK graduates is due to the low work readiness competencies of SMK graduates as the central provision for entering the world of work and industry (Afandi & Wijanarka, 2019; Wibowo & Munadi, 2019) and the reduced job opportunities for SMK graduates (Hwang, 2017; Mgaiwa, 2021). Work readiness has the skills, knowledge, understanding, and personality that make a person able to get the job that will be chosen so that he becomes satisfied and finally achieves success (Schröder, 2019; Spöttl & Windelband, 2021). The high unemployment rate is not because students are unskilled or unable to do work but because of an imbalance between attitudes, knowledge, and skills in these vocational students (Ernawati, 2021; Li & Pilz, 2021; Misbah et al., 2020). Low work readiness impacts low self-confidence, lack of effort, and willingness to enter the world of work. Individuals who have low job readiness are more challenged to enter the world of work or get a job (Hasanah et al., 2017; Hermanto et al., 2019; Permata et al., 2021).

SMK organizers have made efforts to improve the work readiness of SMK graduates. Improvements in learning models, learning methods, curriculum, and completeness of learning infrastructure have been carried out as a solution to increase the work readiness of SMK students (Cindy et al., 2022; Erlinda et al., 2021; López & Rodríguez-López, 2020; Prianto et al., 2020). However, in reality, these efforts have not been optimal in solving the problem of high unemployment. Vocational High Schools need actual industry participation to jointly prepare students' attitudes, knowledge, and skills competencies to match the criteria for the competency needs of the industrial world (Gustiar et al., 2021; Khoerunnisa et al., 2020; Sudarsono, 2022; Wahyuni, 2021).

Thus, to improve work readiness, the competencies mastered by vocational students need to be formulated and adapted to the needs of today's industrial world (Azizah et al., 2019; Ernawati, 2021; Sudira, 2019). Learning competencies are integrated with patterns, rules, and standardization of work in the world of work (Sudarsono et al., 2021; McGrath et al., 2020; Yunikawati et al., 2018). Learning in vocational schools requires the determination of minimum competency standards that students must master, and their success can be measured according to industry criteria (Baitullah & Wagiran, 2019; Rumondang et al., 2019; Sudarsono, 2020b; Sugiartiningsih et al., 2019).

The main key to achieving job readiness is the participation of the industrial world in applying competency standards of attitudes, knowledge, and skills in the learning process in SMK (Lawitta et al., 2017; Sudarsono, 2020a; Syamsuri et al., 2020). The learning model that is currently being emphasized and applied to vocational education is Project Based Learning (PjBL) (Kusumaningrum & Djukri, 2016; Mulyadi, 2016). The PjBL model is applied to stimulate the competency of SMK students with the help of products/projects prepared by the teacher (Azizah et al., 2019). Applying the PjBL learning model directs and forms students to be skilled at working according to projects, services, and services required by customers or the community (Sudira, 2018). Assessment lies in the activities, analysis, manufacture, and presentation of products in the form of designs, works, and technology (Potvin et al., 2021; Wu & Wu, 2020). The PjBL model has characteristics that, if appropriately implemented, will improve vocational students' work readiness, namely developing an attitude of creative thinking, independence, responsibility, and skill in solving problems (Rumondang et al., 2019). PjBL stages can be seen in Figure 1.

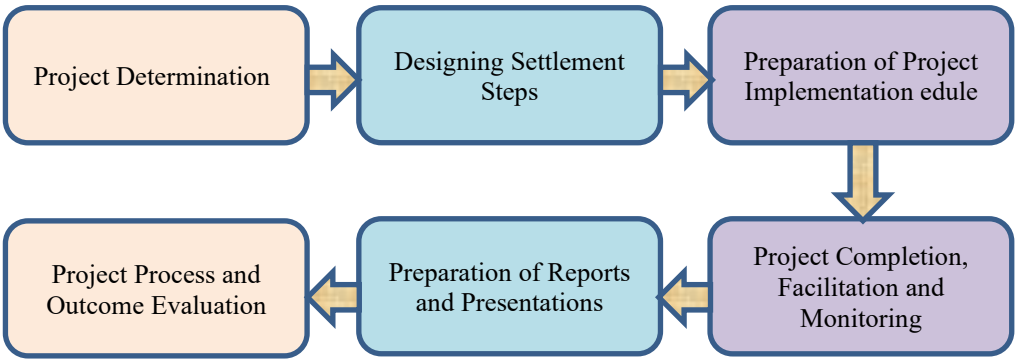

Figure 1. Stages of the Project Based Learning (PjBL)

Model according to previous studies, the PjBL model appears to have weaknesses in practice. The weakness of the PjBL model lies in the participation of the industry. The implementation of the PjBL model is still designed by educators/teachers and has yet to be fully integrated with the industry. So that the PjBL model so far has not fully facilitated the needs and standardization of the world industry (Goyal et al., 2022; Parrado-Martínez & Sánchez-Andújar, 2020; Rio & Rodriguez, 2022). Therefore, an industrial-integrated PjBL model, abbreviated as PjBL-T, is needed. The PjBL-T model has the same stages as PjBL. Only the preparation, implementation, and evaluation are integrated with the needs of the industrial world and involve industry practitioners. The PjBL-T model, which is integrated with the industrial world, is expected to increase the work readiness of SMK students.

RESEARCH METHOD

This study uses a research and development design from Richey and Klein (2014), which can be divided into three stages of development, namely, (1) the stages of model development, (2) internal validation stages, and (3) external validation stages. This research is divided into three stages. First, the stages of model development aim to produce a conceptual PjBL-T model and measure its effectiveness of the PjBL-T model. The research subjects used were vocational school teachers and industry. Second, the internal validation stage contains activities to measure the feasibility of the PjBL-T model. The research subjects used were vocational education learning experts. Third, the external validation stage contains activities to measure the effectiveness of the PjBL-T model to improve the quality of graduate work for SMK students.

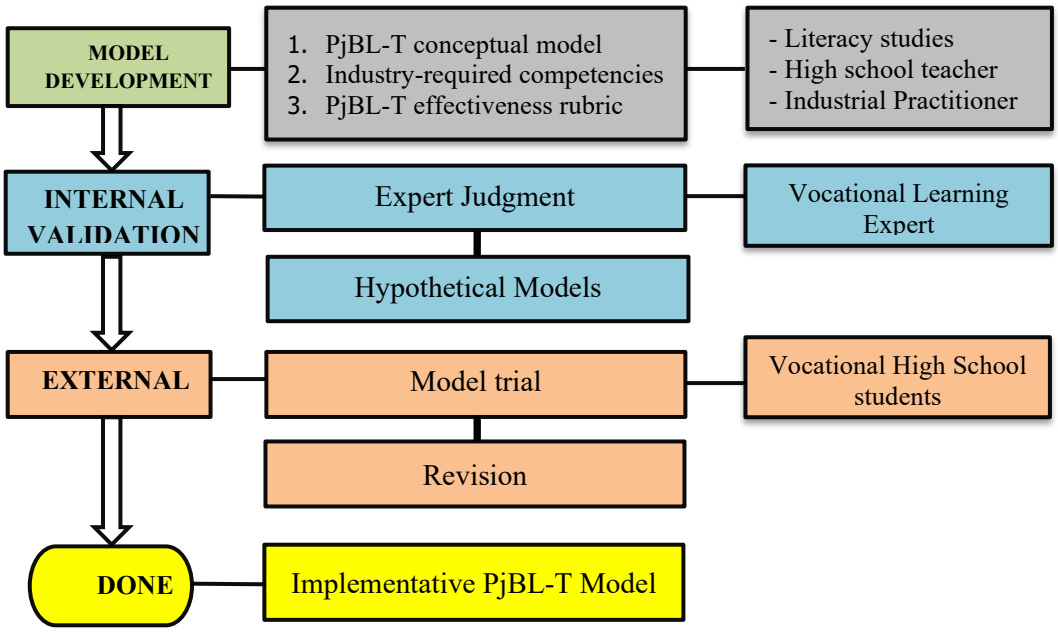

Figure 2. Research Design (Richey & Klein, 2014)

The research subjects were students of class XI automotive engineering at SMK Muhammadiyah 2 Tempel, totaling 54 students. Based on considerations about the pandemic conditions, the sample used was 25 students using a purposive sampling technique. Data collection techniques at the model development stage used interviews with unstructured interview instruments. The internal validation stage uses an expert assessment questionnaire, while the external validation uses a work readiness assessment rubric.

Table 1. Focus Group Discussion (FGD) Grid

Question	Item
The level of support from the world of work and industry at the stages of vocational learning	1
Competency aspects that must be possessed by SMK graduates and in accordance with the needs of the industrial world of work	2
A learning model that is in line with industry expectations	3, 4
What are the stages and technical implementation?	5

Table 2. Model Validation Questionnaire Grid

Question	Item
Suitability with learning objectives	1, 2, 3
Ease of implementation	4, 5, 6
Measuring power of learning objectives	7, 8
The effectiveness of the model in solving problems	9, 10

Table 3. Job Readiness Assessment Criteria

Rating Norms	Score Range	Criteria
$X \geq \mu + 1.\beta$	X ≥ 3,00	Very Good (SB)
$\mu + 1.\beta > X \geq \mu$	3,00 > X ≥ 2,50	Good (B)
$\mu > X \geq \mu - 1.\beta$	2,50 > X ≥ 2,00	Poor (K)
$X < \mu - 1\beta$	X< 2,00	Not Good (T)

Source: (Mardapi, 2018)

RESULT AND DISCUSSION

Result

The first step in developing the PjBL-T model is conducting preliminary and literacy studies. The results of the literacy study were used as material for the FGD activities, which were carried out twice. The first FGD aims to gather information on the learning model implemented in SMK with participants from the industry and five teachers from automotive engineering vocational schools. The results of the first FGD can be concluded that: (1) the learning model in Vocational High Schools has so far been completely dependent on teachers, (2) competencies needed by the industry to support student work readiness include attitude (initiative, responsibility, and cooperation); knowledge of the field of work and skills (process and timeliness of work), and (3) The learning model needed by teachers and industry is a project-based learning model with industry participation in the learning stages.

The second FGD activity was carried out with 8 participants from industry and vocational school teachers. The second FGD aims to explore the PjBL-T conceptual model from literacy studies and input into the FGD process to produce a conceptual PjBL-T model with the stages: job determination, preparing steps for improvement, implementation, and assessment. The results of the second FGD can be seen in Figure 3.

The second stage in this research is the internal validation stage. The stages of internal validation include activities aimed at obtaining input from vocational education learning experts regarding the PjBL-T conceptual model from the results of the model development stages, as well as the rubric for evaluating the model's effectiveness. From the results of internal validation, the results obtained are that: (1) The PjBL-T model developed follows the learning objectives; (2) The suitability of the stages of the PjBL-T model following the learning objectives; (3) The PjBL-T model is easy to apply and implement by teachers and vocational students; (4) The application of the PjBL-T Model following the stages of the model can improve student competence; and (5) The implementation of the PjBL-T Model, which is carried out with industrial support, can solve

problems related to student work readiness. Expert input related to the vocational students' work readiness rubric includes additions and subtractions of aspects. The initiative attitude aspect is omitted because the responsibility attitude aspect can represent it. At the same time, the skill aspect is added to the aspect of using practical tools.

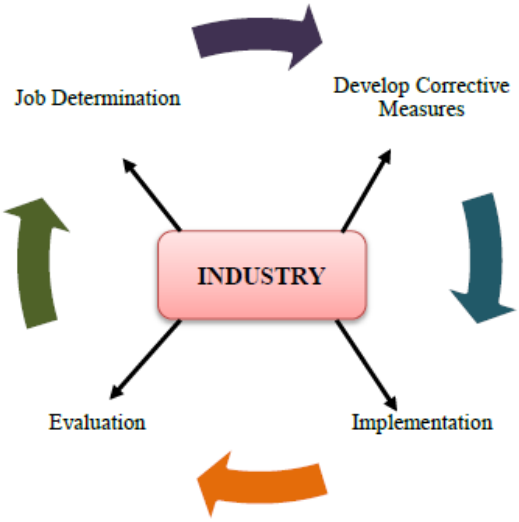

Figure 3. Conceptual PjBL-T Model

Regarding the PjBL-T model, the stages of the PjBL-T model received several inputs from experts/internal validators. The wishes include: (1) The PjBL-T model must involve practitioners before preparation, or pre-learning, which aims to provide a common perception between teachers and industry; and (2) The PjBL-T model will be optimally successful if the industry submits industry criteria at the assessment stage. After the internal validation stage, the PjBL-T model is called the hypothetical PjBL-T model. The hypothetical PjBL-T model, the stages of the hypothetical PjBL-T model, and the work readiness assessment rubric can be seen in Figure 4, Table 4, and Table 5.

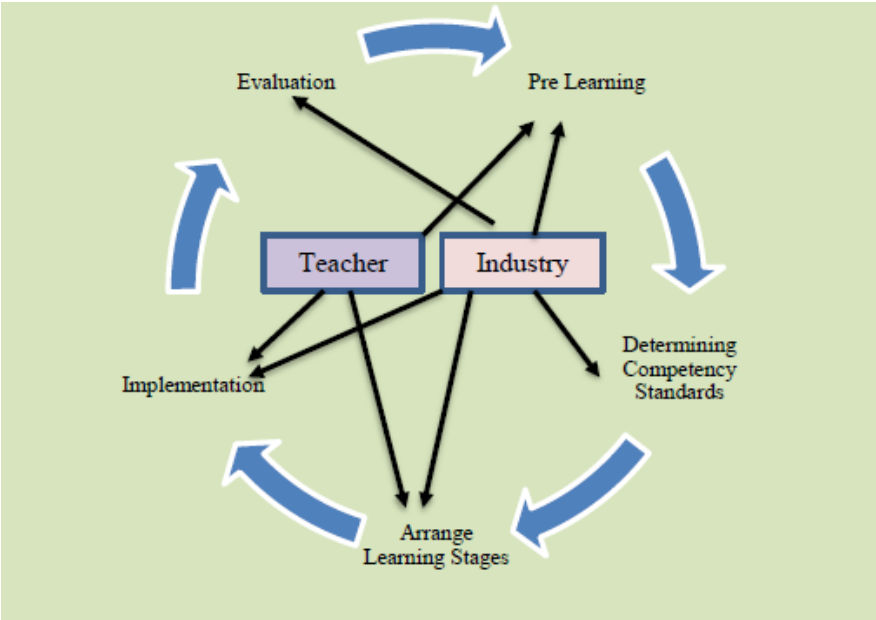

Figure 4. Hypothetical PjBL-T Model

Table 4. Stages of Hypothetical PjBL-T Model

Stages	Activity Description
Pre Learning	Teachers and Industry hold meetings to align learning objectives and prerequisites (materials, infrastructure, and time)
Determining Competency Standards	Teachers and Industrial Instructors discuss to determine the desired competency targets/standards according to industry criteria
Arrange Learning Stages	Teachers and Industrial Instructors arrange together the stages of learning that are in accordance with the learning objectives
Implementation	Students work on all stages of the worksheet and make notes if there are steps that are lacking and difficult to apply. The notes will be discussed with industry instructors in the form of a report
Evaluation	The examiner is an industrial instructor.The assessment is divided into two parts, namely an assessment to measure aspects of knowledge and an assessment to measure aspects of skills. The assessment of the knowledge aspect is carried out by giving theoretical tests related to the measuring instrument material and job specifications

Table 5. Work Readiness Assessment Rubric of the PjBL-T Model

Competency Aspect	Score	Assessment Rubric
Responsibility	4	Completely completed without guidance
	3	Completely completed with guidance
	2	Do some work
	1	Work not executed
Cooperation	4	Help each other in work without guidance
	3	Help each other in work with guidance
	2	Occasionally ask for help with friends without guidance
	1	Individualist
Knowledge	4	Presenting practical components/objects without looking at references
	3	Presenting practice components/objects by looking at references
	2	Some are able to present practical components/objects without looking at references
	1	Not able to present components/objects of practice
Work Process	4	Carry out practical work steps correctly without instructor direction.
	3	Carry out practical work steps correctly with the instructor's direction.
	2	Some carry out the practical work steps correctly without the instructor's direction
	1	Don't understand the job steps
Punctuality	4	The work was completed according to the procedure before the specified time
	3	Work completed according to procedures in a timely manner
	2	The work was completed according to the procedure at the right time
	1	Didn't get the job done
Use of Practical Tools	4	Choose and use practice tools correctly without guidance
	3	Choose and use practice tools properly with guidance
	2	Able to choose but unable to use practical tools properly without guidance
	1	Unable to select and use practice tools

To obtain data from instruments that have been tested and can measure instrument data for vocational readiness assessments, validity and reliability tests are then carried out using Aiken's V coefficients and Cronbach's Alpha theorem. Testing the validity and testing reliability seen in Table 6 and Table 7.

Table 6. Content Validity Calculation Results

Instrument Items	Validity
Responsibility	High
Cooperation	High
Knowledge	High
Work Process	High
Punctuality	High
Use of Practical Tools	High

Table 7. Reliability Test

Alpha Cronbach	N items
0.876	6

From the validity and reliability test data, it is stated that the instruments used to test the effectiveness of work readiness are feasible to use. The third research stage is external validation by testing the PjBL-T model. The trial was carried out in a limited trial and an expanded trial. The limited trial aims to collect initial data regarding the effectiveness of the PjBL-T model in improving students' work readiness. The limited trial material was electric arc welding which ten students carried out. The results of the effectiveness of the PjBL-T model at the limited trial stage can be seen in Table 8 and Figure 5.

Table 8. Limited Trial Results

Competence	Competency Aspect	Score (f) Average
Attitude	Responsibility	1.3
	Cooperation	1.8
Knowledge	Field of work	1.9
	Work Process	1.9
Skills	Punctuality	1.5
	Use of Practical Tools	2.1
Average Total Score		1.75

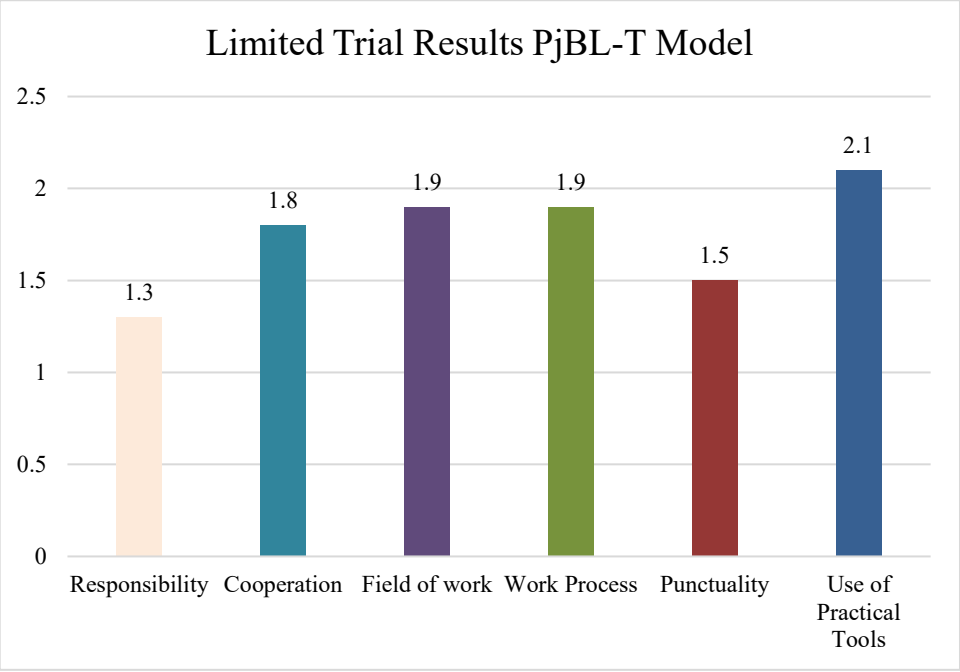

Figure 5. Limited Trial Results

After the limited trial, the researcher evaluated the implementation of the limited trial and obtained the results that although the results of the assessment of student work readiness in the limited trial obtained an average score of 1.75 with the Not Good (TB) category, the PjBL-T model could be implemented well by teachers, industrial instructors, and students. There are several notes related to the implementation of the PjBL-T model: (1) Students still need to participate in the stages of the PjBL-T model actively; (2) The industrial instructor asks one student to help; and (3) The assessment could be more optimal because students are not used to being accompanied by others. The results of the limited trial notes were evaluated and improved, and then the expanded trial phase was carried out with 25 student subjects. The results of the expanded trial can be seen in Table 9 and Figure 6. At the same time, the comparison of the performance tests for each trial can be seen in Figure 7.

Table 9. Extended Trial Results

Competence	Competency Aspect	Score (f) Average
Attitude	Responsibility	2.96
	Cooperation	3.32
Knowledge	Field of work	3.32
	Work Process	3.08
Skills	Punctuality	3.4
	Use of Practical Tools	3.52
Average Total Score		3.27

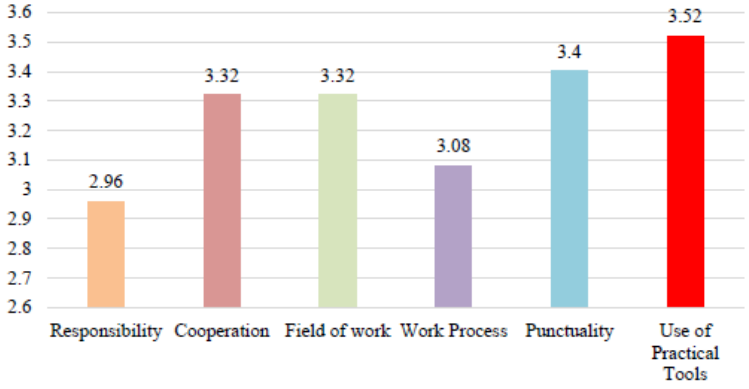

Figure 6. Extended Trial Results

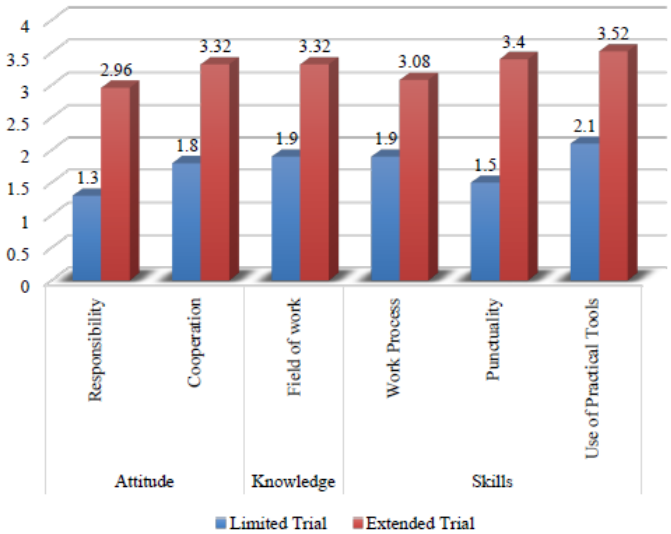

Figure 7. Comparison Data Limited and Extended Trial of the PjBL-T Model

After the pilot was expanded, researchers, teachers, and industry instructors reflected on the results of the expanded pilot implementation. The results of the assessment of student work readiness in the expanded trial obtained an average score of 3.27 in the Very Good (SB) category. The assessment results of student work readiness increased from the limited and expanded trial results. The results of the reflection concluded that there were no problems, and the implementation of learning used the Hypothetical PjBL-T model. The model and work readiness assessment rubric stages have not changed/revisions. Hence, the hypothetical PjBL-T model is a used or implementation learning model and is ready to be applied to improve the work readiness of SMK students.

Discussion

The PjBL-T model is a development of the Project Based Learning (PjBL) model which has been widely applied to the learning process. The goals and benefits of both models are the same, namely increasing student competence. The similarity lies in the learning media in the form of objects, designs and work products. While the difference lies in the actors of learning and the process of industrial participation in all stages of learning.

The stages of the PjBL-T model include: pre-learning, determining competency standards, compiling learning stages, implementation and assessment. Sudjimat et al. (2021) stated that project-based learning with an industrial partnership strategy succeeded in increasing the job readiness of SMK students by referring to three stages of learning. These stages include pre-PjBL, PjBL with simple projects, and models with real or complex projects. Evaluation includes the assessment of processes and products by industry. The implementation of industrial integrated PjBL can shape the character of the 21st century workforce which is developed and integrated into the implementation of the PjBL-T model (Sudjimat et al., 2021).

Project-based learning with industry partnerships can provide students with up-to-date or renewable work readiness. The prerequisites are the need for a common vision, understanding goals, learning design courses, demand for skills for the world of work and an agreed-upon competency outcome between teachers and industry (Kuppuswamy & Mhakure, 2020; Zarte & Pechmann, 2020). Noordin et al. (2011) and Pan et al. (2021) who stated that industrial integrated PjBL is suitable to be applied at the vocational education level and is able to increase students' work readiness. Industry-integrated PjBL can provide competencies with work experience and problem solving from industrial instructors.

The PjBL-T model which was applied in two stages of testing proved capable of improving aspects of attitude competence (cooperation and responsibility), knowledge (field of work) and skills (processing, punctuality and use of practical tools) so that it had an impact on increasing student work readiness. Dunai et al. (2017) and Tran and Tran (2020) who stated that PjBL integrated the development of industrial technology projects. A well-implemented industrial integrated PjBL model can encourage students to achieve project planning skills, collaboration, responsibility, critical thinking, administrative knowledge and problem solving skills. Vila et al. (2017) stated that industry-integrated PBL is the right learning model to encourage increased competency and the demands of the world of work. A well-applied model can improve students' attitudes, knowledge and skills competence. Habók and Nagy (2016) added that project-based methods with industrial integration are preferred among teachers. Teachers only act as facilitators and provide motivation and transmission of values central to student work from industry (Habók & Nagy, 2016).

The PjBL-T model in its implementation has several obstacles that have been summarized from the results of limited trials and expanded trials. The bottleneck of the PjBL-T model lies in the enthusiasm and participation of the industry. So that a sustainable partnership program is needed with a mutually beneficial agreement between SMK and industry. Sapan et al. (2020) and Astarina et al. (2020) stated that PjBL-T has been able to equip students with work-related skills, and with completing projects. Students can improve soft skills, especially in communication and self-confidence. Agreements and partnership programs with industry are needed so that the sustainability of the program continues (Astarina et al., 2020; Sapan et al., 2020).

CONCLUSION

The PjBL-T model, developed from the PjBL model, can overcome the problems of job readiness of SMK students, especially in forming attitudes, knowledge, and skill competencies. The PjBL-T model has stages of Pre Learning, Determining Competency Standards, Arrange Learning Stages, Implementation, and Evaluation. The PjBL-T model was developed to suit the learning objectives of SMK, is easy to implement, and has a high level of effectiveness in improving the quality of graduates, as seen from the work readiness of SMK students. Competency of work readiness attitude includes aspects of competence of cooperation and responsibility. Knowledge competence includes aspects of competence in the field of work. Skill competency, which includes aspects of process competence, timeliness, and use of practice tools, can be very well improved by implementing the PjBL-T stage in two trial stages. It is hoped that the PjBL-T model can be developed in stages and involve a more comprehensive partnership with the industry so that the scope of competence is more diverse. Not only that, the PjBL-T that is being developed should be continued with a broad socialization stage to get input from SMKs, academics/educational experts, and the industry.

REFERENCES

Afandi, K., & Wijanarka, B. S. (2019). Outcomes of vocational high schools in machining expertise in the labor market in Yogyakarta, Indonesia. *American Journal of Educational Research*, *7*(9), 599–603. https://doi.org/10.12691/education-7-9-1

Astarina, S., Barliana, M. S., & Permana, D. C. (2020). Implementation of project-based learning method to increase transferable skills of vocational high school students. *IOP Conference Series: Materials Science and Engineering*, *830*(2), 022065. https://doi.org/10.1088/1757-899X/830/2/022065

Azizah, D. N., Muslim, S., Achmad, R. N., Lukmantoro, D., Farida, U., Ciptono, A., & Joko, J. (2019). Development of teaching factory model at Vocational High School (VHS) in Indonesia. *Indonesian Journal of Learning Education and Counseling*, *2*(1), 1–8. https://doi.org/10.31960/ijolec.v2i1.115

Baitullah, M. J. A., & Wagiran, W. (2019). Cooperation between vocational high schools and world of work: A case study at SMK Taman Karya Madya Tamansiswa. *Jurnal Pendidikan Vokasi*, *9*(3), 280–293. https://doi.org/10.21831/jpv.v9i3.27719

Cindy, A. H., Sugiyono, S., Usman, H., & Herwin, H. (2022). Factors that affect the optimisation of vocational high school facilities and infrastructure. *Cypriot Journal of Educational Sciences*, *17*(2), 586–600. https://doi.org/10.18844/cjes.v17i2.6847

Dunai, L. D., Lengua, I. L., & Fajarnes, G. P. (2017). Improving skills with project based learning in engineering. *IECON 2017 - 43rd Annual Conference of the IEEE Industrial Electronics Society*, 3983–3988. https://doi.org/10.1109/IECON.2017.8216682

Erlinda, V., Muhtar, M., & Noviani, L. (2021). Implementation of vocational high school revitalization program in preparing graduate competencies. *International Journal of English Literature and Social Sciences*, *6*(2), 241–250. https://doi.org/10.22161/ijels.62.35

Ernawati, E. (2021). Implementation of the learning process: Efforts to improve the quality of vocational education graduates. *Jurnal Pendidikan Vokasi*, *11*(2), 243–253. https://doi.org/10.21831/jpv.v11i3.44049

Fathoni, A., Muslim, S., Rahmadyanti, E., Setiyono, S., Kusumawati, N., & Aribowo, W. (2019). Increased competitiveness and work readiness of students four year Vocational High School (VHS). *Indonesian Journal of Learning Education and Counseling*, *1*(2), 186–194. https://doi.org/10.31960/ijolec.v1i2.114

Goyal, M., Gupta, C., & Gupta, V. (2022). A meta-analysis approach to measure the impact of project-based learning outcome with program attainment on student learning using fuzzy inference systems. *Heliyon*, *8*(8), e10248. https://doi.org/10.1016/j.heliyon.2022.e10248

Gustiar, R., Kurniawati, K., & Winarsih, M. (2021). The challenges of teaching Indonesian history in the teaching factory learning model in vocational high school. *AL-ISHLAH: Jurnal Pendidikan*, *13*(2), 971–978. https://doi.org/10.35445/alishlah.v13i2.692

Habók, A., & Nagy, J. (2016). In-service teachers' perceptions of project-based learning. *SpringerPlus*, *5*(1), 83. https://doi.org/10.1186/s40064-016-1725-4

Hasanah, N., Haryadi, B., & Pratama, G. N. I. P. (2017). Vocational high school readiness in facing the ASEAN economic community. *Proceedings of the International Conference on Technology and Vocational Teachers (ICTVT 2017)*, *102*, 361–368. https://doi.org/10.2991/ictvt-17.2017.62

Hermanto, F. Y., Sutirman, S., Hidayati, B., & Sholikah, M. (2019). The need of practical teaching in vocational high school of automation and office management program. *Jurnal Pendidikan Vokasi*, *9*(3), 238–248. https://doi.org/10.21831/jpv.v9i3.26734

Hwang, Y. (2017). What is the cause of graduates' unemployment? Focus on individual concerns and perspectives. *Journal of Educational Issues*, *3*(2), 1–10. https://doi.org/10.5296/jei.v3i2.11378

Khoerunnisa, I., Wahyudin, D., Handayani, S., & Ana, A. (2020). Should vocational schools be strategically located with relevant industries to reduce graduates' competency gaps? *Proceedings of the 4th Asian Education Symposium (AES 2019)*, *438*, 239–243. https://doi.org/10.2991/assehr.k.200513.053

Kuppuswamy, R., & Mhakure, D. (2020). Project-based learning in an engineering-design course – developing mechanical- engineering graduates for the world of work. *Procedia CIRP*, *91*, 565–570. https://doi.org/10.1016/j.procir.2020.02.215

Kusumaningrum, S., & Djukri, D. (2016). Pengembangan perangkat pembelajaran model project based learning (PjBL) untuk meningkatkan keterampilan proses sains dan kreativitas. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 241–251. https://doi.org/10.21831/jipi.v2i2.5557

Lawitta, R., Sihaloho, L., & Arianti, J. (2017). Vocational high school in Indonesia facing ASEAN Economic Community (AEC). *Proceedings of the International Conference on Teacher Training and Education 2017 (ICTTE 2017)*, *158*, 950–957. https://doi.org/10.2991/ictte-17.2017.28

Li, J., & Pilz, M. (2021). International transfer of vocational education and training: A literature review. *Journal of Vocational Education & Training*, 1–34. https://doi.org/10.1080/13636820.2020.1847566

López, I. C., & Rodríguez-López, B. (2020). The relevance of transversal competences in vocational education and training: A bibliometric analysis. *Empirical Research in Vocational Education and Training*, *12*(1), 12. https://doi.org/10.1186/s40461-020-00100-0

Maghfiroh, A., Sudana, I. M., & Syamwil, R. (2019). The evaluation of vocational high school practice room infrastructure for Beauty Department based on curriculum needs. *Journal of Vocational and Career Education*, *4*(2), 101–108. https://doi.org/10.15294/jvce.v4i2.24878

Mardapi, D. (2018). *Teknik penyusunan Instrumen tes dan nontes* (A. Setiawan (ed.)). Parama Publisihing.

McGrath, S., Ramsarup, P., Zeelen, J., Wedekind, V., Allais, S., Lotz-Sisitka, H., Monk, D., Openjuru, G., & Russon, J.-A. (2020). Vocational education and training for African development: A literature review. *Journal of Vocational Education & Training*, *72*(4), 465–487. https://doi.org/10.1080/13636820.2019.1679969

Mgaiwa, S. J. (2021). Fostering graduate employability: Rethinking Tanzania's University practices. *SAGE Open*, *11*(2). https://doi.org/10.1177/21582440211006709

Misbah, Z., Gulikers, J., Dharma, S., & Mulder, M. (2020). Evaluating competence-based vocational education in Indonesia. *Journal of Vocational Education & Training*, *72*(4), 488–515. https://doi.org/10.1080/13636820.2019.1635634

Mulyadi, E. (2016). Penerapan model project based learning untuk meningkatan kinerja dan prestasi belajar fisika siswa SMK. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *22*(4), 385–395. https://doi.org/10.21831/jptk.v22i4.7836

Noordin, M. K., Nabil, A., Ali, D. F., & Nordin, M. S. (2011). Problem-Based Learning (PBL) and Project-Based Learning (PjBL) in engineering education: A comparison. *Proceedings of the IETEC'11 Conference*. https://www.researchgate.net/publication/229036490_Problem-Based_Learning_PBL_and_Project-Based_Learning_PjBL_in_engineering_education_a_comparison

Pan, G., Shankararaman, V., Koh, K., & Gan, S. (2021). Students' evaluation of teaching in the project-based learning programme: An instrument and a development process. *The International Journal of Management Education*, *19*(2), 100501. https://doi.org/10.1016/j.ijme.2021.100501

Parrado-Martínez, P., & Sánchez-Andújar, S. (2020). Development of competences in postgraduate studies of finance: A project-based learning (PBL) case study. *International Review of Economics Education*, *35*, 100192. https://doi.org/10.1016/j.iree.2020.100192

Permata, T. W. I., Nurlaela, L., Ismawati, R., & Rijanto, T. (2021). The effect of teaching factory implementation on the competence and readiness to work of students of the Catering Service Study Program at SMKN 2 Mojokerto. *International Journal for Educational and Vocational Studies*, *3*(3), 227–235. https://doi.org/10.29103/ijevs.v3i3.5412

Potvin, A. S., Boardman, A. G., & Stamatis, K. (2021). Consequential change: Teachers scale project-based learning in English language arts. *Teaching and Teacher Education*, *107*, 103469. https://doi.org/10.1016/j.tate.2021.103469

Prianto, A., Winardi, W., & Qomariyah, U. N. (2020). The effect of the implementation of teaching factory and its learning involvement toward work readiness of vocational school graduates. *International Journal of Instruction*, *14*(1), 283–302. https://doi.org/10.29333/iji.2021.14117a

Richey, R. C., & Klein, J. D. (2014). *Design and development research*. Routledge. https://doi.org/10.4324/9780203826034

Rio, T. G., & Rodriguez, J. (2022). Design and assessment of a project-based learning in a laboratory for integrating knowledge and improving engineering design skills. *Education for Chemical Engineers*, *40*, 17–28. https://doi.org/10.1016/j.ece.2022.04.002

Rumondang, J. R., Basyirun, B., & Zahrulianingdyah, A. (2019). Development of patisserie gastronomy expertise competency test model in teacher professional education of vocational high school culinary program. *Journal of Vocational and Career Education*, *4*(37), 30–37. https://doi.org/10.15294/jvce.v4i1.20566

Sapan, N. S., Johari, S. K., Zulhaimi, N. A., Abdul Hamid, S. N. A., & Ramli, S. A. (2020). Project-based learning equips undergraduate students with workplace skills. *International Journal of Modern Education*, *2*(7), 13–26. https://doi.org/10.35631/IJMOE.27002

Schröder, T. (2019). A regional approach for the development of TVET systems in the light of the 4th industrial revolution: The regional association of vocational and technical education in Asia. *International Journal of Training Research*, *17*(sup1), 83–95. https://doi.org/10.1080/14480220.2019.1629728

Setiaji, K., Wardani, N. W., Farliana, N., Feriady, M., & Purwana, D. (2020). Contribution of 21st century skills to work readiness in industry 4.0. *International Journal of Advanced Science and Technology*, *29*(5), 5947–5955. http://sersc.org/journals/index.php/IJAST/article/view/15568

Spöttl, G., & Windelband, L. (2021). The 4 th industrial revolution – its impact on vocational skills. *Journal of Education and Work*, *34*(1), 29–52. https://doi.org/10.1080/13639080.2020.1858230

Sudarsono, B. (2020a). Competency evaluation of automotive vocational school graduates. *Vanos Journal of Mechanical Engineering Education*, *5*(2), 149–154. https://doi.org/10.30870/vanos.v5i2.9296

Sudarsono, B. (2020b). Industrial-based practical learning development for teacher competence of automobile technology. *Journal of Physics: Conference Series*, *1446*(1), 012062. https://doi.org/10.1088/1742-6596/1446/1/012062

Sudarsono, B., Santosa, B., & Sofyan, H. (2021). Improving the competency of automotive vocational teachers with Partnership-based Training Model (PBK). *JTP - Jurnal Teknologi Pendidikan*, *22*(3), 200–208. https://doi.org/10.21009/jtp.v22i3.18690

Sudarsono, B. (2022). Development of Work-Based Learning Models Based on Work Readiness (WBL-WoRe). *Jurnal IQRA' : Kajian Ilmu Pendidikan*, *7*(1), 44–62. https://journal.iaimnumetrolampung.ac.id/index.php/ji/article/view/2118

Sudira, P. (2018). Metodologi pembelajaran vokasional Abad XXI: Inovasi, teori, dan praksis. In B. Lastariwati (Ed.), *UNY Press* (1st ed.). UNY Press. http://staffnew.uny.ac.id/upload/131655274/penelitian/DOC C 4 Buku Referensi Metodologi Pembelajaran Vokasional Abad XXI Inovasi, Teori, dan Praksis.pdf

Sudira, P. (2019). The role of vocational education in the era of industrial automation. *Journal of Physics: Conference Series*, *1273*(1), 012058. https://doi.org/10.1088/1742-6596/1273/1/012058

Sudjimat, D. A., Nyoto, A., & Romlie, M. (2021). Implementation of project-based learning model and workforce character development for the 21st Century in vocational high school. *International Journal of Instruction*, *14*(1), 181–198. https://doi.org/10.29333/iji.2021.14111a

Sugiartiningsih, S., Subing, H. J. T., & Mulyati, Y. (2019). Analysis of development of high school, vocational school, and total unemployment in Indonesia and its solutions in response to industrial revolution 4.0. *International Journal of Innovation, Creativity and Change*, *6*(7), 40–57. https://www.ijicc.net/images/Vol6Iss7/6704_Sugiartiningsih_2019_E_R.pdf

Syamsuri, A. S., Ishaq, I., & Muhsin, M. A. (2020). Teacher orientation of post competence mapping in 21st century teaching systems. *International Journal of Innovation, Creativity and Change*, *12*(8), 468–484. https://www.ijicc.net/images/vol12/iss8/12844_Syamsuri_2020_E_R.pdf

Tran, T. Q., & Tran, T. N. P. (2020). Attitudes toward the Use of project-based learning: A case study of Vietnamese high school students. *Journal of Language and Education*, *6*(3), 140–152. https://doi.org/10.17323/jle.2020.10109

Vila, C., Ugarte, D., Ríos, J., & Abellán, J. V. (2017). Project-based collaborative engineering learning to develop Industry 4.0 skills within a PLM framework. *Procedia Manufacturing*, *13*, 1269–1276. https://doi.org/10.1016/j.promfg.2017.09.050

Wahyuni, D. S. (2021). Developing competency-based assessment at Vocational High School (VHS) in Bali. *Jurnal Pendidikan Vokasi*, *11*(1), 59–67. https://doi.org/10.21831/jpv.v11i1.37383

Wibowo, A. E., & Munadi, S. (2019). Machining industry's contribution level in vocational high school revitalization. *IOP Conference Series: Materials Science and Engineering*, *535*(1), 012026. https://doi.org/10.1088/1757-899X/535/1/012026

Wu, T.-T., & Wu, Y.-T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. *Thinking Skills and Creativity*, *35*, 100631. https://doi.org/10.1016/j.tsc.2020.100631

Yunikawati, N. A., Prayitno, P. H., Purboyo, M. P., Istiqomah, N., & Yunika, E. (2018). Causes and solution to reduce unemployment vocational school graduate in Indonesia. *The 3rd International Conference on Economics, Business, and Accounting Studies (ICEBAST) 2017*, 200–207. https://jurnal.unej.ac.id/index.php/prosiding/article/view/6585

Zarte, M., & Pechmann, A. (2020). Implementing an energy management system in a learning factory – a project-based learning approach. *Procedia Manufacturing*, *45*(2019), 72–77. https://doi.org/10.1016/j.promfg.2020.04.068

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Students e-learning readiness towards education 4.0: Instrument development and validation

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ABSTRACT

One of the characteristics of Education 4.0, which is a response to the demands of Industry 4.0, is the use of adaptive and artificial intelligence technologies in online education. In relation to e-learning preparedness, many researchers have conducted studies. But in Education 4.0, the teaching and learning processes' peculiarities were not considered. Therefore, this study aims to develop and validate an instrument for assessing the e-learning readiness of students toward Education 4.0. There were 126 undergraduate students participated in this study. The respondents were asked to fill out the online-based questionnaire voluntarily. The data obtained were then statistically analyzed using the Pearson product-moment correlation test to measure the instrument's validity. The validity test showed that all items on the questionnaire are considerably valid at a significance level of 0.01. Meanwhile, the instrument reliability was measured through Cronbach's alpha score. The reliability test confirmed that six aspects out of seven of the instrument are categorized as high reliability (flexibility, learning preferences, project-based learning, data interpretation, improving curriculum, and self-directedness). One aspect (field experience) showed a moderate level of reliability. The study's findings confirmed that the questionnaire developed is valid and reliable for collecting data concerning the students' e-learning readiness toward Education 4.0.

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INTRODUCTION

Today's technological development has a significant impact on how education has developed. Online tests, tailored learning, and digital classrooms are a few examples that frequently appear and are simple to locate in today's current educational period. Some distinctive features of Education 4.0 include using adaptive and artificial intelligence technology in the classroom (Fisk, 2017; Hariyanto & Köhler, 2020). Education theorists refer to how cyber technologies, whether physical or not, are incorporated into learning and educational processes as "education 4.0." Education 4.0 is a phenomenon that satisfies the demands of Industry 4.0, where humans and robots collaborate to find answers, resolve issues, and create new possibilities for innovation.

The ability to learn at any time, anywhere, and without students present is a given in the modern world. E-learning is the term used to describe this sort of education. When referring to e-

learning, the "e" means a process is digitally altered, saved, and transmitted electronically (Clark & Mayer, 2016). E-learning is a well-liked option among students due to the rapid development of Internet users and networking technologies. According to Rosenberg and Foshay (2002), e-learning is typically an online version of traditional learning and depends on the Internet.

It is well recognized that traditional "static" e-learning essentially offers identical instructional resources and setting to every learner (Brusilovsky, 2000). This conventional e-learning recreates conventional face-to-face instruction in a brand-new technology-based learning format. Personalized "dynamic" e-learning is one of the newest e-learning technologies. This results from the widespread acceptance that every pupil is unique. As a result, it is impossible to compare one pupil to another. In this sense, numerous researchers have created individualized e-learning that can be customized to meet the needs of individual students based on their learning preferences, knowledge levels, cognitive styles, and behavior.

By allowing students to employ customized e-learning and choose their learning style and pace, "dynamic" e-learning has achieved several Education 4.0 criteria that Fisk proposed (Fisk, 2017). Concerning e-learning preparedness, other researchers have conducted many studies. To evaluate the readiness for e-learning, Alshaher (2013) employed the McKinsey 7S model. Structure, strategy, system, skill, style, staff, and shared values/goals are the seven variables this model considers. Five components to gauge preparation for e-learning were suggested by Alem et al. (2016). These components include motivation, self-competence, self-directed learning, financial resources, and usefulness. To assess the level of e-learning preparedness in a developing nation, Aydin and Tasci (2005) created the e-Learning Readiness Survey (e-LRS), which included questions about people, technology, innovation, and self-development.

Vicki Williams of Penn State University created the online learning readiness questionnaire, which is frequently used in universities and colleges. It includes questions on self-directedness, learning preferences, study habits, technical skills, and computer equipment capabilities. However, the studies mentioned above are not considered when determining what makes up the teaching and learning process in Education 4.0. Therefore, it's crucial to look into the e-learning readiness among learners toward Education 4.0. The student's willingness to face the learning environment fitting with the digital-based characteristics of Education 4.0 is crucial to absorb the knowledge smoothly. Therefore, this study aims to develop and validate the instrument that could be used to gauge the level of readiness of students toward Education 4.0 characteristics.

RESEARCH METHOD

The research design of this study divides into two stages, as seen in Figure 1. The first stage deals with the development of the instrument, and the second focuses on piloting the instrument to the students to evaluate its validity and reliability. The first stage looks into detail and considers the research purposes (Crocker & Algina, 1986). As already mentioned, the main purpose of this study is to investigate the e-learning readiness of students in higher education to face the education 4.0 paradigm. As such, the authors searched for the already established instrument for measuring students' e-learning readiness. The authors also did review some education 4.0-related literature. The work continued by identifying the aspects that represent the characteristics of education 4.0. Then, developing the questionnaire items for each element specified in this study was done by considering the previous research on e-learning readiness and education 4.0.

The second stage of the research design starts by setting the instrument up based on the online survey. Then, ask the voluntary-based students to fill it up. From the data collected, the process continued by analyzing the validity and reliability of the instrument.

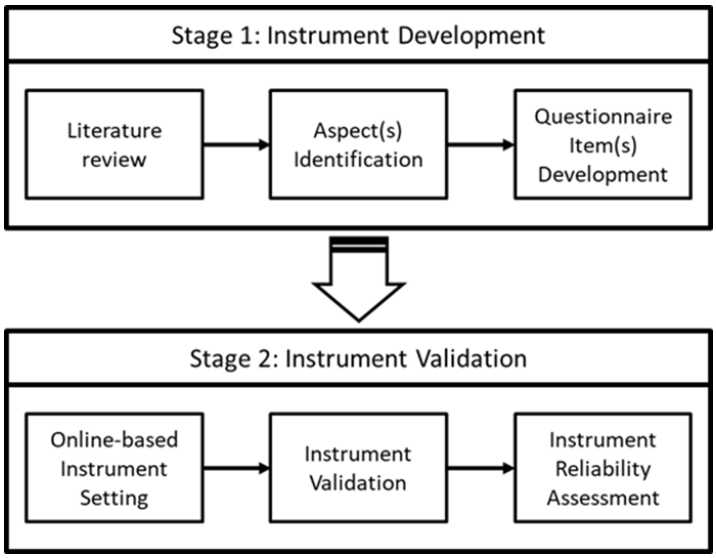

Figure 1. Steps in Developing and Validating the Instrument

RESULT AND DISCUSSION

Reviewing the Existing Instrument

A literature review was performed by first looking at the definitions of e-learning readiness, including the factors that may influence the assessment of e-learning readiness. One commonly used purpose is readiness can be seen as a factor that must be achieved before an e-learning implementation is successful. This can be defined as several factors that can positively impact the successful implementation of e-learning (Odunaike et al., 2013). Concerning that definition, Alshaher (2013) conducted a study to assess e-learning readiness through McKinsey 7S Model. This model was developed by Peters et al. (1983). This model deals with seven variables, and all the variables begin with the letter "S," including structure, strategy, systems, skills, style, staff, and shared values/superordinate goals (Franta, 2012; Liutu, 2010).

Another researcher proposed a multidimensional construct consisting of five factors: self-competence, self-directed learning, motivation, finances, and usefulness (Alem et al., 2016). Srichanyachon (2010) has identified critical components of e-learning readiness and concluded that there were three major factors: technology, human resources, and culture. Meanwhile, Aydin and Tasci (2005) developed the e-Learning Readiness Survey (e-LRS). It includes elements such as technology, innovation, people, and self-development. In addition to these factors, each may have three different components: resources, skills, and attitudes.

One commonly used and adopted by many universities and colleges to evaluate the e-learning readiness of students is the online learning readiness questionnaire Vicki Williams initially made from Penn State University. This questionnaire comprised dimensions of self-directedness, learning preferences, study habits, technology skills, and computer equipment capabilities with three options of response: agree, somewhat agree, and disagree. The list of the existing instruments already used by researchers to measure e-learning readiness can be seen in Table 1. Previous studies have developed the instrument to evaluate e-learning readiness in an organization, school, college, and company context. Nevertheless, it is found that the existing instruments have little contribution to accommodating education 4.0 characteristics.

Table 1. The Existing Instruments for Measuring E-learning Readiness

Name	Description
E-learning System Readiness Assessment (ELSRA) (Alshaher, 2013)	The instrument assesses the readiness of an organization to implement an e-learning system based on the McKinsey 7S model. This model deals with seven variables: structure, strategy, system, skill, style, staff, and shared values/superordinate goals.
E-learning Readiness (ELR) (Alem et al., 2016)	The instrument measures the concept of e-readiness in the online learning environment. It consists of a five-dimensional structure of self-competence, self-directed learning, motivation, finance, and usefulness.
E-learning Readiness (Srichanyachon, 2010)	The instrument evaluates e-learning readiness in Thailand, divided into three factors: technology, human resources, and culture.
e-Learning Readiness Survey (e-LRS) (Aydin & Tasci, 2005)	The instrument assesses the e-learning readiness of companies in Turkey which comprises of factors: technology, innovation, people, and self-development.
Online Learning Readiness Questionnaire (Williams & Pennsylvania State University, n.d.)	The instrument evaluates the e-learning readiness of students, which comprises dimensions of self-directedness, learning preferences, study habits, technology skills, and computer equipment capabilities.
E-learning Readiness (Ünal et al., 2014)	The instrument investigates the e-learning readiness level of students at Haceteppe University, which has five main components: availability of technology, use of technology, self-confidence, acceptance, and training.
Online Learning Readiness Scale (OLRS) (Hung et al., 2010)	The instrument validates the college student's readiness to learn online in five dimensions: self-directed learning, motivation for learning, computer/internet self-efficacy, learner control, and online communication self-efficacy.
McVay's Readiness for Online Learning Questionnaire (Smith et al., 2003)	The instrument evaluates a student orientation course towards online learning which comprises 13 items.

Identifying the Instrument's Aspects

Identifying the instrument's aspects in this study was based on the characteristics of education 4.0. The evolution of education 4.0 cannot be separated from the effect of the revolution of industry 4.0. Diwan (2017) exemplified that industrial revolution 4.0 involved big data, the internet of things, and adaptive and artificial intelligence techniques in the industrial mechanism. Therefore, the characteristics of education 4.0 are considerably influenced by the usage of those industry 4.0-related technologies. Postulated nine characteristics of education 4.0, namely:

> *(1) learning processes can be performed anytime, anywhere, (2) learning can be personalized to individual students, (3) students can determine their own learning path, (4) students will be exposed to more project-based learning, (5) learning focuses on field experiences such as internships, project consulting and collaboration, (6) students are exposed to data interpretation, (7) students are being examined in different ways, (8) students may help to improve the curriculum that can assist in renewal, and (9) students learn independently and the role of the teacher as a moderator changes (Fisk, 2017).*

The process continued by identifying the main aspects of education 4.0. These aspects may become the initial construction of the instrument to measure the e-learning readiness that represents Education 4.0. After reviewing each characteristic of education 4.0, the authors identified seven aspects as the representation of education 4.0, as seen in Table 2.

Table 2. Instrument's Aspects Identification

No.	Education 4.0 Characteristics	Aspects
1	learning processes can be performed anytime, anywhere	Learning Flexibility
2	learning can be personalized to individual students students can determine their own learning path	Learning Preferences
3	students will be exposed to more project-based learning students are being examined in different ways	Project-based Learning
4	learning focuses on field experiences such as internships, project consulting and collaboration	Field Experience
5	students are exposed to data interpretation	Data Interpretation
6	students may help to improve the curriculum that can assist in renewal	Curriculum Improvement
7	students learn independently and the role of the teacher as a moderator changes	Self-directedness

Developing the Instrument

After the aspects of the instrument were identified, the work continued by constructing and developing the instrument. Since there are some similar aspects with the existing instrument, thus the questionnaire items of the instruments were adopted from those related instruments. The other questionnaire items were newly created by considering some related literature. The questionnaire outline of the student e-learning readiness evaluation can be seen in Table 3.

Table 3. The Questionnaire Outline

Aspects	Items Number	References
Learning Flexibility	1, 2, 3, 4	(Alshaher, 2013; Aydin & Tasci, 2005; Smith et al., 2003; Srichanyachon, 2010; Ünal et al., 2014; Williams & Pennsylvania State University, n.d.)
Learning Preferences	5, 6, 7, 8	(Hung et al., 2010; Williams & Pennsylvania State University, n.d.)
Project-based Learning	9, 10, 11, 12	(Fisk, 2017; Lou & MacGregor, 2004)
Field Experience	13, 14, 15	(Fisk, 2017; Lou & MacGregor, 2004)
Data Interpretation	16, 17	(Fisk, 2017)
Curriculum Improvement	18, 19, 20	(Fisk, 2017)
Self-directedness	21, 22, 23, 24, 25	(Alem et al., 2016; Aydin & Tasci, 2005; Smith et al., 2003)

Evaluating the Instrument Validity

In order to measure the validity and reliability of the instrument, the questionnaire was distributed to 126 undergraduate students of Universitas Negeri Yogyakarta. The participants in this study were asked to fill out the online-based questionnaire voluntarily. The questionnaire consisted of 25 items on a 5-point Likert scale, from 'strongly disagree' (point 1) to 'strongly agree' (point 5). The data obtained were then statistically analyzed using the Pearson product-moment correlation test. The result, as seen in Table 4, showed that all items on the questionnaire are considerably valid at a significance level of 0.01.

Table 4. The Instrument Validity

No.	Statement	Validity
1	I can learn from e-learning anytime	Valid (0.575**)
2	I can learn from e-learning anywhere	Valid (0.472**)
3	I have an internet access whenever I need to study	Valid (0.493**)
4	I have an internet access wherever I need to study	Valid (0.477**)
5	I learn pretty easily	Valid (0.562**)
6	I am able to develop a good way to solve problems I run into	Valid (0.684**)
7	I prefer to learn with my own learning style	Valid (0.513**)
8	I like to learn with my own learning pace	Valid (0.436**)
9	I know the meaning of project-based learning	Valid (0.621**)
10	I prefer to learn by working on a project	Valid (0.555**)
11	I am ready to be evaluated through field project	Valid (0.494**)
12	I am ready to be evaluated through assignments	Valid (0.677**)
13	I like doing an internship	Valid (0.552**)
14	I like doing a mentoring project	Valid (0.455**)
15	I like doing a collaboration project	Valid (0.421**)
16	I know about a big data	Valid (0.604**)
17	I know how to interpret data	Valid (0.678**)
18	I know my university's curriculum	Valid (0.610**)
19	I may provide suggestion for updating the curriculum	Valid (0.554**)
20	I may provide suggestion for improving the improvement	Valid (0.531**)
21	I effectively take responsibility for my own learning	Valid (0.655**)
22	I am confident in my ability to independently prioritize my learning goals	Valid (0.752**)
23	I am good at setting goals and deadlines for myself	Valid (0.622**)
24	I am autonomous/independent	Valid (0.631**)
25	I can keep myself on track and on time	Valid (0.599**)

** : Correlation is significant at the 0.01 level (2-tailed)
* : Correlation is significant at the 0.05 level (2-tailed)

Evaluating the Instrument Reliability

This study measured the reliability test through Cronbach's Alpha score. Researchers agreed that one instrument could be considered reliable when the reliability score reached 0.7 or higher (Landauer, 1997; Nunnally, 1978; Robinson et al., 1991). In addition, Guilford in Durrheim and Tredoux (2004) provided a classification of reliability coefficients for interpreting reliability levels, as shown in Table 5.

Table 5. Reliability Coefficients Interpretation

Reliability Coefficient (r)	Interpretation
0,00 ≤ r < 0,20	Very low
0,20 ≤ r < 0,40	Low
0,40 ≤ r < 0,70	Moderate
0,70 ≤ r < 0,90	High
0,90 ≤ r ≤ 1,00	Very high

As seen in Table 6, six aspects of the instrument were categorized as high reliability ranging from 0.717 to 0.830. Those six aspects are learning flexibility (0.755), learning preferences (0.717), project-based learning (0.784), data interpretation (0.777), improving curriculum (0.761), and self-directedness (0.830). This evidence represented high internal consistency. Nevertheless, one aspect (field experience with Cronbach's Alpha 0.561) showed a moderate level of reliability which is still acceptable.

Table 6. The Instrument Reliability

Variables	Number of items	Cronbach's Alpha	Interpretation
Learning flexibility	4	0.755	High
Learning preferences	4	0.717	High
Project-based learning	4	0.784	High
Field experience	3	0.561	Moderate
Data interpretation	2	0.777	High
Improving curriculum	3	0.761	High
Self-directedness	5	0.830	High

CONCLUSION

There are seven aspects used in order to measure the students' e-learning readiness, namely (1) Learning flexibility; (2) Learning preferences; (3) Project-based learning; (4) Field experience; (5) Data interpretation; (6) Curriculum improvement; and (7) Self-directedness. The instruments developed were first validated by the experts and then got some adjustments according to the experts' feedback. The work continues by asking voluntary the students to fill out the questionnaire through the online-based application. One hundred twenty-six undergraduate students of Universitas Negeri Yogyakarta participated in the online survey. The questionnaire developed comprised 25 items with a 5-point Likert scale ranging from 'strongly disagree' (point 1) to 'strongly agree' (point 5). The data obtained were then statistically analyzed using the Pearson product-moment correlation test. The result showed that all items on the questionnaire are considerably valid at a significance level of 0.01. The work continues by assessing the reliability of each aspect of the questionnaire by using Cronbach's alpha approach. The results showed that six aspects of the instrument were categorized as high reliability ranging from 0.707 to 0.830. Those six aspects are learning flexibility (0.755), learning preferences (0.717), project-based learning (0.784), data interpretation (0.777), improving curriculum (0.761), and self-directedness (0.830). This evidence represented high internal consistency. Nevertheless, one aspect (Field Experience with Cronbach's Alpha (0.561) showed a moderate level of reliability which is still acceptable. It is concluded that the questionnaire developed has been tested and categorized as a valid and reliable instrument.

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REFERENCES

Alem, F., Plaisent, M., Zuccaro, C., & Bernard, P. (2016). Measuring e-Learning readiness concept: Scale development and validation using structural equation modeling. *International Journal of E-Education, e-Business, e-Management and e-Learning*, *6*(4), 193–207. https://doi.org/10.17706/ijeeee.2016.6.4.193-207

Alshaher, A. A.-F. (2013). The McKinsey 7S model framework for e-learning system readiness assessment. *International Journal of Advances in Engineering & Technology*, *6*(5), 1948. https://www.proquest.com/docview/1468932560

Aydin, C. H., & Tasci, D. (2005). Measuring readiness for e-learning: Reflections from an emerging country. *Journal of Educational Technology & Society*, *8*(4), 244–257. https://www.jstor.org/stable/pdf/jeductechsoci.8.4.244.pdf

Brusilovsky, P. (2000). Adaptive hypermedia: From intelligent tutoring systems to web-based education. In G. Gauthier, C. Frasson, & K. VanLehn (Eds.), *International Conference on Intelligent Tutoring Systems* (pp. 1–7). Springer. https://doi.org/10.1007/3-540-45108-0_1

Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning* (4th ed.). John Wiley & Sons.

Crocker, L., & Algina, J. (1986). *Introduction to classical and modern test theory*. Harcourt Brace Jovanovich College.

Diwan, P. (2017). *Is Education 4.0 an imperative for success of 4th industrial revolution*. Medium. https://pdiwan.medium.com/is-education-4-0-an-imperative-for-success-of-4th-industrial-revolution-50c31451e8a4

Durrheim, K., & Tredoux, C. (2004). *Numbers, hypotheses & conclusions: A course in statistics for the social sciences*. Juta and Company Ltd.

Fisk, P. (2017). *Education 4.0 ... the future of learning will be dramatically different, in school and throughout life*. Peterfisk. https://www.peterfisk.com/2017/01/future-education-young-everyone-taught-together/

Franta, D. (2012). *SOF as a Learning Organization* [Naval Postgraduate School]. https://core.ac.uk/download/pdf/36700908.pdf

Hariyanto, D., & Köhler, T. (2020). A web-based adaptive e-learning application for engineering students: An expert-based evaluation. *International Journal of Engineering Pedagogy (IJEP)*, *10*(2), 60–71. https://doi.org/10.3991/ijep.v10i2.11834

Hung, M.-L., Chou, C., Chen, C.-H., & Own, Z.-Y. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education*, *55*(3), 1080–1090. https://doi.org/10.1016/j.compedu.2010.05.004

Landauer, T. K. (1997). Behavioral research methods in human-computer interaction. In M. G. Helander, T. K. Landauer, & P. V. Prabhu (Eds.), *Handbook of Human-Computer Interaction* (pp. 203–227). Elsevier. https://doi.org/10.1016/B978-044481862-1/50075-3

Liutu, R. (2010). *Subway market research* [Saimaa University Applied Sciences]. https://www.theseus.fi/bitstream/handle/10024/23519/Liutu_Riina.pdf?sequence=1&isAllowed=y

Lou, Y., & MacGregor, S. K. (2004). Enhancing project-based learning through online between-group collaboration. *Educational Research and Evaluation*, *10*(4–6), 419–440. https://doi.org/10.1080/13803610512331383509

Nunnally, J. C. (1978). *Psychometric theory*. McGraw-Hill.

Odunaike, S. A., Olugbara, O. O., & Ojo, S. O. (2013). E-learning implementation critical success factors. *Proceedings of the International MultiConference of Engineers and Computer Scientists*, *1*. https://www.iaeng.org/publication/IMECS2013/IMECS2013_pp560-565.pdf

Peters, T. J., Waterman, R. H., & Jones, I. (1983). In search of excellence: Lessons from America's best-run companies. *Administrative Science Quarterly*, *28*(4), 621–624. https://doi.org/10.2307/2393015

Robinson, J. P., Shaver, P. R., & Wrightsman, L. S. (1991). Criteria for scale selection and evaluation. In *Measures of Personality and Social Psychological Attitudes* (Vol. 1, Issue 3, pp. 1–16). Elsevier. https://doi.org/10.1016/B978-0-12-590241-0.50005-8

Rosenberg, M. J., & Foshay, R. (2002). E-learning: Strategies for delivering knowledge in the digital age. *Performance Improvement*, *41*(5), 50–51. https://doi.org/10.1002/pfi.4140410512

Smith, P. J., Murphy, K. L., & Mahoney, S. E. (2003). Towards identifying factors underlying readiness for online learning: An exploratory study. *Distance Education*, *24*(1), 57–67. https://doi.org/10.1080/01587910303043

Srichanyachon, N. (2010). Key components of e-learning readiness. *Bangkok University Academic Review*, *9*(1), 55–61. https://www.bu.ac.th/knowledgecenter/epaper/jan_june2010/pdf/Page_56.pdf

Ünal, Y., Alır, G., & Soydal, İ. (2014). Students readiness for e-learning: An assessment on Hacettepe University Department of Information Management. In J. N. Gathegi, Y. Tonta, S. Kurbanoğlu, U. Al, & Z. Taşkın (Eds.), *International Symposium on Information Management in a Changing World* (pp. 137–147). Springer. https://doi.org/10.1007/978-3-662-44412-2_13

Williams, V., & Pennsylvania State University. (n.d.). *Online readiness assessment*. Pennstate.Qualtrics. Retrieved June 6, 2022, from https://pennstate.qualtrics.com/jfe/form/SV_7QCNUPsyH9f012B

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Technical education teachers' perception of higher-order thinking skills and their ability to implement it in Indonesia

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ABSTRACT

World Economic Forum's report reported that the top five out of 10 skills needed by employers in 2025 are: (1) analytical thinking and innovation, (2) active learning and learning strategies, (3) complex problem solving, (4) critical thinking and analysis, and (5) creativity, originality, and initiative. These skills thrive workers entering the Fourth Industrial Revolution (4IR) and are the core of Higher Order Thinking Skills (HOTS). Parallelly, educationists conclude that teaching students with HOTS is a must, but the challenge is how to do it effectively. This study's objectives were to know vocational and technical teachers' perception of HOTS and their ability to teach HOTS in their classrooms. The study population was State Vocational and Technical Senior High School (SMKN) in Yogyakarta Special Region (DIY) and Central Java Province in Indonesia. The sample was determined by quota technique sampling and came up with SMKN 2 Yogyakarta in Yogyakarta, SMKN 2 Klaten, and SMKN Magelang in Central Java Province, Indonesia. Collecting data technique used closed- and open-questionnaires and documentation. Data analysis used statistical descriptive and qualitative description. Research findings revealed that teachers' perception of HOTS was very positive. At the same time, their ability to integrate HOTS concepts in their lesson plans and to implement them in the classroom still has significant difficulties.

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INTRODUCTION

By 2021, the Fourth Industrial Revolution (4IR) will come to advanced robotics and autonomous transport, artificial intelligence, machine learning, advanced materials, biotechnology, and genomics. According to Gray (2016), these global developments will transform how people work. Some jobs will disappear, others will grow, and jobs that do not exist today will become commonplace. To maintain and thrive in employees' jobs in this era, they must master the ten skills: complex problem solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgment and decision making, service orientation, negotiation, and cognitive flexibility. Referring to the UNESCO report on what kind of learning for the 21st Century (Scott, 2015) and revised Bloom Taxonomy (Krathwohl, 2002), those ten skills above should be categorized as Higher Order Thinking Skills (HOTS).

The Indonesian Chamber of Commerce and Industry (KADIN) reported relatively low national workforce productivity. Hence, their competencies need to be improved, and one of the main components of the workforce is senior vocational school (SMK) graduates (Republika, 12/12/2013). Then, the Central Bureau of Statistics of the Republic of Indonesia reported that the rate of open unemployment of SMK graduates is the highest among others (Badan Pusat Statistik Republik Indonesia, 2017). Respectively, the unemployment rate for each school level was elementary school-3.54%; junior high school-5.36%; general senior high school-7.03%; vocational senior high school-11.30%; 3-year diploma-6.35%; and university-4.98%.

In response to the issues above, the President of Indonesia enacted President Instruction (Inpres) No. 09 of 2016 About The Revitalization of Vocational Senior High School (SMK) as an effort to raise the quality and competitiveness of human resources. Specifically, this instruction mandates MOEC to "link" and "match" SMK curriculum to the needs of business and industry. As a result, the existing 2013 curriculum was revised, which some people called the "2022 curriculum". This new curriculum was designed to accommodate competencies required by national businesses and industries and by global industries that emphasize HOTS.

Teaching HOTS is considered a new concept and practice for most vocational and technical teachers in Indonesia. Therefore, the mandate for teachers to implement it is a challenging task. MOEC considers integrating HOTS into subject matter teaching as an innovation. Furthermore, national seminars, workshops, training, and in-house training on implementing HOTS have been carried out. In-house training has also been conducted in most vocational schools.

Up to now, there has yet to be any research to describe whether vocational and technical teachers can teach HOTS effectively. Therefore, this study was conducted to describe: (1) vocational and technical teachers' perception of HOTS; (2) vocational and technical teachers' ability to integrate HOTS into their lesson plans; and (3) vocational and technical teachers' ability to implement HOTS in vocational subject matters.

Review of Literature

The concepts and principles of HOTS

A comprehensive definition describes that HOTS is a thinking process that consists of complicated procedures and needs to be based on various skills such as analysis, synthesis, comparison, inference, interpretation, assessment, and inductive and deductive reasoning to be employed to solve unfamiliar problems (Budsankom et al., 2015; Smith & MacGregor, 1992; Sutarto, 2017; Zohar, 2013). Referring to the revised Bloom taxonomy that covers six orders of thinking: remembering, understanding, applying, analyzing, evaluating, and creating process, HOTS focuses on the three upper levels or the last three levels, while the first three are called lower-order thinking skills (LOTS). The description of each order thinking skill of the six orders is illustrated in Figure 1.

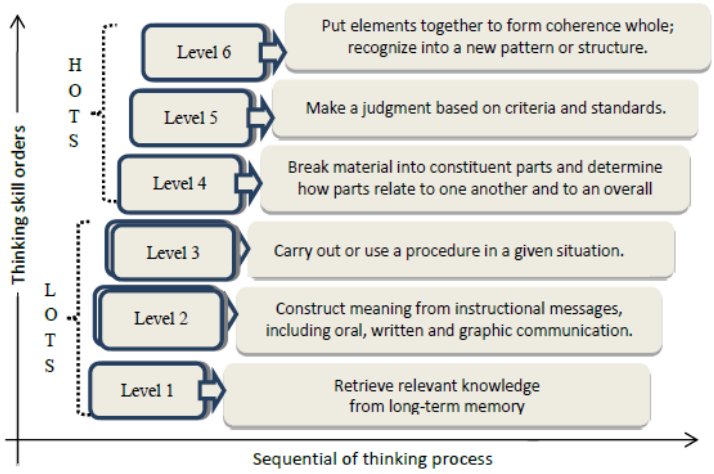

Figure 1. Six Levels of Thinking Skills

HOT is complex and may not be easily defined (Yen & Halili, 2015), however for the sake of clarification in teaching and learning purposes, Yen and Halili (2015) have identified some prominent indicators to differentiate between teaching in HOTS modes and the traditional ones as shown in Table 1.

Table 1. Comparison Between Teaching of HOT and Traditional Teaching

Teaching in HOTS	Traditional Teaching
Not routine/not fully known in advance	Routine/outcome planned in advance
Complex	Clear purpose and goal
Yields multiple solutions/view points	Yields converging outcomes
Involves uncertainty	Seeks certainty
Involves process of making meaning	Involves process of doing
Is effortful, requires mental work	Is judged by outcome rather than effort

Teachers' Perception on New Curriculum

Perception is how someone thinks and feels about a company, product, service, and so on (Woodruff et al., 2018). In this study, teachers' perceptions may be described as how teachers think and feel about the new curriculum. The more positive teachers' perception of a new curriculum, the better impact of curriculum implementation. It is in line with research findings stated by Gordon and Yocke in Onyia et al. (2016) that the teacher is pivotal in any change within the school system.

Duke (2003) also claimed that teachers have increasingly been considered the centerpiece of educational change rather than mere executors of policies enforced on them. According to Charalambous and Philippou (2010), attention has now been given to teachers' characteristics and capacities that could affect curriculum reform implementations. Therefore, relevant to this article, teachers' perception of HOTS should be considered a vital element in its implementation.

The teaching of HOTS is categorized as an educational innovation defined as an idea, practice, or project perceived as new by an individual or other unit of adoption (Eberle & Childress, 2009; Hashim et al., 2015). Rogers et al. (2008) elaborated that the adoption rate of an innovation depends on five characteristics of the innovation: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability.

Rogers et al. (2008) provides a detailed description of those respective five characteristics. Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. In the case of this study, the more advantages teacher perceived by implementing HOTS (e.g., rewards, acknowledgment, and academic status), the earlier and more intensive teachers implement it. Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (p. 15).

Thus, the more consistent the concept and principles of HOTS perceived by the teachers' or schools' values (e.g., personnel teacher's vision, school's vision, and mission), the more enthusiastic teachers implement it. Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers et al., 2008). It means that the teachers perceive that the more complex the concept and principles of HOTS, the more reluctant teachers are to integrate HOTS in planning and teaching implementation.

Trialability is the degree to which an innovation may have experimented on a limited basis (Ducharme et al., 2007). It follows that the more practical or easier to integrate HOTS into the lesson plan and its implementation in the classroom, the more passionate teachers are to implement it. Observability is the degree to which the results of an innovation are visible to others (Sanson-Fisher, 2004). It follows that the more visible the positive impact of HOTS implementation in teaching, the more motivated teachers are to adopt its concept and principles in their teaching practices. A colleague teacher who successfully implements HOTS principles in his/her teaching is visible to other teachers. It becomes a role model and observable as a best practice.

Teaching HOTS

According to Thomas and Thorne (2009), exercising HOTS in classroom teaching may seem uneasy. They offer a number of strategies to be selected to enhance the teaching of HOTS, which include:

> *(1) Teaching the concept of concepts and making sure students understand the critical features that define a particular concept and are able to distinguish it from other concepts; (2) Name key concepts to guide students to identify which type(s) of each concept is concrete, abstract, verbal, nonverbal or process; (3) Categorize concepts and guide students to identify important concepts and decide which type of each concept is (concrete, abstract, verbal, nonverbal, or process); (4) Tell and show the concepts because some students need to be "told me" while others need to be "showed me."; (5) Move from the concrete to abstract and back to concrete so that students can state an abstract concept in terms of everyday practical applications, then that person has gotten the concept; (6) Teach steps for learning concepts that include naming the critical (main) features of the concept, name some additional features of the concept, name some false features of the concept, give the best examples or prototypes of the concept (what it is), give some non-examples or non-prototypes (what the concept is not), and identify other similar or connected concepts; and (7) go from basic to sophisticated so that students can master basic concepts before proceeding to more sophisticated concepts* (Thomas & Thorne, 2009).

Another strategy suggested by Thomas and Thorne (2009) to enhance HOTS teaching is actively involving students in metacognitive aspects. Students need to know how they think and learn, which leads them to mental self-management and successful intelligence. It is explained that successful intelligence consists of six components of successful intelligence: (1) know your strengths and weaknesses; (2) capitalize on your strengths and compensate for your weaknesses; (3) defy negative expectations; (4) believe in yourself, called self-efficacy; (5) seek out role models — people from whom you can learn; and (6) seek out an environment where you can make a difference (Thomas & Thorne, 2009).

Callison (1998) stated that HOTS implementation in the teaching-learning process needs to be followed by an authentic assessment type with six main characteristics.

> *First, Constructed Response: Students construct responses to the situation, and multiple new resources are explored to create a product. Second, Higher-Order Thinking Needs: responses are made to open-ended questions and require analysis, evaluation, and creative skills. Third, Authenticity: tasks are meaningful and engaging activities relevant to a real-world context. Four, Integrative: tasks call for a combination of skills and content open to assessment. Fifth, Process and Product: procedures and strategies for deriving potential responses and exploring multiple solutions to complex problems. Six, Depth in Place of Breadth: performance assessments build over time with varied activities to reflect growth, maturity, and depth, leading to mastery of strategies and processes for solving problems in specific areas with the assumption that these skills will transfer to solving other problems* (Callison, 1998).

RESEARCH METHOD

Type of Research

This study is a survey type of research asking sample teachers about their perception of HOTS and their ability to teach it by questionnaire (Driscoll, 2011). In addition, the interview also was administered to have detailed data or opinions that the questionnaire could not fulfill. The interview also functions to crosscheck or even complement survey-collected data.

The Population and Sample

This study population was vocational and technical education teachers in Yogyakarta Special Region and Central Java Province, Indonesia. The sample was taken from vocational and

technical teachers in three piloting schools that have attended national training on the new (revised) curriculum. This assigned sampling technique is classified as a quota sampling technique (Alvi, 2016). The three vocational schools are SMKN 2 Yogyakarta, SMKN 1 Klaten, and SMKN 1 Magelang in Central Java Province, Indonesia. The total number of respondents in the study was all 30 vocational and technical teachers.

Technique of Data Collection

Data collection techniques were questionnaires (closed and open) and documentation. Triangulation of data collection techniques (questionnaire, interview, and documentation) was conducted to ensure the data's reliability and validity, as suggested by Bechhofer and Paterson (2012). There were three questionnaires developed in this study. The first questionnaire was to measure teachers' perception of the concept and principles of HOTS. The second and third questionnaires measured teachers' ability to integrate HOTS principles into their lesson plans and implement those lesson plans. Construct validity and reliability of the three instruments were judged by relevant experts (Kimberlin & Winterstein, 2008). The three instruments' documentation was derived from teachers' lesson plans and analyzed to ensure that teachers' responses to the questionnaire corresponded to their descriptions in their lesson plans.

Analysis Technique

Quantitative data were analyzed by descriptive statistics, while qualitative data were analyzed by descriptive qualitative. To measure the three objectives previously described, it is necessary to perform some statistical calculations, for example, the ideal average and ideal standard deviation based on weighting scores which refer to the normal distribution of curves with six cross-sectional areas. Based on four Likert scales (1, 2, 3, and 4) used in the instruments and referring to Smith M. (2015) describes that Ideal Mean (Mi) = ½ (4+1) = 2.5 and Ideal Standard of Deviation (SDi) = 1/6 (4-1) = 0.5. Table 2 shows categorizing criteria for teachers' competence in authentic assessment.

Table 2. Category of Teacher's Perception on Concept and Principles of HOTS

Criteria	Interval Score	Category
$X \geq (M_i + 1.5\ SD_i)$	$X \geq 3.25$	Strongly agree*3)
$M_i \leq X < (M_i + 1.5\ SD_i)$	$2.50 \leq X < 3.25$	agree*2)
$(M_i - 1.5\ SD_i) \leq X < M_i$	$1.75 \leq X < 2.50$	less agree*1)
$X < (M_i - 1.5\ SD_i)$	$X < 1.75$	Strongly disagree*0)

Notes for Teachers' ability to integrate HOTS in their lesson plan and to implement HOTS in their teaching:
*3) have integrated/implemented the concept and principles of HOTS without difficulty.
*2) have integrated/implemented the concept and principles of HOTS with minor difficulty
*1) have integrated/implemented the concept and principles of HOTS with significant difficulty
*0) have not integrated/implemented at all HOTS in their teaching due to limited ability.

RESULT AND DISCUSSION

Result

Teachers' Perception on Concept and Principles of HOTS

Teachers' perception of the concept and principles of HOTS was measured by 12 items in the first close questionnaire with four Likert scales (4 = strongly agree to 1 = strongly disagree). An open questionnaire cross-checked this perception measure. Data from the close questionnaire was analyzed, and the result is presented in Table 3.

Table 3 shows the score distribution of vocational and technical teachers' perception of HOTS ranks from a minimum score of 3.00 to a maximum score of 3.43 with a mean score of 3.22 on a 1-4 scale or 80.05% level of agreement. Referring to categorizing criteria in Table 2, vocational

and technical teachers' perception of the concept and principles of HOTS is in the category of "agree" (falls between Mi and Mi + 1.5 SDi). It means that the teachers agree that those 12 concepts and principles of HOTS need to be integrated into vocational and technical subjects.

However, the open-questionnaire question: "To what extent do you understand the concept and principles of HOTS?" in the data analysis reveals that more than half (55%) of the teachers do not understand the essential concept and principles of HOTS. Therefore, even though those teachers' perception of HOTS is good, more than half have not yet understood how to implement it.

Table 3. Teachers' Perception on HOTS

No.	Concept and Principles of HOTS	Mean (X)
1	Involves varieties (complex) teaching approaches	3.03
2	Yields multiple solutions/viewpoints of learning outcome	3.10
3	Involves uncertainty teaching and learning process	3.07
4	Emphasizes on process of making meaning than process of doing	3.13
5	Enhance analysing ability in vocational and technical work	3.23
6	Enhance evaluating ability for vocational and technical work	3.30
7	Lead to be creative in work	3.40
8	Develop problem solving skills	3.43
9	Develop inquiry skills	3.30
10	Develop reasoning skills	3.30
11	Develop communicating skills	3.30
12	Develop conceptualizing skills	3.00

Teachers' ability to Integrate HOTS in Their Lesson Plan

This teacher's ability is also measured based on 12 items in the second closed questionnaire with four Likert scales (4 = strongly agree to disagree 1 = strongly). This teacher's ability was triangulated by data analysis of an open questionnaire and document of lesson plans written by the sampled teachers. Data from a close questionnaire was analyzed, and the result is presented in Table 4.

Table 4. Teachers' Ability to integrate HOTS in Their Lesson Plans

No.	Concept and Principles of HOTS	Mean (X)
1	Present variety (complex) of teaching approaches	3.03
2	Provide multiple solutions/viewpoints of learning outcome	3.03
3	Accommodate uncertainty teaching and learning process	2.93
4	Present the process of making meaning than process of doing	3.10
5	Show how to analyse problem in vocational and technical work	3.20
6	Show how to evaluate vocational and technical work	2.90
7	Show how to be creative in working field	3.10
8	Show how to develop problem solving skills	3.03
9	Show how to develop inquiry skills	2.90
10	Show how to develop reasoning skills	2.97
11	Show how to develop communicating skills	3.27
12	Show how to develop conceptualizing skills	3.03

Table 4 shows the score distribution of vocational and technical teachers' ability to integrate HOTS in their lesson plans ranking from a minimum score of 2.90 to a maximum score of 3.27 with a mean score of 3.04 on a 1-4 scale or 76.00% level of integration. Referring to categorizing criteria in Table 2, the vocational and technical teachers' ability to integrate HOTS in their lesson plan falls in the category "have integrated HOTS with minor difficulty" (falls between Mi and Mi + 1.5 SDi). However, data analysis from the open questionnaire question: "To what extent do you integrate HOTS into your subject matters without difficulty?" reveals that only a tiny portion (1.11%) of

teachers have no difficulty integrating HOTS in their lesson plan, the rest (88.89%) have difficulty to do so.

The data analysis from teachers' lesson plan documents reveals that almost all teachers do not integrate HOTS principles in their lesson plans. It can be indicated by the verbs used in teaching objectives written in their lesson plans that (99.30%) represent only lower-order thinking skills (memorizing, understanding, and application), and only two out of 30 lesson plans (0.70%) reflect HOTS implementation. By the triangulation approaches above (closed- and open-ended instruments and documents, it can be inferred that vocational and technical teachers in the study sample did not have adequate ability to integrate HOTS in their lesson plans.

Teachers' ability to implement HOTS

The teachers' ability to implement HOTS in vocational and technical subject matter teaching is measured by 12 items in the third closed questionnaire with four Likert scales (4 = strongly agree to 1 = strongly disagree). This teacher's ability was also triangulated by open questionnaires, interviews, and documents of teachers' lesson plans. Comparable questionnaire data were analyzed; the result is presented in Table 5.

Table 5. Teachers' Ability to Implement HOTS

No.	Implement aspects of HOTS Concept and Principles	Mean (X)
1	Implement variety (complex) of teaching approaches	3.83
2	Accommodate multiple solutions/viewpoints of learning outcome	2.93
3	Show uncertainty teaching and learning process	2.70
4	Demonstrate the process of making meaning than the process of doing	2.82
5	Demonstrate how to analyse problem in the field of work	2.83
6	Demonstrate how to evaluate vocational and technical work	3.08
7	Implement ways to be creative in working field	3.29
8	Implement how to develop problem solving skills	3.08
9	Implement how to develop inquiry skills	3.02
10	Implement how to develop reasoning skills	3.07
11	Implement how to develop communicating skills	3.52
12	Implement how to develop conceptualizing skills	3.19

Table 5 shows the score distribution of vocational and technical teachers' ability to implement HOTS ranking from a minimum score of 2.70 to a maximum score of 3.84 with a mean score of 3.11 on a 4-1 scale or 78.00% level of implementation. Therefore, vocational and technical teachers' ability to implement HOTS in their teaching falls in the category of "have to implement HOTS with minor difficulty" (falls between Mi and Mi + 1.5 SDi). However, data analysis from the open questionnaire question: "To what extent do you implement HOTS into your subject matters teaching," reveals that only a tiny portion (11.11%) of teachers have no difficulty implementing HOTS in their teaching. However, the rest (88.89%) have difficulty doing so.

Data analysis of teachers' lesson plan documents shows that the form has been in line with MOEC's format. It starts with competence standards to be acquired by students, then by learning objectives and teaching-learning activities, and ends with an evaluation. The competence standards have already covered HOTS principles: C4 to C6, curiosity, critical thinking, communication, collaboration, and problem-solving. However, as described earlier, these competencies are not reflected in learning objectives. Most written learning objectives (99.30%) represent only lower-order thinking skills (C1-C3), and only two out of 30 lesson plans (0.70%) reflect principles C4-C6.

In teaching-learning activities, all teachers write scientific approaches in their lesson plans. The scientific approach consists of 5: observing, questioning, collecting data/information, connecting, and communicating. Teachers also write teaching methods about HOTS implementation, especially student assignments, learning discovery, and problem-solving. However, the description of that approach and methods need to be presented. In a more detailed description, only two out of

30 lesson plans (0.07%) describe teaching-learning activities that lead students to be creative, and only one out of 30 lesson plans (0.35%) lead students to the acquisition of inquiry skills.

Regarding assessment, data analysis of teachers' lesson plans reveals that (1) Almost all (90%) assessments written in teachers' lesson plans also represent lower-order thinking skills (C1-C3), and only a small portion (10%) represents higher-order thinking skills (C4-C6); and (2) Almost a half (45%) assessments for skills do not involve performance test that explores multiple solutions to complex problems.

Based on the data analysis above, it can be concluded that the sample vocational and technical teachers have integrated the concept and principles of HOTS in their lesson plans and have implemented HOTS in their teaching with "major" difficulties.

Discussion

Data analysis from a closed questionnaire of teachers' perception of the HOTS concept and principles concludes that the teachers agree that the HOTS concept and principles need to be integrated into vocational and technical subject matter teaching. This finding is supported by other research findings that teaching HOTS is crucial, primarily to guide students' idea generation (Yee et al., 2012). Teaching HOTS is relevant to global economic growth, information and communications technology (ICT) development, a knowledge-based economy, and a fast-paced world (Yen & Halili, 2015). Furthermore, developing students' HOT is complementary to the inculcation of lifelong learning among them and leads students to respond incessantly to real-world demands (Vijayaratnam, 2012).

However, data analysis from the open questionnaire reveals that more than half (55%) of the teachers still need to understand how to integrate them into their teaching. This condition is not ideal yet, but it is a good signal that the teachers are willing to implement HOTS. MOEC needs to respond to this signal intensively to facilitate vocational and technical teachers to fully understand the concept and principles of HOTS and then adopt it in their lesson plan and implement it in their teaching. In this situation, those teachers will seek information to reduce uncertainty about the advantages and disadvantages of implementing HOTS. Referring to Rogers et al. (2008) innovation-decision process theory, MOEC and relevant stakeholders need to empower vocational and technical teachers in five steps towards fully implementing HOTS in their teaching. Knowledge, persuasion, decision, implementation, and confirmation are the five steps.

Furthermore, Rogers et al. (2008) explained those five steps. First, the knowledge step means teachers need to be able to answer at least three questions: (1) what is HOTS, (2) why vocational schools need to teach HOTS, and (3) how teachers teach HOTS to their students. The second persuasion step occurs when teachers have a negative or positive attitude toward HOTS. Colleagues, peers, and close relatives affected the teachers' opinions on HOTS, and trusted friends and colleagues are the most convincing decision-makers.

Third, the decision step refers that teachers' preference to adopt or reject HOTS. Rogers et al. (2008) stated that in paternalistic cultures (which may be suitable in Indonesia), this collective adoption can transform into a personal decision. Fourth, the implementation step means integrating the HOTS concept and principles into lesson plans and implementing them in the classroom. However, uncertainty about the outcomes of HOTS implementation can still be a problem. Thus, the teachers may need technical assistance from MOEC or relevant experts to reduce uncertainty about the consequences.

Fifth, the confirmation stage refers to teachers seeking support for their decision. The implementation step may include discontinuance when HOTS integration in their teaching does not meet the teacher's or school's needs. So, it does not provide a perceived relative advantage, which is the first attribute of innovations described earlier in the rate of HOTS adoption. So, MOEC and the under bow have to facilitate teachers in those five aspects to reap maximal results of teaching HOTS at schools.

Data analysis from the closed questionnaire reveals that the second and third research findings conclude that vocational and technical teachers have integrated the concept and principles of HOTS in their lesson plans and have implemented it in their vocational subject matter teaching with "major" difficulties. These findings were supported by data analysis from opened questionnaire

question, "What are the obstacles in implementing the teaching of HOTS?" the results were 50% due to inadequate HOTS socialization and seminar on HOTS and 50% due to inadequate workshops and in-house training on HOTS.

Most educationists agree that HOTS must be taught to students (Sutarto, 2017; Thomas & Thorne, 2009; Yen & Halili, 2015). However, beyond the teachers, some factors still need to support the implementation of HOTS. Yen and Halili (2015) remind us of the following factors. The first is time constraint. It refers to tight allocation for each subject matter. Teaching HOTS is an internal process that needs to develop continuously for extended periods. When a student faces a problem, he/she needs time to observe, ask a question, interact with, discuss, analyze, and solve the problem, all in a one-time frame. It is a challenging task and becomes a time-consuming effort. Teachers may need help integrating HOTS into their lesson planning and implementing it in traditional classroom settings.

Second is students' motivation. According to McGregor (1966), several students, even the good ones, may fall into the X type of person who works as little as possible, taking the easy way out to complete their tasks both in and out of class. Students need to be more motivated to think harder to achieve higher learning outcomes. The third is the standardized test. It inhibits and contradicts the development of higher-order thinking skills (Zohar, 2013).

Students learning outcome assessments should be directed toward appreciating and meriting higher thinking skills. However, it has become a norm that content goals are prioritized over thinking goals. The inflexibility of a standardized test will always be a constraint to teaching HOT effectively (Zohar, 2013). Fourth is the learning environment. In a traditional classroom, the arrangement, desk, and table are set in rows, and students sit in pairs facing the whiteboard. This environment does not support teaching HOTS, and this remains up to this day. The Fifth is a resource. Teaching HOTS effectively requires more media and facilities, such as internet connection, reference books, and newspapers.

Therefore, HOTS teaching will only be effective if MOEC, especially teachers, shift their paradigm from traditional teacher-centered to student-centered that hold a constructivist view to lead students to become active towards meaning-making in the learning process. In addition, Hashim (2015) suggested that the change in the educational setting, in this case, HOTS, should be considered a process, not an event. Adapting developmental sequence proposed by Tuckman (1965) and Sutarto (2017) compiled five phases by technical teachers in implementing HOTS: announcing, storming, accommodating, norming, and performing, as illustrated in the following Figure 2.

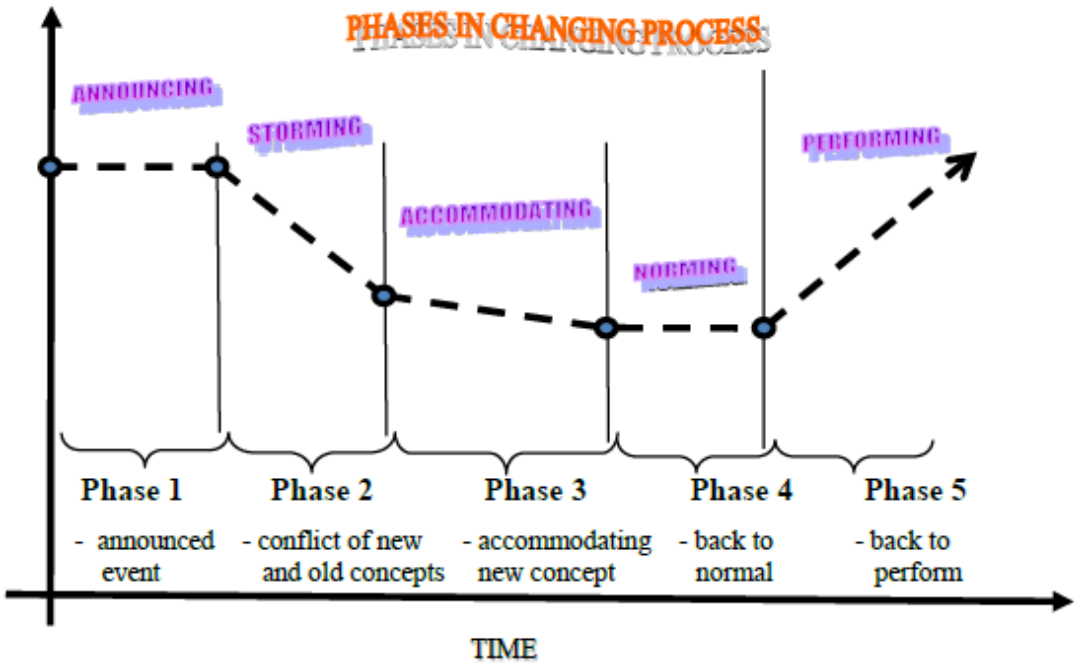

Figure 2. Five Phases in Changes Process

Each phase should be described as the following. Announcing (An) refers to the event that MOEC announced HOTS through implementing a new curriculum (2013 revised curriculum). Storming (S) refers to the phase of conflict between new (required) teaching practices relevant to the concept and principles of HOTS with existing teaching practices based on old concepts and principles of the previous curriculum (school-based Curriculum – KTSP) that have to be left. Accommodating (A) refers to the technical teachers' willingness to learn, understand, and eventually accommodate the new concept and principles of HOTS in their practices. Norming (N) refers to the normal situation in which technical teachers accept and apply the principles of HOTS appropriately with comfort. Performing (P) refers to the phase in which technical teachers can effectively implement teaching HOTS.

The time needed for a phase to be completed and move on to others (for S, A, N, and P) rely on the intensity of teachers' empowerment by MOEC and related stakeholders. The more intensive the teachers' empowerment, the shorter time to move from one phase to another.

CONCLUSION

Vocational and Technical teachers' perception of HOTS in Indonesia was very positive. It was indicated by an 80.05% level of agreement that students need to be equipped with HOTS. However, teachers still have significant difficulties integrating HOTS concepts and principles into their lesson plans and implementing HOTS in their classrooms. MOEC and relevant stakeholders need to acknowledge that HOTS teaching is a process rather than an event. Therefore, they should not target the deadline for HOTS implementation. From the MOEC perspective, support and facilitation should be provided with a focus on teacher empowerment. To speed up the transition process from the current practices towards teaching HOTS successfully, MOEC should provide a template of lesson plans and teaching materials as references. Workshop, in-house training (IHT), sabbatical teaching, and other activities should also be conducted. The number of pilot schools should be assigned as a model for other schools to implement successful HOTS teaching. Curriculum and other related programs at the university level should be reviewed and revised to meet the needs of HOTS teaching at vocational and technical schools.

REFERENCES

Alvi, M. H. (2016). *A manual for selecting sampling techniques in research*. https://mpra.ub.uni-muenchen.de/70218/

Badan Pusat Statistik Republik Indonesia. (2017). *Agustus 2017: Tingkat Pengangguran Terbuka (TPT) sebesar 5,50 persen*. Badan Pusat Statistik Republik Indonesia. https://www.bps.go.id/pressrelease/2017/11/06/1377/agustus-2017--tingkat-pengangguran-terbuka--tpt--sebesar-5-50-persen.html

Bechhofer, F., & Paterson, L. (2012). *Principles of research design in the social sciences*. Routledge. https://doi.org/10.4324/9780203136720

Budsankom, P., Sawangboon, T., Damrongpanit, S., & Chuensirimongkol, J. (2015). Factors affecting higher order thinking skills of students: A meta-analytic structural equation modeling study. *Educational Research and Reviews*, *10*(19), 2639–2652. https://doi.org/10.5897/ERR2015. 2371

Callison, D. (1998). Authentic assessment. *School Library Media Activities Monthly*, *14*(5), 42–43. https://www.ala.org/aasl/sites/ala.org.aasl/files/content/aaslpubsandjournals/slr/edchoice/SLMQ_AuthenticAssessment_InfoPower.pdf

Charalambous, C. Y., & Philippou, G. N. (2010). Teachers' concerns and efficacy beliefs about implementing a mathematics curriculum reform: integrating two lines of inquiry. *Educational Studies in Mathematics*, *75*(1), 1–21. https://doi.org/10.1007/s10649-010-9238-5

Driscoll, D. L. (2011). *Introduction to primary research: Observation, surveys, and interview*. Parlor Press. https://wac.colostate.edu/docs/books/writingspaces2/driscoll--introduction-to-primary-research.pdf

Ducharme, L. J., Knudsen, H. K., Roman, P. M., & Johnson, J. A. (2007). Innovation adoption in substance abuse treatment: Exposure, trialability, and the Clinical Trials Network. *Journal of Substance Abuse Treatment*, *32*(4), 321–329. https://doi.org/10.1016/j.jsat.2006.05.021

Duke, D. L. (2003). *The challenges of educational change*. Allyn & Bacon.

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

Gray, A. (2016). *The 10 skills you need to thrive in the fourth industrial revolution*. World Economic Forum. https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/

Hashim, A. T., Osman, R., Arifin, A., Abdullah, N., & Noh, N. M. (2015). Teachers' perception on higher order thinking skills as an innovation and its implementation in history teaching. *Australian Journal of Basic and Applied Sciences*, *9*(32), 215–221. http://www.ajbasweb.com/old/ajbas/2015/Special IPN Oct/215-221.pdf

Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. *American Journal of Health-System Pharmacy*, *65*(23), 2276–2284. https://doi.org/10.2146/ajhp070364

Krathwohl, D. R. (2002). A revision of Bloom's Taxonomy: An overview. *Theory Into Practice*, *41*(4), 212–218. https://doi.org/10.1207/s15430421tip4104_2

McGregor, D. M. (1966). The human side of enterprise. In J. M. Shafritz, J. S. Ott, & Y. S. Jang (Eds.), *Classics of organization theory* (pp. 6–15). Cengage Learning.

Onyia, C. R., Egbo, O., & Onyeneho, N. (2016). Demographic and cognitive factors in teachers' perception of curriculum innovations in Enugu State, Nigeria. *Mediterranean Journal of Social Sciences*, *7*(2), 331–342. https://www.mcser.org/journal/index.php/mjss/article/viewFile/8850/8551

Rogers, E. M., Singhal, A., & Quinlan, M. M. (2008). Diffusion of innovations. In D. W. Stacks & M. B. Salwen (Eds.), *An Integrated Approach to Communication Theory and Research* (2nd ed., p. 17). Routledge. https://doi.org/10.4324/9780203887011

Sanson-Fisher, R. W. (2004). Diffusion of innovation theory for clinical change. *Medical Journal of Australia*, *180*(S6). https://doi.org/10.5694/j.1326-5377.2004.tb05947.x

Scott, C. L. (2015). *The futures of learning 2: What kind of learning for the 21st century?* (No. 14; ERF Working Papers). https://unesdoc.unesco.org/ark:/48223/pf0000242996

Smith, B. L., & MacGregor, J. (1992). *Collaborative learning: A soucebook for higher education*. https://www.evergreen.edu/sites/default/files/facultydevelopment/docs/WhatisCollaborativeLearning.pdf

Sutarto, H. P. (2017). Articulation of high order thinking skills in competency-based instruction in Indonesia Vocational and Technical High School. *Proceedings of the International Conference on Technology and Vocational Teachers (ICTVT 2017)*, 211–217. https://doi.org/10.2991/ictvt-17.2017.36

Thomas, A., & Thorne, G. (2009). *How to increase higher order thinking*. Center for Development and Learning. http://www.thekeytotorah.com/uploads/2/5/5/8/25587179/how_to_increase_higher_order_thinking0001.pdf

Tuckman, B. W. (1965). Developmental sequence in small groups. *Psychological Bulletin*, *63*(6), 384–399. https://doi.org/10.1037/h0022100

Vijayaratnam, P. (2012). Developing higher order thinking skills and team commitment via group problem solving: A bridge to the real world. *Procedia - Social and Behavioral Sciences*, *66*, 53–63. https://doi.org/10.1016/j.sbspro.2012.11.247

Woodruff, A., Fox, S. E., Rousso-Schindler, S., & Warshaw, J. (2018). A qualitative exploration of perceptions of algorithmic fairness. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–14. https://doi.org/10.1145/3173574.3174230

Yen, T. S., & Halili, S. H. (2015). Effective teaching of Higher-Order Thinking (HOT) in education. *The Online Journal of Distance Education and E-Learning*, *3*(2), 41–47. https://tojdel.net/journals/tojdel/articles/v03i02/v03i02-04.pdf

Zohar, A. (2013). Challenges in wide scale implementation efforts to foster higher Order Thinking (HOT) in science education across a whole school system. *Thinking Skills and Creativity*, *10*, 233–249. https://doi.org/10.1016/j.tsc.2013.06.002

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Transformation of vocational skills for doormat craftsmen from persons with disabilities using assistive technology

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ABSTRACT

Vocational skills in an inclusive society are needed in business trips within an organization. The Mitra Sejahtera Center for Disability Empowerment (PPDMS) is an organization of persons with disabilities that is productive in producing patchwork mat products in quite a large capacity. This research wants to reveal how assistive technology in their business can change their vocational skills before and after knowing technology. This study uses a qualitative approach with a unique case of doormat crafts at PPDMS in Gunungkidul Regency. The research subject is the organizational chart, including the chairman and members involved in the production of doormats. The results of this study indicate that their vocational skills underwent a significant transformation after assistive technology was introduced. Before they learn assistive technology, their skill is to weave mats with the help of conventional looms. Developing more modernly, the use of mechanization with non-machine looms accessible for persons with disabilities has changed weaving skills to weaving skills complemented by skills in spinning threads. Developing even more rapidly, engineering technology-based vocational skills create job specifications for persons with disabilities. The users of these semi-automatic machines must be skilled and understand the machine mechanization system. This research implies that with the existence of assistive technology, the transformation of vocational skills goes hand in hand with developments in technology and science.

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INTRODUCTION

The Sustainable Development Goals (SDGs) have an extraordinary impact on the development of equality between people worldwide, including Indonesian people, both non-disabled and disabled. Through a distinctive motto, namely left no one behind which illustrates the hope that no one will be left behind due to certain conditions such as poverty, vulnerability, and disability (Hoelman et al., 2015). Getting decent work and economic growth is one of the goals in the SDGs, namely goal 8. One of the targets in goal 8 is to achieve permanent and productive employment and decent work for all women and men by 2030-men, including youth and persons with disabilities, and equal pay for work of equal value (Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional (BAPPENAS), 2020).

The involvement of disabilities in supporting the fulfillment of the 17 goals in the SDGs is, of course, inseparable from government support which can be seen from various regulations in various sectors. For example, various laws, regulations, and other policies encourage various parties to provide opportunities for persons with disabilities to play a role and participate in sustainable development in Indonesia. The problem is that the implementation of the SDGs is still the same as the MDGs. Some groups in society are still left behind, for example, people with disabilities (Trani & VanLeit, 2010).

This can be proven by providing opportunities to work; not all sectors can accept persons with disabilities to work there. Article 53 of Law no. 8 of 2016, it was evident that it is stated that starting from the central government to the regions, as well as state-owned enterprises, are required to accept at least 2% of persons with disabilities from the number of existing employees. For private companies, it is 1%. The company owner does not necessarily do this. However, according to Csillag et al. (2019), it is caused by an unsupportive ecosystem, and there is still much stigma built up in a society that the abilities of people with disabilities are still far below those of non-disabled people.

People with disabilities are the same as non-disabled people. Only the way of carrying out activities is different; some of them need assistive technology support to make it easier for them to carry out activities. Insights regarding opportunity, equality, inclusiveness and assistive technology need to be disseminated to encourage the implementation of the 8th SDGs goal without leaving anyone behind. In various countries, including Indonesia, the government has taken the best steps by collaborating with various communities, including the disabled community, in developing creative industries (Mandrysz, 2020; Rakhmani & Bhinekawati, 2020).

Pusat Pemberdayaan Disabilitas Mitra Sejahtera (PPDMS) is one of the organizations for persons with disabilities that exist in Gunungkidul Regency. This organization has a noble goal: to improve the welfare of people with disabilities in all fields in inclusive development. The purpose of this organization is in line with the opinion of Gupta and Vegelin (2016), which states that the concept of inclusive development emphasizes the dimensions of social, ecological, and political development, which emphasizes the need for sustainable economic growth in a business paradigm. PPDMS is related to social activities and economic empowerment in their daily activities.

One of PPDMS's productive businesses developing since 2019 is the handicraft of patchwork mats. As many as 35 people are involved in running this business involving five partners. From 2019 to 2020, PPDMS will participate in the doormat craft business with minimal production. The use of traditional mat-woven tools results in low product quality. This has an impact on complaints from consumers about their doormat products. In addition, the price of doormat products could be more competitive with market prices.

From 2021 to 2022, PPDMS will start innovating to accelerate production through the use of technology in production. This technology is assistive for non-machine looms used to produce patchwork mats. Before this technology, PPDMS members only had the skills to make doormats with simple woven tools. The production of mats for one day is five mats. This technology's existence impacts the need for additional technical skills to operate the technology. Vocational education and training are crucial for PPDMS members so that the transformation of production progress goes well. After using this technology, the production of PPDMS mats significantly increased, where it can produce 30 mats a day. The production process is also more effective and saves time.

The description above attracted researchers to explore the impact of the use of assistive technology on the transformation of the vocational skills of disabled mat craftsmen in PPDMS. Hopefully, the findings from this study will illustrate the application of technology to increase the productivity of persons with disabilities. In particular, this research aims to determine the effect of using assistive technology on business progress and identify the tools needed to accelerate the doormat business with assistive technology.

RESEARCH METHOD

Setting

The research method uses qualitative case studies. This research involved the PPDMS disability group organization, whose address is Kapanewon Nglipar, Gunungkidul Regency, Yogyakarta Special Province, Indonesia. The reasons for choosing this group were because: (1) PPDMS is a community empowerment organization for persons with disabilities who are active in socio-economic activities; (2) PPDMS has a clear organizational structure such as a chairman, secretary, treasurer, and members; (3) PPDMS has several partner children; and (4) PPDMS has the potential to develop entrepreneurship and an inclusive economy.

The partner children owned by PPDMS are the Disabled Persons Group (KPD) Mitra Manunggal, KPD Mitra Ananda, KPD Dadapayu Sejahtera, KPD Mitra Handayani, and KPD Mitra Mandiri. PPDMS members primarily consist of persons with disabilities who are economically vulnerable. To empower its members, PPDMS has a patchwork doormat production activity. The proceeds from the sale of the mats are to meet the daily needs of its members.

Respondent

Respondents in this study consisted of chairs, secretaries, treasurers, and PPDMS members. The chairman, secretary, and treasurer are the core team that drives PPDMS activities, especially in the production of patchwork mats. PPDMS members are 35 people who have a role in producing patchwork mats. Almost all PPDMS members are persons with disabilities, but they have the enthusiasm and willingness to be independent.

Role of the Researcher

The researcher acts as a participant observer. Researchers were involved in the production of patchwork mats carried out by PPDMS. Besides acting as a participant observer, the researcher also acts as an interviewer. For more than eight months, the researchers observed and were involved in producing patchwork mats using assistive technology access for persons with disabilities. Researchers also conducted interviews with research respondents during the observation.

Data Collection Procedure

Data for this case study research were collected using participant observation and interviews. Participant observation was used to collect data on the advantages and disadvantages of using assistive technology in patchwork production. In-depth interviews were used to explore the impact of using assistive technology on improving the vocational skills of persons with disabilities. Researchers used field notes to record any research data obtained during participant observation.

Data Analysis

The research data analysis was carried out by adopting qualitative data analysis techniques from Miles and Huberman (1994), which consisted of data collection, data reduction, data display, and drawing conclusions. Data from participant observations, interviews, and field notes were read, reduced, and analyzed to answer research questions. The researcher summarizes and synthesizes the patterns that emerge as answers to research questions, including adding and deleting irrelevant data. The researcher also triangulated the data by triangulating sources and methods to ensure the validity of the data.

RESULT AND DISCUSSION

Result

Pre-conditions

Vocational skills for persons with disabilities in running a doormat business through assistive technology have recently been carried out. This was conveyed by informant 1 "before there was a vocational skills improvement program through assistive technology, we only practiced on our own and developed our own business. The results are unsatisfactory, and customers often receive complaints." This initial condition indicates minimal technological touch in mat production for persons with disabilities. Researchers explored the initial conditions through in-depth interviews with the PPDMS central board consisting of the chairman, secretary, treasurer, and field implementers, who were key informants who could be explored to explain the history of the doormat craft business.

The journey of the doormat business at PPDMS was first established in 2019 with ten active members with disabilities. These people have limitations or experience physical barriers, such as the disabled, blind, and families who have children with disabilities. So far, work has been done in each house with a manual woven tool the size of an average doormat. Every time they reach a specific target, families with disabilities collect them at PPDMS to be marketed conventionally to buyers using word-of-mouth. This concept is running slowly due to low product quality and the absence of contributions from various parties to run this mat business.

The vocational skills of doormat craftsmen at that time were mat weaving skills. The basic skills of weaving with conventional equipment cause the development of the mat business not to work optimally. This vocational skills analogy is equivalent to odd jobs with a minimum skill level. Regarding the educational background of the doormat workers, most workers come from elementary and junior high school graduates. Informant 1 revealed that "our human resources are minimal given their educational background and skills. We usually participate in training organized by the relevant Social Services, but they are not specifically relevant to our doormat business." Conventional manufacturing processes become obstacles in accelerating business performance.

"The demand for turnover at that time put much pressure on PPDMS to move to support the organization's economy and impact on family welfare," said informant 2. The primary vocational skills of woven mats for persons with disabilities have made the mats add value for social observers of persons with disabilities. The sense of community togetherness makes traditional woven doormat products sell well in the community.

Assistive Technology of Doormat Production

The development of doormat production increased when assistive technology arrived in 2020. This was conveyed by informant 1 "in 2020, the involvement of universities has made our doormat business move quickly. Appropriate technological assistance adapted to our conditions makes our work system efficient." This expression shows that technology in conventional businesses changes how people with disabilities work from manual to mechanical. This mechanization was introduced as an early transition to the advancement of doormat production technology. Informant 3, the partner's son, explained, "assistive technology for wheelchair users is needed to produce doormats with more effective and efficient assistance and methods." The contribution of assistive technology, even though it is included in the mechanical category, can still be accepted by the doormat craft business group.

The initial assistive technology known to doormat makers of persons with disabilities can help increase production by up to 200%. Informant 4 believes that "turnover resulting from the mechanized work of making doormats had doubled from the turnover before we were introduced to production technology. Therefore, the turnover we get can be used to run programs in PPDMS." Assistive technology can impact an organization's economic growth. People with disabilities need technological assistance to accelerate their performance and impact their welfare.

The mechanization of assistive technology in 2020 is in the form of non-machine looms accessible for persons with disabilities. The loom is made of wood that is managed by the surrounding environment. Informant 1 explained, "collaboration with universities has produced

assistive technology innovations for non-machine looms for our doormat business operations. The materials used use natural materials in our area, such as wood and joining techniques that use locked wood joints. In addition, in 2022, these mat craftsmen and universities will innovate in making mat weaving technology with a semi-automatic drive system. This technology is far more efficient than mechanization because the work system adopted is semi-automatic. Assistive technology can be an effective and efficient work transformation in managing the PPDMS mat business.

Vocational Skills of Persons with Disabilities in the Use of Assistive Technology

The trend of assistive technology in various businesses of people with disabilities is growing for those who are productive, creative, innovative, and collaborative with various parties. Informant 1 explained that "PPDMS grew rapidly because the internals was very supportive in encouraging us to be active in the organization inside and outside. Inside it means that we protect all members, and outside we constantly promote our work program. As a result, we participate in many vocational training pieces, both in-house and out-of-house training. The vocational skills possessed by persons with disabilities are influenced by organizational leadership, where the role of the leader is to liaise between the organization and stakeholders. Effective communication from the head of the organization can be a link in accelerating the vocational skills of persons with disabilities. They find it very difficult to develop their vocational skills if there is no special mentor to develop vocational skills. Additionally, vocational skills for using assistive technology are needed in the role of trainers and assistants.

The skill transition from self-taught and guided learning is found when using assistive technology in mat production. Skills in using non-machine and semi-automatic looms provide a variety of vocational skills. Vocational skills in operating non-machine looms can be done by certain people who understand tool mechanization. The observation shows that there are special techniques when the tools used are still semi-conventional. In moving the camran, the right and left levers must be paid attention to by the mat craftsmen so that the hands are not pinched, and the woven crossing process can be tight and well-formed.

In the yarn spinning process, persons with disabilities work in two stages: transferring the yarn to a special place to separate the threads. The following process is to transfer to the large roll by regularly pulling one small roll after another. The vocational skills of persons with disabilities began to shift when the initial conditions were not familiar with non-machine looms, shifting by gaining experience and skills in spinning yarn as a material for woven doormat hooks.

Vocational skills when using semi-automatic mat production machines differ from vocational skills using semi-conventional looms. Vocational skills for using semi-automatic machines are specifically for skilled workers who are proficient in weaving. Due to the limited number of tools, the operation is only done by certain people with basic skills, namely weaving and understanding how the machine works. This shows a change in vocational skills from skilled manual weaving to weaving with the help of looms and weaving using machines.

Doormat craftsmen from persons with disabilities experience significant vocational skills transformation with assistive technology. Especially for assistive technology in the production of doormats, the existence of these tools supports the vocational abilities of persons with disabilities, both hard and soft skills. Observations related to hard skills show that people with disabilities can produce up to 50 meters of mats daily or around 100 pcs. This production speed is supported by a machine work system that has been adapted to the size and ergonomics of workers.

Repeated observations on the work habits of workers in using assistive technology show that precision and accuracy in work grew significantly with an emphasis on quality and quantity control. In addition, the mass-produced workflow with assistive technology requires them to work beyond the target so that it can become a mat stock that can be marketed in large capacity. With this assistive technology, PPDMS has been able to market its products regularly and at a large capacity.

Discussion

Inclusion in the labor market and access to work for persons with disabilities has long been agreed upon by various countries, including Indonesia, through the United Nations Convention on

the Rights of Persons with Disabilities (UNCRPD). However, social inclusion has yet to materialize for persons with disabilities who are still very much excluded from social and political-economic life (Georgiadou et al., 2022). Based on the results, the number of people working is only around 44% of the total 17 million people with disabilities in Indonesia. Meanwhile, based on data provided by the International Labour Office (ILO) in 2015, around 15% of the world's population experience disabilities, and 80% or 785 million people are of working age.

Various factors can affect the work participation of persons with disabilities, and it is very important to understand for planning and government policies as well as recommendations for social workers to improve the welfare of persons with disabilities (Bartram & Cavanagh, 2019; Nofiani et al., 2022). For example, by providing assistive technology and improving vocational skills for persons with disabilities that are adapted to the conditions of each person with disabilities. Vocational skills for persons with disabilities are not only related to inclusion in the world of work but will also be related to the quality of life of persons with disabilities (Beyer et al., 2010; Foley et al., 2012; Verdugo et al., 2019). Because improving vocational skills is expected to support persons with disabilities in meeting quality standards of life and better facing challenges at work to reduce unemployment rates in this marginalized group (Smythe et al., 2020).

Based on the results of research conducted by Ebuenyi et al. (2020), it is known that apart from increasing vocational skills, the provision of assistive technology that is not suitable or difficult to accommodate is also a challenge for persons with disabilities in paving the way towards equality in work. Assistive technology has a positive impact on changing the lives of persons with disabilities, ensuring they can access every aspect of society, from daily activities that promote independent living skills to vocational and recreational activities (Paris & Miller, 2018).

The problem in PPDMS around 2020 is that they are slow in weaving mats due to the inaccessibility of the tools used by persons with physical disabilities. So it is necessary to develop an accessible ATBM for persons with physical disabilities. The presence of more accessible tools is expected to support and improve the quality of the products made and the speed of producing quality products. Because based on research conducted by (Collins & Collet-Klingenberg, 2018), there is a significant increase in persons with disabilities regarding their vocational abilities when they use assistive technology.

The development of mat looms to make them more accessible by embedding assistive technology is carried out through a need assessment process for users. This research has revealed some of the limitations and needs of prospective users to be very important to know. This is in line with the results of research conducted by Kisanga et al. (2018). An understanding of the conditions and needs of users with disabilities in designing friendly tools to overcome their challenges and increase the productivity of people with disabilities. In addition, the use of assistive technology support can also make it possible to eliminate stigmatization in society through forms of support that prioritize the abilities of persons with disabilities rather than the obstacles they have (Wicker et al., 2022).

CONCLUSION

Vocational and Technical teachers' perception of HOTS in Indonesia was very positive. It was indicated by an 80.05% level of agreement that students need to be equipped with HOTS. However, teachers still have significant difficulties integrating HOTS concepts and principles into their lesson plans and implementing HOTS in their classrooms. MOEC and relevant stakeholders need to acknowledge that HOTS teaching is a process rather than an event. Therefore, they should not target the deadline for HOTS implementation. From the MOEC perspective, support and facilitation should be provided with a focus on teacher empowerment. To speed up the transition process from the current practices towards teaching HOTS successfully, MOEC should provide a template of lesson plans and teaching materials as references. Workshop, in-house training (IHT), sabbatical teaching, and other activities should also be conducted. The number of pilot schools should be assigned as a model for other schools to implement successful HOTS teaching. Curriculum and other related programs at the university level should be reviewed and revised to meet the needs of HOTS teaching at vocational and technical schools.

REFERENCES

Bartram, T., & Cavanagh, J. (2019). Re-thinking vocational education and training: Creating opportunities for workers with disability in open employment. *Journal of Vocational Education & Training*, *71*(3), 339–349. https://doi.org/10.1080/13636820.2019.1638168

Beyer, S., Brown, T., Akandi, R., & Rapley, M. (2010). A comparison of quality of life outcomes for people with intellectual disabilities in supported employment, day services and employment enterprises. *Journal of Applied Research in Intellectual Disabilities*, *23*(3), 290–295. https://doi.org/10.1111/j.1468-3148.2009.00534.x

Collins, J. C., & Collet-Klingenberg, L. (2018). Portable electronic assistive technology to improve vocational task completion in young adults with an intellectual disability: A review of the literature. *Journal of Intellectual Disabilities*, *22*(3), 213–232. https://doi.org/10.1177/1744629516689336

Csillag, S., Gyori, Z., & Svastics, C. (2019). Long and winding road? *Journal of Enterprising Communities: People and Places in the Global Economy*, *13*(1/2), 42–63. https://doi.org/10.1108/JEC-11-2018-0097

Ebuenyi, I. D., Rottenburg, E. S., Bunders-Aelen, J. F. G., & Regeer, B. J. (2020). Challenges of inclusion: a qualitative study exploring barriers and pathways to inclusion of persons with mental disabilities in technical and vocational education and training programmes in East Africa. *Disability and Rehabilitation*, *42*(4), 536–544. https://doi.org/10.1080/09638288.2018.1503729

Foley, K.-R., Dyke, P., Girdler, S., Bourke, J., & Leonard, H. (2012). Young adults with intellectual disability transitioning from school to post-school: A literature review framed within the ICF. *Disability and Rehabilitation*, *34*(20), 1747–1764. https://doi.org/10.3109/09638288.2012.660603

Georgiadou, I., Vlachou, A., & Stavroussi, P. (2022). Quality of life and vocational education service quality in students with intellectual disability. *International Journal of Developmental Disabilities*, *68*(5), 681–691. https://doi.org/10.1080/20473869.2021.1887435

Gupta, J., & Vegelin, C. (2016). Sustainable development goals and inclusive development. *International Environmental Agreements: Politics, Law and Economics*, *16*(3), 433–448. https://doi.org/10.1007/s10784-016-9323-z

Hoelman, M. B., Parhusip, B. T. P., Eko, S., Bahagijo, S., & Santono, H. (2015). *Panduan SDGs: Untuk pemerintah daerah (kota dan kabupaten) dan pemangku kepentingan daerah*. International NGO Forum on Indonesian Development. https://www.batukarinfo.com/system/files/Buku_PANDUAN-SDGs.pdf

Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional (BAPPENAS). (2020). *Metadata indikator: Tujuan Pembangunan Berkelanjutan (TPB)/Sustainable Development Goals (SDGs) Indonesia*. Kedeputian Bidang Kemaritiman dan Sumber Daya Alam, Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional. https://sdgs.bappenas.go.id/website/wp-content/uploads/2020/10/Metadata-Pilar-Sosial-Edisi-II.pdf

Kisanga, D., Wambura, D., & Mwalongo, F. (2018). Exploring assistive technology tools and e-learning user interface in Tanzania ' s vocational education institutions. *International Journal of Education and Development Using ICT*, *14*(3), 50–71. https://www.learntechlib.org/p/188281/

Mandrysz, W. (2020). Community-based social economy–social capital and civic participation in social entrepreneurship and community development. *Management Dynamics in the Knowledge Economy*, *8*(1), 81–93. https://core.ac.uk/download/pdf/289277578.pdf

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis* (2nd ed.). SAGE Publication. https://vivauniversity.files.wordpress.com/2013/11/milesandhuberman1994.pdf

Nofiani, N. S., Kasnawi, M. T., & Hasbi. (2022). Partisipasi kerja penyandang disabilitas: Keterkaitan faktor internal dan eksternal. *Sosio Informa: Kajian Permasalahan Sosial Dan Usaha Kesejahteraan Sosial*, *8*(1), 27–46. https://doi.org/10.31595/inf.v8i1.2979

Paris, D. G., & Miller, K. R. (2018). Wearables and people with disabilities. In Information Resources Management Association (USA) (Ed.), *Wearable Technologies: Concepts, Methodologies, Tools, and Applications* (pp. 833–849). IGI Global. https://doi.org/10.4018/978-1-5225-5484-4.ch035

Rakhmani, V. A., & Bhinekawati, R. (2020). The impact of entrepreneurial orientation of social entrepreneurship towards social capital and organization performance: A case study of precious one. *International Journal of Business Studies*, *4*(2), 56–68. https://doi.org/10.32924/ijbs.v4i2.106

Smythe, T., Adelson, J. D., & Polack, S. (2020). Systematic review of interventions for reducing stigma experienced by children with disabilities and their families in low- and middle-income countries: State of the evidence. *Tropical Medicine & International Health*, *25*(5), 508–524. https://doi.org/10.1111/tmi.13388

Trani, J.-F., & VanLeit, B. (2010). *Increasing inclusion of persons with disabilities: Reflection from disability research using the ICF in Afghanistan and Cambodia* (11). Leonard Cheshire Disability and Inclusive Development Centre. http://www.ucl.ac.uk/lc-ccr/centrepublications/workingpapers

Verdugo, M. A., Fernández, M., Gómez, L. E., Amor, A. M., & Aza, A. (2019). Predictive factors of quality of life in acquired brain injury. *International Journal of Clinical and Health Psychology*, *19*(3), 189–197. https://doi.org/10.1016/j.ijchp.2019.06.004

Wicker, M. R., Davis, T. N., & Hrabal, J. M. (2022). Use of technology in vocational skills training for individuals with intellectual and developmental disabilities: A systematic review. *Education and Training in Autism and Developmental Disabilities*, *57*(2), 135–150. https://www.proquest.com/openview/7ef185770555151278b6ec146ca64f84/1?pq-origsite=gscholar&cbl=2032023

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Blended learning as an effective method for school and university teachers of Kazakhstan

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ABSTRACT

In this article, the author compares different definitions of the term blended learning given by foreign and local scientists and gives his interpretation. The article analyzes world scholars' works on blended learning, determining the advantages and disadvantages of this method. The online survey method was used to find out how far Kazakhstani teachers are familiar with the blended learning method, whether they use it or not, and understand if it is effective. The survey results showed that school and university teachers use blended learning in their lessons and will use it in the future. According to the questionnaire, the benefits of this method are that it encourages teachers to be creative, increases students' interest, and helps them to study independently. Significant shortcomings of blended learning are technical problems and poor Internet connection. Also, teachers need more time to prepare for their lessons. It is challenging for them. Although there are disadvantages to blended learning, the benefits outweigh the disadvantages. Therefore, today this method is effective.

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INTRODUCTION

What is blended learning? There are definitions of blended learning given by different researchers. Blended learning is an approach that is used adopted by many institutes due to its effectiveness in providing timely, continuous, and flexible learning (Prasad et al., 2018). Two definitions are popular among scholars. Graham (2006) and Garrison and Kanuka (2004) offered them. Graham (2006) gives the following definition: blended learning joins face-to-face education and computer-assisted education, while Garrison and Kanuka (2004) define blended learning as integration of face-to-face learning in the class with online learning. As we can see, face-to-face and online teaching are essential things in blended learning. The following definitions support this belief.

According to Porter et al. (2014), blended learning is realized through the combination of face-to-face and technology. Broadbent (2017) thinks this method connects only the advantages of face-to-face and online teaching. Akkoyunlu and Soylu (2008) believe blended learning is the most comfortable method for modern students and teachers that combines online and class teaching. From

the definitions earlier, blended learning is a way of teaching and learning that allows different groups of students to learn in an effective classroom and online environment.

Blended learning is a technique that has gained traction in educational communities in recent years and has shown promise in effectively doing what it set out to do: educate students in ways that fit their learning style (Turpin, 2018). According to Thorne (2003), the main ingredients of blended learning are face-to-face and online learning/teaching, where the usage delivers the knowledge of IT with a good level of classroom interaction. Allen and Seaman (2010) define blended learning as a course that combines online and face-to-face delivery where a significant portion of the content is delivered online through online discussions. In contrast, face-to-face meetings are usually reduced. Horn and Staker (2017) define blended learning as a form of online learning where students control elements such as time, place, path, or pace of learning.

Jusoff and Khodabandelou (2009) show that blended learning reduces network transaction distances and increases interaction between teachers and their students. Finn and Bucceri (2004) provide a more detailed definition of blended learning as an effective integration of several teaching methods, technologies, and delivery modes to meet students' specific communication, knowledge, and information needs. Oliver and Trigwell (2005) concluded that blended learning requires two or more different objects, which can then be mixed.

Driscoll (2002) stated that blended learning had adopted several tools that combine web technology modes, pedagogical approaches, learning technologies, and specific work tasks. Considering the previously described definitions, researchers concluded that blended learning is a pedagogical approach that delivers the lesson's content in a traditional face-to-face and online manner where students manage their time, place, and pace.

What are the advantages and disadvantages of blended learning? Blended learning as a pedagogical approach has certain advantages. According to Horn and Staker (2011), blended learning is an evolutionary and justified change of e-learning. The importance of developing this approach is that it increases active knowledge and strategies aimed at students who need to be visible in e-learning (Horn & Staker, 2011). Thus, blended learning is a successful combination of face-to-face and e-learning aimed at satisfying students' individual needs. Graham (2006) supports this idea and points out that one of the advantages of blended learning is its technological nature and its ability to find the best ways to help students achieve their goals.

Other benefits of integrating blended learning into the classroom have been identified in many studies. This technology allows teachers to use more diverse and engaging methods than face-to-face teaching (Graham, 2006). The role of the teacher is essential because his task is to combine teaching and learning. According to Wu et al. (2010), blended learning is a platform for teachers to improve their skills using different pedagogical strategies. In addition, the role of the teacher becomes a "facilitator" or an "advisor" that shows students how to work better, helps them find methods and techniques, and leads them to success, rather than being a "simple teacher."

Many researchers also note blended learning is important in motivating students and improving their academic performance. In addition, using digital technology in the classroom leads to students' interactive learning and cognitive development (Arlinwibowo et al., 2021; Kassymova et al., 2019; G. K. Kassymova et al., 2021; Pratama et al., 2022). Raes et al. (2020) believes that the hybrid virtual classroom is promising regarding flexibility in education as it gives students a choice of where to attend the course.

Ware and Warschauer (2005) conducted a study and found that blended learning is very useful in "bringing the outside world to class". This means that students have the opportunity to work with teachers around the world to access a variety of materials. When students realize they are getting a unique experience, they are more motivated and want to learn new things. Despite the apparent advantages of using blended learning, practice shows some disadvantages and risks associated with its implementation.

DeLacey and Leonard (2002) are among those who have studied the negative effects of blended learning. For example, this method is more expensive than the traditional one. At the initial stage of implementation, this method requires funds to purchase computers, access to the internet for teachers, schoolchildren, and home students, payment for certain internet resources, and others. At

the same time, blended learning does not promote the development and formation of communication and discussion skills among students as it is focused on individual work.

According to Rasheed et al. (2020), teachers' challenges are mainly in using technology for teaching. Challenges in providing suitable instructional technology; and effective training support to teachers are the main challenges faced by educational institutions. Technical issues related to the poor Internet connection, lack of materials related to the subject they teach, and time-consuming lesson preparation can be obstacles to BL (Zenchuk, 2019).

Hofmann (2011) discusses the challenges of blended learning in the classroom and their causes. For example: (1) The teacher must be good use of technology. Due to the technological nature of blended learning, teachers and students must be familiar with computer operating systems, be able to work on the internet, and solve minor technical problems that may arise during the course. Unfortunately, many teachers, especially in rural areas, are still struggling with ICT literacy, and this approach can be challenging for them;

(2) One of the biggest mistakes in introducing this method is that teachers continue comparing this method with traditional teaching methods. The professional knowledge of educators should inspire the use of new methods but should not be an obstacle; (3) Management and control of participants' progress. Teachers often say this because the available literature needs to provide a clear answer on monitoring and assessing students' achievement when using blended learning. It is difficult for teachers to get evidence that students have completed assignments on their own, so there are questions about how to record progress.

(4) Minimization of teacher participation in the learning process. The key here is to understand the role of the educator in teaching. Introducing a computer into the classroom does not mean avoiding human involvement or minimizing its position. The teacher still plays an important role in educating students by guiding and supporting them and providing valuable feedback at every stage of the learning process.

The literature generally states that blended learning is a complex method that uses many methods and is unique before it is implemented. This study aims to determine: (1) If Kazakhstani teachers are familiar with blended learning; (2) If Kazakhstani school and university teachers use blended learning methods in their lessons; and (3) If using blended learning is effective in Kazakhstan.

RESEARCH METHOD

These days an online survey is widely and successfully used in research practices in Kazakhstan and abroad. This method allows quick processing and analysis of large amounts of information, saving time. The authors used an online survey to determine if Kazakhstani teachers and educators are familiar with blended learning and if they use it in their lessons. Also, it helped to understand if using blended learning is effective. The survey was conducted remotely, without direct contact with the respondent, in March-April, 2021. The survey questions were compiled and distributed on the Google Forms platform.

RESULT AND DISCUSSION

Twenty-eight school teachers and university teachers took part in the survey. Eight of them were men, and 20 were women. 88% work in educational institutions and most participants are school teachers (Figure 1). The respondents are 21 and over 40, and one-third are 31-35. A quarter of teachers are 36-40 and over 40. That is, the age of the participants is above average. Most have much experience, 7 to 15 years (Figure 2). School and university teachers gave different answers to the question 'What is blended learning?'. However, about half of them showed that they were familiar with this teaching method. It also turned out that some confuse this method with other forms of education (Figure 3).

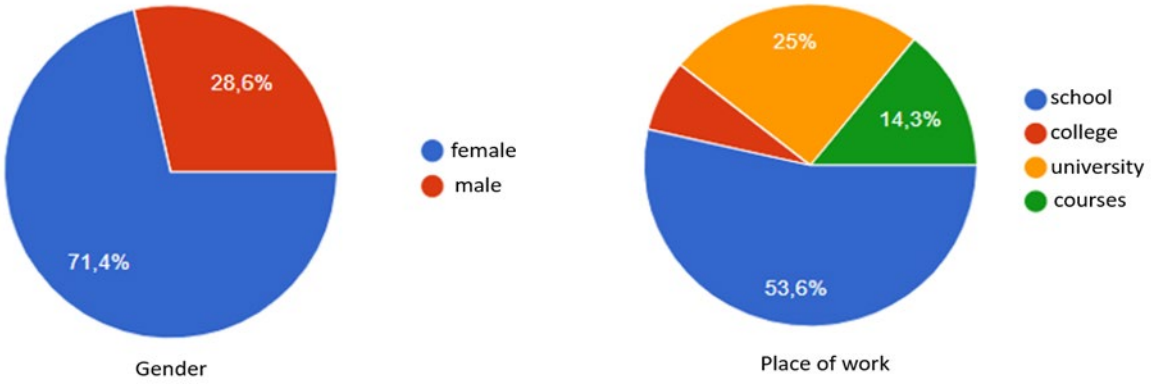

Figure 1. Gender and Respondens' Place of Work

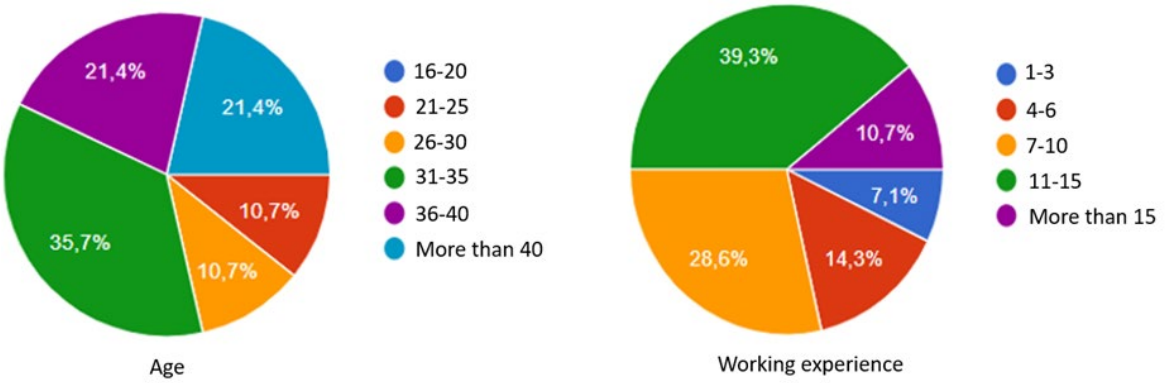

Figure 2. Age and Working Experience of Survey Participants

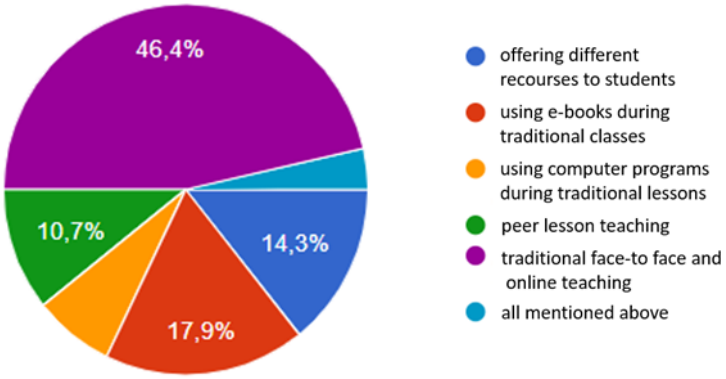

Figure 3. What is Blended Learning?

Most respondents use this method in their lessons, but a third say they do not use it, but 86 percent of educators will use this form of education in the future (Figure 4). School and university educators have shown that the most effective aspect of this method is that it encourages teachers to be creative. They also noted that it would improve students' interest, increase their participation and accountability for their own learning, and develop communication and collaboration skills. It also aims to make teaching and learning relevant and personalized (Figure 5).

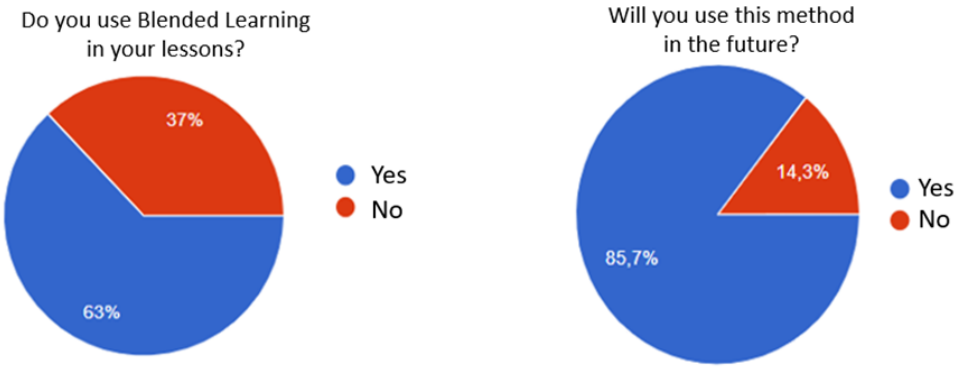

Figure 4. Educators' Response to the Use of Blended Learning in the Future

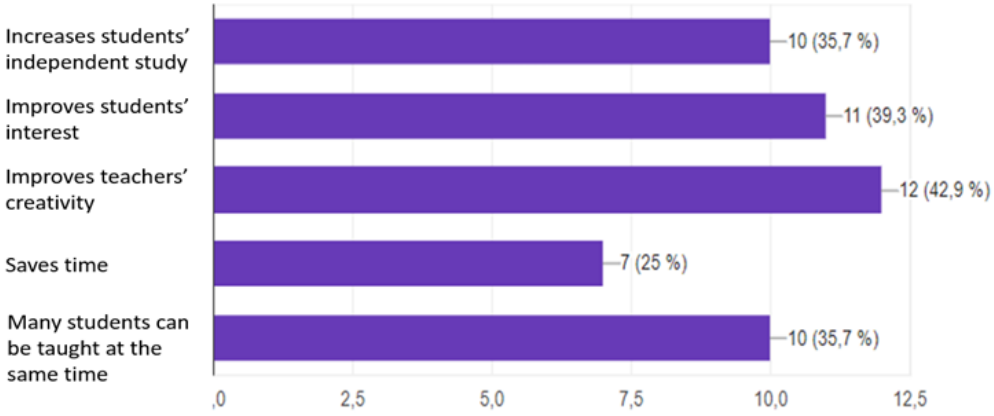

Figure 5. Advantages of Blended Learning

Most respondents answered that online work, technical problems, and problems with the Internet are shortcomings of "blended learning." Another problem is that teachers need more time to prepare for their lessons. Some teachers think this method is unsuitable for their subject due to certain features, and few say that blended learning as a whole did not improve their practice and could not improve students' progress. So, these disadvantages can make teachers avoid using this method in the future (Figure 6). About 80% of teachers answered "Yes" about this method's effectiveness. It means that despite the shortcomings of this method, many school and university teachers recognize its usefulness (Figure 7).

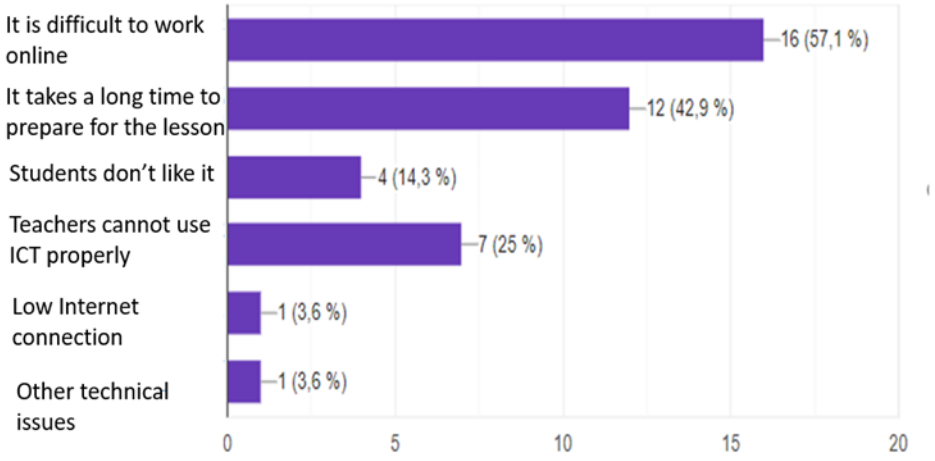

Figure 6. Challenges of Blended Learning

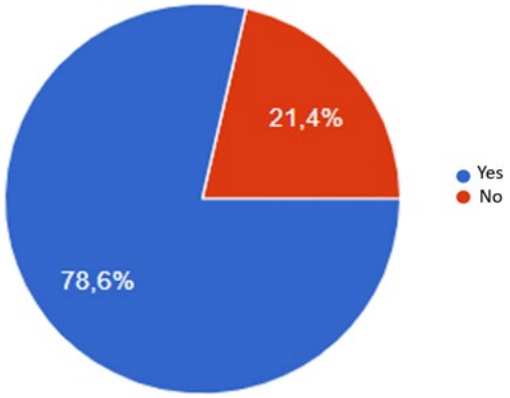

Figure 7. Blended Learning Effectiveness Level

CONCLUSION

In conclusion, blended learning is a pedagogical approach that combines elements such as delivering lesson content online and in a traditional face-to-face manner and managing students' time, place of study, and path. Blended learning can increase students' participation and responsibility for their learning and develop communication and collaboration skills. According to the survey results, the blended learning method is used in educational institutions in Kazakhstan. School and university teachers have shown that they use this method in their lessons and will continue to do so in the future. Although there are disadvantages to blended learning, the benefits outweigh the disadvantages. Therefore, today this method is effective. In the future, another research will be conducted to find out in which subjects the use of blended learning is more effective and what exercises and tasks should be given to students to make this method more productive. This is because Kazakhstani scientists need clear answers to these questions.

REFERENCES

Akkoyunlu, B., & Soylu, M. Y. (2008). A study of student's perceptions in a blended learning environment based on different learning styles. *Educational Technology & Society*, *11*(1), 183–193. https://www.jstor.org/stable/jeductechsoci.11.1.183

Allen, I. E., & Seaman, J. (2010). *Class differences: Online education in the United States, 2010*. Babson Survey Research Group. https://files.eric.ed.gov/fulltext/ED529952.pdf

Arlinwibowo, J., Retnawati, H., & Kartowagiran, B. (2021). How to integrate STEM education in the Indonesian Curriculum? A systematic review. *Challenges of Science*, 18–25. https://doi.org/10.31643/2021.03

Broadbent, J. (2017). Comparing online and blended learner's self-regulated learning strategies and academic performance. *The Internet and Higher Education*, *33*, 24–32. https://doi.org/10.1016/j.iheduc.2017.01.004

DeLacey, B. J., & Leonard, D. A. (2002). Case study on technology and distance in education at the Harvard Business School. *Educational Technology & Society*, *5*(2), 13–28. https://www.jstor.org/stable/jeductechsoci.5.2.13

Driscoll, M. (2002). *Blended learning: Let's get beyond the hype*. IBM Global Service. https://d1wqtxts1xzle7.cloudfront.net/7691892/blended_learning-libre.pdf?1390852743=&response-content-disposition=inline%3B+filename%3DBlended_learning_Lets_get_beyond_the_hyp.pdf&Expires=1674706687&Signature=QyYUFHUYaZ67qZ7mo3fbrB~HDSM0O-KtuTaQWar-lTVa3e

Finn, A., & Bucceri, M. (2004). *A case study approach to blended learning*. Centra Software.

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, *7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk & C. R. Graham (Eds.), *Handbook of Blended Learning*. Pfeiffer Publishing. https://www.researchgate.net/publication/258834966_Blended_learning_systems_Definition_current_trends_and_future_directions

Hofmann, J. (2011). *Top 10 challenges of blended learning*. Trainingmag. http://www.cedma-europe.org/newsletter articles/Training Magazine/Top 10 Challenges of Blended Learning (Apr 11).pdf

Horn, M. B., & Staker, H. (2011). *The rise of K-12 blended learning*. Innosight Institute. https://aurora-institute.org/wp-content/uploads/The-Rise-of-K-12-Blended-Learning.pdf

Horn, M. B., & Staker, H. (2017). *Blended: Using disruptive innovation to improve schools*. John Wiley & Sons.

Jusoff, K., & Khodabandelou, R. (2009). Preliminary study on the role of social presence in blended learning environment in higher education. *International Education Studies*, *2*(4), 79–83. https://files.eric.ed.gov/fulltext/EJ1065767.pdf

Kassymova, G. K., Arpentieva, M., Kosherbayeva, A., Triyono, M., Sangilbayev, O., & Kenzhaliyev, B. (2019). Science, education & cognitive competence based on e-learning. *Bulletin of the National Academy of Sciences of the Republic of Kazakhstan*, *1*(377), 269–278. https://doi.org/10.32014/2019.2518-1467.31

Kassymova, G. K., Vafazov, F. R., Pertiwi, F. D., Akhmetova, A. I., & Begimbetova, G. A. (2021). Upgrading quality of learning with e-learning system. *Challenges of Science*, 26–34. https://doi.org/10.31643/2021.04

Oliver, M., & Trigwell, K. (2005). Can 'blended learning'be redeemed? *E-Learning*, *2*(1), 17–26. https://journals.sagepub.com/doi/pdf/10.2304/elea.2005.2.1.17

Porter, W. W., Graham, C. R., Spring, K. A., & Welch, K. R. (2014). Blended learning in higher education: Institutional adoption and implementation. *Computers & Education*, *75*, 185–195. https://doi.org/10.1016/j.compedu.2014.02.011

Prasad, P. W. C., Maag, A., Redestowicz, M., & Hoe, L. S. (2018). Unfamiliar technology: Reaction of international students to blended learning. *Computers & Education*, *122*, 92–103. https://doi.org/10.1016/j.compedu.2018.03.016

Pratama, H., Azman, M., Zakaria, N., & Khairudin, M. (2022). The effectiveness of the kit portable PLC on electrical motors course among vocational school students in Aceh, Indonesia. *Kompleksnoe Ispolzovanie Mineralnogo Syra*, *320*(1), 75–87. https://doi.org/10.31643/2022/6445.09

Raes, A., Vanneste, P., Pieters, M., Windey, I., Van Den Noortgate, W., & Depaepe, F. (2020). Learning and instruction in the hybrid virtual classroom: An investigation of students' engagement and the effect of quizzes. *Computers & Education*, *143*, 103682. https://doi.org/10.1016/j.compedu.2019.103682

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, *144*, 103701. https://doi.org/10.1016/j.compedu.2019.103701

Thorne, K. (2003). *Blended learning: How to integrate online & traditional learning*. Kogan Page Publishers.

Turpin, C. M. (2018). *Blended learning and its effect on student achievement: An action research study* [University of South Carolina].

https://www.proquest.com/openview/71c052f6899d8eb9f882af4cda107879/1?pq-origsite=gscholar&cbl=18750&diss=y

Ware, P. D., & Warschauer, M. (2005). Hybrid literacy texts and practices in technology-intensive environments. *International Journal of Educational Research*, *43*(7–8), 432–445. https://doi.org/10.1016/j.ijer.2006.07.008

Wu, J.-H., Tennyson, R. D., & Hsia, T.-L. (2010). A study of student satisfaction in a blended e-learning system environment. *Computers & Education*, *55*(1), 155–164. https://doi.org/10.1016/j.compedu.2009.12.012

Zenchuk, I. (2019). *Kazakhstani secondary teachers' attitudes towards blended learning* [Nazarbayev University]. http://nur.nu.edu.kz/handle/123456789/4334

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Evidence-based geology as a basis for improving the efficiency of innovative design of the development of Tengizchevroil oil fields

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ABSTRACT

The article's main purpose is to study the method of storing sulfur in solid form in a large block at Tengizshevroil deposits and dispose of sulfur residues. Thus, we have to admit that, in this case, the evaluation of the effectiveness of the innovation at the stage of its development was performed incorrectly, and thus the consumer was misled. As a rule, the production activities of enterprises are planned according to the average parameters that are not known reliably in advance and can change randomly. At the same time, a situation with sharp changes in these indicators is extremely undesirable because this means the threat of loss of control. The smaller the deviation of the indicators from the average expected value, the greater the stability. That is why the statistical method based on mathematical statistics has become the most widespread in assessing investment risk. A more complex mathematical apparatus (regression and correlation analysis, simulation modeling methods) allows for a deeper analysis of the risk and its causes. The discrepancy between modern progressive technical capabilities and archaic "expert" geological thinking. Unfortunately, when making decisions, geologists often rely solely on personal experience, while the basis of evidence-based geology is experimental research (including statistical experiments), which serves as material for a systematic review, meta-analysis, and the development of practical guidelines (recommendations) based on them. The use of the principles of evidence-based geology involves a combination of individual practical experience and optimal evidence obtained through a systematic analysis of experimental and experimental-methodical studies. The instrumental support of evidence-based geology is modern technologies of statistical data analysis, data mining and artificial intelligence, and analytical platforms to build applied solutions.

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INTRODUCTION

In modern realities, a constant increase in the share is hard-to-recover reserves. The complication of mining and geological conditions of development and the need to use new technological solutions to improve the efficiency of the domestic oil and gas production complex, the development of the country's mineral resource base and the preservation of its economic stability, innovative design of geological and technological measures is of crucial importance (Scholz & Wellmer, 2013). The new Kazakhstan classification of hydrocarbon reserves and resources is now

project-oriented, i.e., at any stage of geological exploration of the subsurface, the main document determining further study and development is the project of geological study, trial operation, field development, and others (Sergeev et al., 2014).

It was evident that the cost-effective development of reserves, previously considered complex or difficult to recover, is possible only based on introducing new technologies, which, in turn, requires effective, innovative design (Dodson et al., 2012). Here, as an assessment of the effectiveness of innovative design, one can take the share of implemented innovative projects that have given an acceptable economic effect from introducing innovation. Innovation activity is the process of creating a new product, new technology, or service based on the results of scientific research in order to gain competitive advantages in the sale of manufactured products, works, and services in the markets (Baigabylov et al., 2020).

Innovation (innovation) is the final result of innovative activity, which has been implemented as a new (improved) product or technological process (Ionescu & Dumitru, 2015). Each specific innovation appears as a result of the scientific and production cycle and goes through certain stages of development - creation, development, and dissemination (Chiesa et al., 1996). Each of these stages contains several mandatory stages.

Thus, the stage of innovation creation contains the stages of fundamental (obtaining new knowledge) and applied (practical application of knowledge) research, experimental (design, manufacture, testing) development, and others. Product development is the final stage of research, characterized by the transition from laboratory conditions and experimental production to industrial production (Pisano, 1994). At this stage, the final verification of theoretical research results is carried out, the corresponding design and technical documentation are developed, and a technical prototype or an experimental technological process is manufactured and tested.

Based on the results of this stage, an assessment of the effect of the implementation of innovation is carried out, which is necessary to compare the results obtained with the results of using other similar-in-purpose innovation options. The general principle of evaluating effectiveness is comparing results and costs; this comparison is usually made in effect = Result/cost ratio (Reardon, 2005). The above ratio can be expressed both in natural and monetary terms. Effective implementation of innovations involves exceeding the result of introducing innovation over the cost of implementing innovation.

Currently, the specifics of most innovative projects in the oil and gas production complex are such that any assessment is subjective because it is based on the opinions and knowledge of experts. High uncertainty about the future consequences at the time of deciding on the implementation of the project makes it impossible to make a final decision based on the use of formalized methods of investment assessment (Gluch & Baumann, 2004). This increases the risk of making a wrong choice of innovative projects and suboptimal decisions when implementing innovations (Moldabayeva et al., 2021). For example, studying the experience of various organizations' specialists in the geological and hydrodynamic modeling of oil field development processes shows that their points of view need to be revised.

On the one hand, it is noted that "the mass application of modeling technologies has made noticeable improvements in the design practice: the quality of documentation has been unified, the quality of design work has improved," on the other hand, "despite a significant increase in various kinds of research, design work and the volume of costs in general, the existing main drawback of forecasts remains - the discrepancy between actual and calculated technological indicators (current and final oil production)." For mature deposits with a long development history and are in a late stage, the accuracy of forecasts made using traditional analytical techniques is equal to those obtained from reservoir modeling. Meanwhile, numerical reservoir modeling is more time-consuming and expensive and involves significant human and technical resources (Jalalov et al., 2021).

RESEARCH METHOD

Using quantitative methods makes it possible to obtain a numerical assessment of the project's riskiness to determine the degree of influence of risk factors on its effectiveness. Unfortunately, many authors of innovative projects need to pay more attention to the practical

(statistical) assessment of the proposed methods' geological (field) effectiveness. As shown below, the success examples cited by the authors to justify the effectiveness of innovative technologies often need to contain sufficient data for reliable, statistically sound conclusions (Chubukova, 2006). In confirmation of the high efficiency of acoustic impact on the formation to increase permeability and flow rate, the author gives an example of successful impact in 3 wells (3 successes in 3 cases).

However, the estimation of the probability of success by the Wilson method, taking into account the sample size, in this case, is only 76% (Sahu & Smith, 2006). The calculation of the interval estimate (confidence probability – 0.95) by the Klopper-Pearson method shows the lower limit of the confidence interval of 37%, i.e., the real success of acoustic exposure, according to this example, may well be below 50% (Ludvigsen et al., 1987). It is evident that these and other similar examples, which are practically useless in terms of evidence due to the small volume of samples used, are given by the authors of innovations solely to have an emotional impact on a potential consumer. Today, the world is transitioning from "impressionist" geology, based on opinions and impressions, to evidence–based geology - "evidence-based geology."

Evidence-based geology is not a new science but a new technology for collecting, analyzing, and interpreting scientific information. The main reasons for the transition to evidence-based geology: First, increasing the volume and access to scientific information. Dozens of geological journals are published in Kazakhstan, and it is almost impossible to assimilate this massive flow of information, sometimes contradictory. Moreover, the introduction of the Internet into everyday activities opens up limitless opportunities for access to information.

All this creates the need for analysis, generalization of the available information, and its presentation in a form ready for practical use. Second, the emergence of new, as a rule, expensive methods of geological-geophysical, geochemical, and others. Research. There is a need to choose methods with high efficiency and lower cost. The emergence of numerous pseudoscientific "methods," lobbying of oil companies, and the so-called "corruption component" further complicate the situation. At the same time, it should be borne in mind that neither the high cost nor the duration of application ("traditional") methods is not a guarantee of its high efficiency (Muslimov, 2018).

The literature generally states that blended learning is a complex method that uses many methods and is unique before it is implemented. This study aims to determine: (1) If Kazakhstani teachers are familiar with blended learning; (2) If Kazakhstani school and university teachers use the blended learning method in their lessons; and (3) If using blended learning is effective in Kazakhstan.

RESULT AND DISCUSSION

This allows us to identify reliable patterns that, unlike expert opinions, are completely objective. Evidence-based geology tools complement the intuition and qualifications of geologists with up-to-date, reliable information about the most effective and economically justified approaches to solving various geological and field tasks, which allows us to offer the best option of geological and technological measures in each case. It is essential to adhere to the principles of evidence-based geology when designing the development of hard-to-recover reserves because it is advisable to provide benefits only to those subsoil users who can correctly and objectively justify the need for this.

At the same time, it should be taken into account that in most real situations, many parameters of the geological environment and, consequently, the forecast and the result of geological and technological measures are uncertain and, therefore, should be expressed in probabilities. In addition, there is always some bias and systematic errors embedded in observations, and any research is subject to the influence of chance. This leads to a natural conclusion: all researchers (including geologists-practitioners) should rely only on such observations based on solid scientific principles, including ways to reduce systematic errors and bias, as well as an assessment of the role of random factors.

In order to meet the above requirements, it is necessary to consider many aspects related to the measurements of the studied indicators and the assessment of the reliability of measurements, their reproducibility, accuracy, interpretability, and others (Volkov et al., 2019). As an example demonstrating the importance of advanced (pre-project) Research and development, it is possible to

cite studies carried out under the guidance of Academician Muslimov (2018) in 1998-2008. The results of these studies conducted by TSSMrneft LLC showed that changing the methods of constructing a geological model and revaluation of the Romashkinskoye field, as well as further exploration in combination with measures aimed at increasing the KIN, will extend the development period to 250 years and increase recoverable reserves by at least 770 million tons.

An essential area of the Center's activity is the examination of the innovative infrastructure of oil and gas production enterprises and the developing recommendations for optimizing the interaction of all its elements. Currently, Tengizchevroil has sufficient scientific potential and practical experience both to carry out pre-project studies (assessments, examinations) of the degree of readiness of innovations for pilot tests and to assist the authors of innovative developments in improving the proposed technologies and justifying the feasibility of their implementation (Lobankov & Sviatokhin, 2014).

Table 1. Sulfur Sublimation on Tengizchevroil's Sulfur Maps According to IHN

Card number	Length, m	Width, m	Area, m2	Weight of sublimation sulfur during storage of the block g / m2 per year	Total sublimated sulfur residue per year, t / year
1	227	105	23835	11,25	0,269
2	237	110	26070	11,25	0,294
3	237	110	26070	0	0
4	351	110	38610	11,25	0,435
5	425	310	131750	11,25	1,483
6	425	310	131750	11,25	1,483
7	504	281	141624	11,25	1,594
	Total		352015		5,558

According to Tengizchevroil's sulfur maps, sulfur sublimation is estimated at 5.6 tonnes per year. As a result of research conducted by Zaurbekov et al. (2018), the following conclusions can be made:

(1) Tengizchevroil's sulfur stored on sulfur maps is of high purity and meets the requirements of grade 9998, while long-term storage sulfur meets grades below 9995; (2) The primary sources of Tengizchevroil's sulfur in open storage are: microabiological sulfuric acid, sulfur sublimation, dust-forming elemental sulfur, and separation of hydrogen sulfide from sulfur blocks; (3) Elements of arsenic, selenium, Mercury, manganese, and copper were not observed in the Tengizchevroil environment. A low ash content characterizes sulfur here. It is found in small amounts of iron, which has fallen into sulfur from technological equipment; (4) The acidity of sulfur increases depending on the shelf life. Thus, the sulfur content stored for ten years can increase by 25 times, and by weight is 0.025%. This fact indicates the contribution of the process of microbiological acidification of sulfur; (5) The content of organic substances in samples of Tengizchevroil sulfur is 0.006% by weight. 0.0 IR spectrometry methods detected 0.016 and 0.021% organic substances; (6) Sulfur in Tengizchevroil's sulfur Maps has low micro-monopolistic properties, i.e., sulfur extraction technology at TCO prohibits the presence of gaseous compounds; (7) No sulfuric organic substances (mercaptans) were detected in the samples of Tengizchevroil sulfur; (8) The average daily hydrogen sulfide residue from Tengizchevroil's sulfur Maps is at most 3 kg per 1 million tons of open-air sulfur storage; (9) The dust distribution of sulfur in Tengizchevroil's sulfur Maps is 4 tons per year; and (10) Sulfur sublimation in Tengizchevroil's sulfur Maps was 5.6 tons per year.

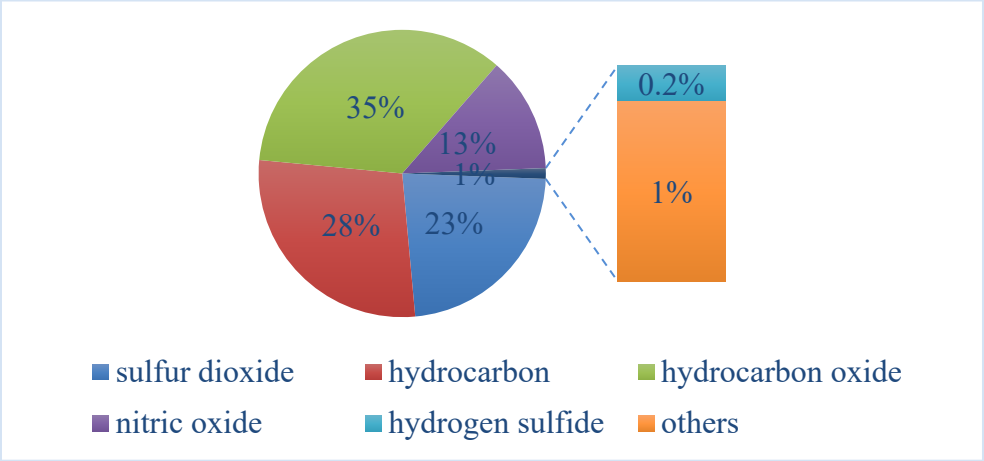

Figure 1. Proportion of Pollutants in Total Emissions

In particular, air pollution is one of the most pressing problems with the excessive release of H2S (hydrogen sulfide). To solve this problem, it is necessary to prevent the release of harmful substances into the air, including eliminating toxic gases and waste, which every resident should deal with. We can not hide the fact that environmental problems are also associated with the destruction of the atmosphere. Thus, the volume of oil production amounted to 13.5 million tons, from which 68.2 thousand tons of harmful substances were released into the atmosphere.

CONCLUSION

Measures to reduce emissions into the atmosphere for Tengizchevroil include (1) a foam dedusting system device, (2) device of a liquid desulfurization system for trapping hydrogen sulfide vapors from liquid sulfur, (3) the Use of two mechanical pumps that reduce waste by 100%, (4) closing fittings with open Stoppers, (5) the use of graphite seals in valves, and (6)control of gasification levels using electronic gas detection systems.

Removal of waste gases (hydrogen sulfide or sulfur dioxide) from sulfur maps. This process has a place because technological sulfur is obtained by acidification of hydrogen sulfide with air, so hydrogen sulfide is constantly present in dissolved sulfur in the form of a semi-sulfide of hydrogen. The residual sulfur content in sulfur dioxide is also taken into account.

Sublimation and dust formation of elemental sulfur on sulfur maps. Sublimation sulfur can be partially oxidized to sulfur dioxide, and the second part of it can form finely dispersed dust. In addition, finely dispersed dust can also form during ventilation, which can harm the health of personnel. On the other hand, sulfur dust can get into the soil, which causes changes in the acidity and alkalinity of the groundwater.

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One of the most pressing problems at present is the sharp deterioration of human health by polluting the ecology of nature. Toxic substances, heavy metals, nitrates, nitrites, pesticides, and others. Among the most common chemicals, carcinogens are the most dangerous - benzopyrene. These substances enter the human body through air, water, and food. Such toxic substances often disrupt the functioning of the respiratory organs-lungs and aorta.

It is known that if we pass 200 liters of air a day through the lungs, we will take in harmful gases in the structure of the air. In particular, air pollution is one of the most pressing problems with the excessive release of H2S (hydrogen sulfide). To solve this problem, it is necessary to prevent the release of harmful substances into the air, including eliminating toxic gases and waste, which every resident should deal with.

REFERENCES

Baigabylov, N., Dodonov, V., Helm, T., Kashkinbekov, A., Kaukenov, A., Khassenov, M., Mussayeva, M., Mussina, A., Oshakbayev, R., Otar, E., Rudert, D., Satpayev, D., Seilekhanov, Y., Syzdykov, N., Tokar, P., & Uakpayev, B. (2020). *The transformation of Kazakhstan's economy*. Konrad-Adenauer-Stiftung e. V. https://www.kas.de/documents/266501/0/Book_ENG.pdf/cc37ea7d-b2fa-f67d-2485-37d4939c984f?version=1.0&t=1595319835106

Chiesa, V., Coughlan, P., & Voss, C. A. (1996). Development of a technical innovation audit. *Journal of Product Innovation Management*, *13*(2), 105–136. https://doi.org/10.1111/1540-5885.1320105

Chubukova, I. A. (2006). *Data mining: Textbook*. Internet Information Technology University, BINOM, Laboratoriya Znanii.

Dodson, J. R., Hunt, A. J., Parker, H. L., Yang, Y., & Clark, J. H. (2012). Elemental sustainability: Towards the total recovery of scarce metals. *Chemical Engineering and Processing: Process Intensification*, *51*, 69–78. https://doi.org/10.1016/j.cep.2011.09.008

Gluch, P., & Baumann, H. (2004). The Life Cycle Costing (LCC) approach: A conceptual discussion of its usefulness for environmental decision-making. *Building and Environment*, *39*(5), 571–580. https://doi.org/10.1016/j.buildenv.2003.10.008

Ionescu, A., & Dumitru, N. R. (2015). The role of innovation in creating the company's competitive advantage. *Ecoforum Journal*, *4*(1), 99–104. http://www.ecoforumjournal.ro/index.php/eco/article/view/115

Jalalov, G., Kunayeva, G., & Bayamirova, R. (2021). Horizontal wells as a means of intensification of oil production. *Kompleksnoe Ispolzovanie Mineralnogo Syra*, *319*(4), 37–47. https://doi.org/10.31643/2021/6445.39

Lobankov, V. M., & Sviatokhin, V. (2014). Measurements in petroleum geology and geophysics. *6th EAGE Saint Petersburg International Conference and Exhibition*, 1–5. https://doi.org/10.3997/2214-4609.20140244

Ludvigsen, C. W., Swanson, J. L., Thompson, T. R., & McCullough, J. (1987). The Failure of neonates to form red blood cell alloantibodies in response to multiple transfusions. *American Journal of Clinical Pathology*, *87*(2), 250–251. https://doi.org/10.1093/ajcp/87.2.250

Moldabayeva, G., Agzamov, A., Suleimenova, R., Elefteriadi, D., Abileva, S., & Baluanov, B. (2021). Hydrodynamic modeling of field development using enhanced oil recovery methods. *Kompleksnoe Ispolzovanie Mineralnogo Syra*, *317*(2), 14–22. https://doi.org/10.31643/2021/6445.13

Muslimov, R. K. (2018). Problems of exploration and development modeling of oil fields. *Георесурсы*, *20*(3), 134–138. https://cyberleninka.ru/article/n/problems-of-exploration-and-development-modeling-of-oil-fields

Pisano, G. P. (1994). Knowledge, integration, and the locus of learning: An empirical analysis of process development. *Strategic Management Journal*, *15*(S1), 85–100. https://doi.org/10.1002/smj.4250150907

Reardon, T. (2005). Research findings and strategies for assessing telemedicine costs. *Telemedicine and E-Health*, *11*(3), 348–369. https://doi.org/10.1089/tmj.2005.11.348

Sahu, S. K., & Smith, T. M. F. (2006). A Bayesian method of sample size determination with practical applications. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *169*(2), 235–253. https://doi.org/10.1111/j.1467-985X.2006.00408.x

Scholz, R. W., & Wellmer, F.-W. (2013). Approaching a dynamic view on the availability of mineral resources: What we may learn from the case of phosphorus? *Global Environmental Change*, *23*(1), 11–27. https://doi.org/10.1016/j.gloenvcha.2012.10.013

Sergeev, V. A., Kipcharskaya, E. V., & Podymalo, D. K. (2014). *The fundamentals of innovative design: The manual*. UlSTU.

Volkov, V. A., Falovskiy, V. I., Prokhorov, P. E., & Turapin, A. N. (2019). Geological accumulation of CO2 snd its use in oil fileds of the Samara Region. *Oilfield Engineering*, *8*, 11–18. https://doi.org/10.30713/0207-2351-2019-8(608)-11-18

Zaurbekov, S. A., Chugunova, N. I., Tatichanova, G. S., & Nursultanov, M. E. (2018). Characteristation of solid sulfur in the Tengizchevroil. *Journal of Chemical Technology and Metallurgy*, *53*(1), 37–42. https://journal.uctm.edu/node/j2018-1/5_17-102_p_37-42.pdf

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Development of e-wallet application "DASIGU" - based teaching factory

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Teaching factory

ABSTRACT

The trend of non-cash or cashless payments through e-wallet applications is increasing because the application presents the ease of transacting features accompanied by discounts and cashback that are attractive to its users. Not realizing it increases people interest in transacting and shopping both it increases their interest in transacting and shopping online and offline, which will encourage the country's economic growth. So many start-ups and institutions are vying to develop digital wallet applications. Likewise, SMK YPM 3 Taman Sidoarjo is an educational institution based on vocational or expertise to support teaching factory learning and facilitate consumers in transacting it is necessary to develop e-wallet applications in schools. The purpose of this study is to provide an overview of the importance of developing e-wallets in schools aimed at improving the quality of schools through online transactions on products by students. This type of research and development (R&D) with a 4D development model. The stages in this research are defined, designed, developed, and disseminated. The application's assessment instrument uses a Likert scale questionnaire distributed online. A sample was randomly selected from users of the e-wallet application, some teachers and students. The results of the digital wallet application product trial "DASIGU" to 173 students responded with 26 user experience questionnaire indicators resulted in a figure of 73.4% and belonged to the category of "Worth" use. Through the development of this e-wallet application, it will be easier for the school community to transact support products in the form of student services and goods.

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INTRODUCTION

The rapid development of technology accompanied by creative innovations produces a variety of technologies and products that make it easier for human work. Technology is generally tasked with facilitating all human activities. From the productive work sector in the form of machines or tools in factories, transportation tools to human needs ranging from clothing, food, and residence can be easily met with application features (Austin et al., 2014).

One of the applications that are trending and is a large market share is the existence of e-wallet applications or digital wallets. If, in the past, to buy, we need to bring money in cash, now

click through mobile phone, we can easily buy according to non-cash payments. This e-wallet greatly facilitates human work in reducing the risk of loss and does not need to bring money with a large nominal for a transaction of great value (Kalyani, 2016).

Many of us still need to understand the difference between e-wallets and e-money, although they are related (Widiyati & Hasanah, 2020). The main difference between an e-wallet and e-money is in the form its shape. E-money is usually in the form of a chip implanted on a card or other media. In other words, e-money uses chip-based (Mulyana & Wijaya, 2018). Meanwhile, digital wallets or e-wallets are electronic money from servers or so-called server-based systems, so a mobile phone must be connected first to the publisher's server, meaning that internet access is needed for its use (Mulyana & Wijaya, 2018).

Another difference is the limit on the balance amount in e-wallets and e-money. The maximum balance amount in e-money is 1 million Rupiah only, while the maximum balance e-wallet can reach 10 million Rupiah (Rosmayanti, 2019). In addition, security features in e-money have yet to be available so that e-money can be used easily by others. At the same time, an e-wallet has security features in activating mobile numbers and pin codes. If we are transparently based on history, e-money comes first, then the e-wallet application. E-wallets emerged and were introduced due to the increasingly sophisticated development of smartphones through digital transactions and weaknesses related to the security features of e-money itself (Fitria et al., 2022; Shetty et al., 2014). So e-wallet is a reincarnation of e-money with various narrowing features that are not contained in e-money.

E-wallets are proliferating with government support. The Indonesian government has long planned efforts to safely use non-cash payment instruments until, in 2014, Bank Indonesia launched the GNNT program (non-cash national movement) so that Indonesians become less cash society (Sari et al., 2019). The policy is a continuation of the program in 2009, which refers to three essential aspects: increasing the distribution of safe, reliable, and efficient money, improving excellent cash services, and improving the quality of goods (Austin et al., 2014).

Based on Bank Indonesia's record in 2018, transactions that occurred using e-wallets in Indonesia reached 21,3 trillion Rupiah (Anggraeni, 2019). Until February 2019, there were the five highest local e-wallets in transactions, namely: Go-Pay in the first place with a transaction value of 89.5 trillion Rupiah, followed by OVO, DANA, LinkAja, and iSaku (Safarudin et al., 2020). It is estimated that this value will continue to grow, accompanied by the development of the less cash society trend. The magnitude of the e-wallet platform business opportunity, accompanied by growing interest in the cashless trend, makes start-ups compete with e-wallets by cooperating with online and offline market share (Tasci, 2017). This can be seen by the increasing number of online and offline stores that provide non-cash or cashless payment systems.

Therefore, as a school engaged in the vocational or expertise sector, SMK YPM 3 Taman wants to develop an e-wallet application integrated with all school digitization systems and other supporting facilities. In addition to being a non-cash payments tool, this e-wallet is expected to become a teaching factory (Tefa) based learning media that is an industry-based learning concept (products and services) that refers to standards and procedures applicable in the business and industrial world (DUDI) (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2012).

Teaching factories can also be interpreted as a combination of competency-based learning and industry learning, with a process of expertise or competence designed and implemented based on working procedures and standards that produce products following the market or consumer demands (Puspita et al., 2020). The resulting products can be in the form of services or goods (Fajaryati, 2012). The implementation of teaching factory (Tefa), according to the Directorate of Vocational Development, can be applied in various studies of expertise, among others: Agribusiness and Agrotechnology, Business and Management, Technology and Engineering, Information Communication and Technology (ICT), Craft Arts and Tourism (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2012).

Previous research conducted by Andri et al. (2019) regarding e-wallets was the development of mobile and web-based E-Canteen applications at Microskil University, Indonesia. The canteen owned by Mikroskil University is already equipped with WiFi internet with a payment system through GoPay e-wallet, but the booking system is still conventional. The purpose of the study was

to develop an E-Kantin app that makes it easier to order food and beverages. The app was developed on an Android-based platform for visitors and booth tenants to access and a web-based app for use by canteen managers. System development uses waterfall methodology. Systems testing through the black box method shows that the functional system is functioning correctly to improve service and comfort to visitors and facilitate the management of the canteen by getting accurate transaction reports of each booth (Andri et al., 2019).

Another research is about the Android-based e-wallet application on the bus Transmetro Pekanbaru City conducted by Tendra and Suwarti (2020). The development of an e-wallet application on Transmetro bus Pekanbaru City aims to facilitate passengers' transactions because cash payments are needed in return if there is no money right. Charging the balance can be done through two methods: through the Bank account of the Transmetro bus that is entered on the application or through charging the balance to the operator in charge (Tendra & Suwarti, 2020).

Payment is enough through a QR code scan at the time of the transaction and will be recorded automatically in the Transmetro database without the need to recap the data. The QR code provided by each transaction is sometimes different because every second, the application will create a QR code automatically according to passenger data and some additional codes. This is done in anticipation of cheating (Tendra & Suwarti, 2020).

From some previous research, e-wallet applications have been widely developed in universities and public transportation facilities. However, the development of e-wallet applications in the world of secondary education has yet to be implemented, so the development of digital wallets (e-wallets) is a new thing that must be introduced and developed. In addition to being a non-cash payment tool that facilitates every transaction, this digital wallet will encourage the school digitization system so that the school's financial system statements become more transparent and accurate.

RESEARCH METHOD

This type of research is included in research and development (R&D) using a 4D (define, design, develop, disseminate) development model. Model 4D development is a model developed by Thiagarajan et al. (1974). This development model consists of 4 stages: define, design, develop and disseminate (Thiagarajan, 1974). In the first stage, the definition starts from the initial analysis, analysis of tasks and concepts, characteristics of application user targets, and the formulation of application development goals. A preliminary analysis is needed to discover what needs and problems need to be solved through this research and development. Analysis of tasks and concepts is necessary to find out the potential and skills of the school that will later be identified in the main concepts to be developed. The characteristics of the application's target users are intended so that the development of the application is in accordance with the intended target. Then the formulation of the purpose of application development must be carried out so that the context of the application development runs following the original purpose of the formulation.

The second stage is the design stage of the e-wallet application, with the selection of the initial format and the application's design. This stage is closely related to the selection of the application name, the primary color of the application, and the menus in the application. The e-wallet application is designed using the "Visual Studio Code" application. In addition, at the initial design stage of the application, it is determined how the system tops up (fills) e-money and at least fills it up.

In the third stage, the development stage goes through two stages: expert validation and product development trials. Expert validation is required to ensure the safety and comfort of application users (Wong & Li, 2010). Expert judgment will be the basis for product revision and improvement of deficiencies found in the application to be developed (Khotima et al., 2022). Product development trials were conducted on a small sample of some teachers and students. From this stage, the final storyboard will be generated from the e-wallet application.

In the last stage, namely the deployment, three stages of validation testing, packaging, diffusion, and adoption are carried out. At the validation testing stage, the revised e-wallet application at the development stage is implemented in the target application users, namely school residents. The

packaging stage, through the launching of the application, was festively accompanied by cashback and discounts to give a positive impression on the development of the e-wallet application. Later, it is hoped that the e-wallet application can be absorbed and adopted by school residents as a digital transaction tool.

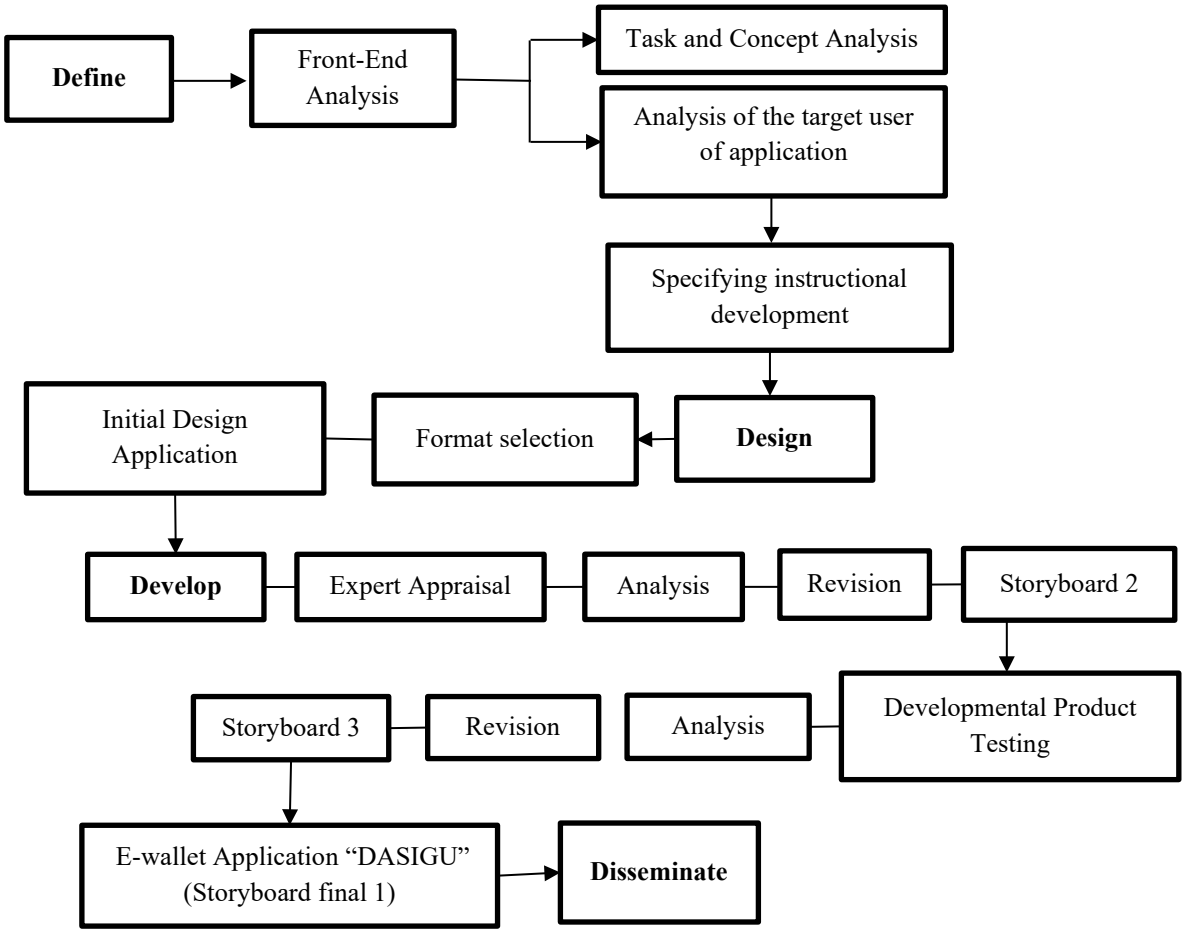

Figure 1. Research Stages

This research and development were carried out at SMK YPM 3 Taman. The school is located at Jl. Ngelom Megare No. 30, Sidoarjo, Indonesia. SMK YPM 3 Taman is a private school under the auspices of the Ma'arif Education and Foundation (YPM) Sepanjang, Sidoarjo. The target of the development of this application is all school residents ranging from student guardians, educators, education personnel, and all learners.

The data used in this study is qualitative and quantitative data (mix) that is concluded descriptively. Using qualitative and quantitative data (mix) aims to provide a detailed picture of planning, developing, and implementing (Greene et al., 1989) e-wallet applications as a legitimate transaction tool in schools. The data analysis techniques used in this study are descriptive verbal data analysis, expert validation data sheets, and product feasibility trial data.

Descriptive verbal data obtained from interviews and observations are analyzed by transcribed oral verbal data, selecting and making classifications, analyzing data, and formulating the conclusion of analysis results as the basis for the preparation of developed products (Hanafi, 2019). Depth interviews and observations need to be conducted to obtain valid data on the planning, development, and implementation of the e-wallet application.

Data on the feasibility trial of e-wallet products are obtained through the questionnaire assessments given to a sample of teachers and students. A sample was randomly selected from users of the e-wallet application, some teachers and students. The number of samples used in this study was 173 learners. The questionnaire model used is a user experience questionnaire model with 26

indicators that aim to determine the feasibility of e-wallet products based on the Likert scale. The Likert scale measures individual behavior by responding to five preferred points on each question item with a linear scale model (Likert, 1932). The Likert scale is not a data type that measures individual traits but a measurement of knowledge or attitude using a total score of question items based on the interval measurement scale (Budiaji, 2013).

RESULT AND DISCUSSION

The development of digital wallet applications or e-wallets uses a 4D model consisting of several stages: define, design, develop and dissemination. Each of these stages will be detailed into several development processes.

Define

This stage is done to determine the school's needs and the purpose of developing e-wallet applications. This stage is divided into several development stages: front-end analysis, task and concept analysis, characteristics of the target user of the application, and specifying instructional development.

Front-end Analysis

Front-end analysis is done to discover what needs and problems can be solved through this research and development. The results of the front-end analysis based on interviews with the principal stated that SMK YPM 3 Taman has a school-owned business entity or teaching factory. The existence of this teaching factory facilitates learners to be able to carry out learning based on procedures and standards that produce products both in the form of services and goods (Fajaryati, 2012).

Three school-owned business entities in SMK YPM 3 Taman-based teaching factory involve students in its management: UPJ (service unit), which serves the graphic design, printing, and photography services. In addition, the business entity routinely holds youtube podcast activities by bringing in sources from inside and outside the school.

The second business entity is BNI (Bank Nurul Islam) banking laboratory, a mini-bank owned by the school that serves savings transactions and money laundering. In its management, both related administration and bookkeeping involve learners. The last school-owned business entity is SMART, a mini market that provides school supplies and necessities, food, and beverage products produced by students and guardians of students. The payment system in this mini market is already integrated with computers.

Through the e-wallet application, each individual will have an account. These individual accounts will store your personal information and account balance. The balance can purchase goods or services from merchants or sales access points. Non-cash transactions are carried out using the buyer's smartphone will scan the seller's QR code through the camera and transfer funds according to the transaction made. Later automatically, the buyer's account funds will be channeled to the seller's account (Shetty et al., 2014).

The development of an e-wallet integrated into the teaching factory will facilitate every transaction. In addition, it will encourage the digitization of the school's financial system to be more transparent and accurate.

Figure 2. Banking Laboratories and S-MART Mini Market

Task and Concept Analysis

SMK YPM 3 Taman must apply a learning-based teaching factory as a vocational or skill-based school. There are three expertise departments at SMK YPM 3 Taman, namely multimedia (MM), which is included in the study of information and communication technology expertise, accounting and financial institutions (AKL), and automation of office governance (OTKP). Both majors are included in the study of business and management expertise.

Schools engaged in the field of expertise must have a process of expertise and competence based on work procedures and standards to produce products according to market or consumer demand (Fajaryati, 2012). School-owned business entities issue products in the form of goods and services by involving learners in it. Product transactions produced in the form of goods and services can be done in cash and non-cash (cashless). For non-cash schools will provide e-wallet applications that can be accessed through the web and mobile applications based on android and iOS.

Characteristics of the Target User of the Application

Almost all school residents use a smartphone to communicate. In addition, most of these phones are already connected to the internet so that anyone can access the e-wallet application. However, some mobile phones do not support payment systems through QR code scans. Therefore, the development of e-wallet applications must pay attention to this so that additional menus that are transaction options other than QR code scans are needed.

Specifying Instructional Development

As explained above, the development of this e-wallet generally aims to facilitate every payment transaction at a school-owned business entity based on a teaching factory. Payment in the payment system in cash be overcome with the application. In particular, the application will encourage the school's financial digitization system to be more transparent and accurate. In addition, coding classes will gradually be developed to equip learners to develop an application.

Design

Format Selection

Format selection is related to the selection of application names, the design of the appearance of the developed application, as well as the composition of the menus available in the application. Based on these discussions, the IT developer and management of SMK YPM 3 Taman came up with a name for the e-wallet application, "DASIGU." It stands for "Dana Siswa dan Guru" as the target of the application development.

The application's appearance in design is exciting and includes some of the characteristics of the school in the e-wallet application. The characteristics of schools implemented in e-wallet applications are related to color selection. Scouting purple and white as the primary color is a characteristic of SMK YPM 3 Taman. In addition, the location of the school is included in the initial display menu by connecting to google maps.

Apss can be accessed via the web, android based mobile apps, and iOS. Payment methods and bookings are through QR code scans, but we provide a "Transfer" menu to facilitate mobile phones that do not yet support barcode scan payment systems. The programming language used in developing this e-wallet is a visual studio code application.

Initial Design

In the initial appearance of the menu on the web, there is an application recognition feature related to the usability of the e-wallet application, introduction of application features, teacher and student login, and application user registration menu. To access an e-wallet, users must first activate the application by registering themselves on the web. Self-registration must be done on the web and can not be on android mobile applications or iOS. Android and iOS mobile apps can be used for login and transaction only. To log in, use the email registered in the application and the password verified during registration. Here is the web link to the e-wallet application "DASIGU": https://dasigusmkypm3.com/

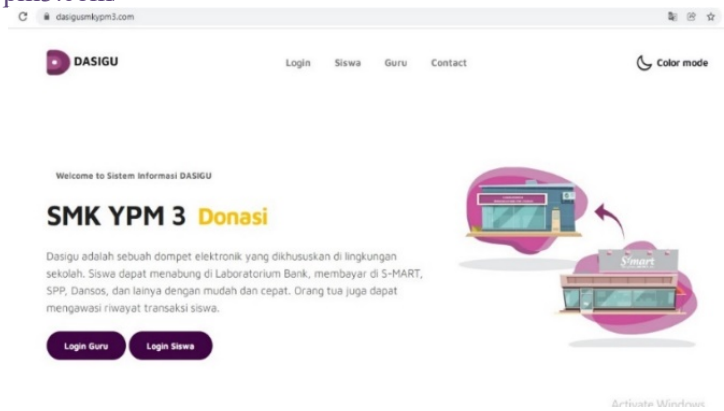

Figure 3. View App Start Menu

Based on the application development results and with the approval of the school leadership, there are several menus in the e-wallet application "DASIGU," namely: scan QR code, donation, SPP (school fees), transfer, transaction history, change password, and logout.

Scan QR code, QR code is a type of two-dimensional matric code developed by Japanese company Denso wave in 1994. The main functional QR code is to be easily scanned by a quick response scanner (QR) (Mulyana & Wijaya, 2018). QR codes automatically hold more information, such as website address, contact number, email, or plain text (Tendra & Suwarti, 2020).

Figure 4. QR Code

Donations are made regularly to provide relief to underprivileged learners, natural and non-natural disasters, and death compensation. The addition of the donation menu is a micro context of integration of character values implemented in an e-wallet application (Hamid & Sudira, 2013). With the menu, students can learn to share through donations managed by the school. The donation menu can be accessed when provided by the server, accompanied by the purpose of donation later.

This menu will display the amount of SPP (school fees) numbers each month that the student guardian must pay. After the payment is made, automatically, the SPP statement every month will be written, "it has been paid off."

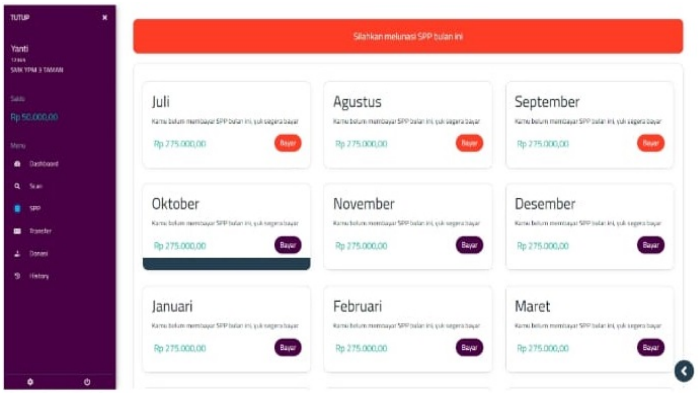

Figure 5. Transfer Menu on the Application

Transaction history helps know incoming and outgoing funds. The student's guardian can access his child's transaction history by simply checking through the application and logging in according to his email account and password. This menu is expected to prevent and avoid misappropriation of funds, especially SPP (school fees) student payments. In addition, the menu is equipped with access to printing transaction history that has been done.

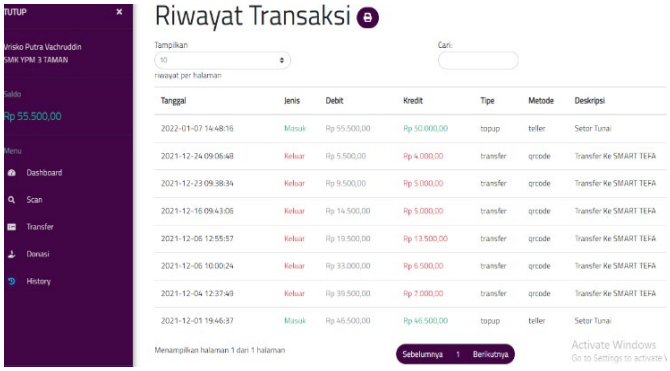

Figure 6. Transaction History on the Application

Charging funds on the e-wallet application "DASIGU" or top can be done in the banking laboratory "Mini Bank" SMK YPM 3 Taman located on the first floor of SMK YPM 3 Taman building adjacent to min market S-MART. The minimum number of top-up transactions on e-wallet applications is 10 thousand Rupiah.

Develop

Expert Appraisal

After the initial design of the e-wallet application "DASIGU" has been done, conducting a product development trial to a sample of application users required expert appraisal. There are two experts, namely the content validator and the media validator. The instrument prepared for expert assessment is a validation sheet. On the validation sheet, there are 11 statement indicators for content validation. On the media validation sheet, there are 10 statement indicators, as well as comments and suggestions from content and media validators.

The percentage of scores generated from the 11 indicators on the content validation sheet reached 85%. Based on the Likert scale interval, the number falls into the category "Very Worthy" of use. The content validator suggests that it is necessary to add an image showing SMK YPM 3 Taman because if the school's identity is only in the form of a name, then it does not represent the school.

Table 1. Content Validation Indicator

Indicators	Score	Average
User Friendly	5	4,2
App view	3	
Menu requirements with application needs	4	
Menu order layout	4	
Selection of logos on the app	4	
Practicality of DASIGU application	4	
DASIGU app access speed	5	
Clarity and suitability of the language used (communicative) ini the DASIGU application	4	
The usefulness of the application as a payment medium	5	
Ease of transaction using DASIGU application	5	
Image clarity, graphic illustration, visual and verbal on DASIGU application	4	

While the percentage of scores generated from 10 indicators on the media validation sheet reaches 72%, based on the interval scale Likert, the number falls into the category of "Worthy" use. Media expert validator provides advice for developing e-wallet applications that optimize android version applications and needs to be created a guide module on how to use applications in the form of videos or others.

Table 2. Indicators on Media Validation

Indicators	Score	Average
Initial view on DASIGU application	4	3,8
DASIGU app menu view (icon)	4	
DASIGU app content view	4	
Flexibility of DASIGU application	3	
Suitability of color proportions (color balance) application	4	
Practicality of DASIGU application	4	
DASIGU app access speed	3	
Clarity and suitability of the language used (communicative) in the DASIGU application	4	
DASIGU application attractiveness	4	
Clarity of images and illustrations on the DASIGU application	4	
Initial view on DASIGU application	4	

Developmental Product Testing

The sample selected for the e-wallet product trial was 173 consisting of students in grades 10, 11, and 12. The total population of education educators and students in SMK YPM 3 Taman is 1.241. The technique used in selecting this sample is stratified random sampling, which is selecting a random sample whose population consists of levels or strata (Herdiansyah, 2019).

The product trial was conducted for a month by requiring students appointed as samples to fill the balance on the e-wallet application by top-up at the mini Bank SMK YPM 3 Taman Laboratory. Students selected as samples must fill in a minimum of 10 thousand Rupiah pulses and use this balance to make purchases at the S-MART SMK YPM 3 Taman mini market, which has integrated a non-cash payment system through the "DASIGU" e-wallet application. Transactions are made by scanning the QR code or transferring to the S-MART account code.

After conducting a whole month of products trial, the user experience questionnaire model was developed through google Forms with 26 indicators related to the development of e-wallet products. Then the questionnaire is distributed through google classroom and WhatApps to facilitate filling the questionnaire by a predetermined sample.

The percentage of scores generated from questionnaires filled by 173 samples with 26 user experience indicators resulted in a figure of 73,4 %. Based on the interval scale Likert, the number falls into the category of "Worth" use. For the lowest score, there is an indicator of the difficulty level in learning the concept of non-cash transactions through the e-wallet application "DASIGU," which

produces a figure of 65%. Therefore, clear guidelines must be made for using e-wallet applications in videos and other forms.

The highest percentage score of 26 indicators indicates e-wallet application development in support of school programs. This indicator produces a percentage of 85.6%. SMK YPM 3 Taman already has three business entities (UPJ, Mini Bank, S-MART), implementing non-cash payments via e-wallets to make it easier for consumers to make transactions. From the data that has been described, the developed e-wallet application can provide convenience in transactions. The questionnaire results the state that most e-wallet application users are satisfied.

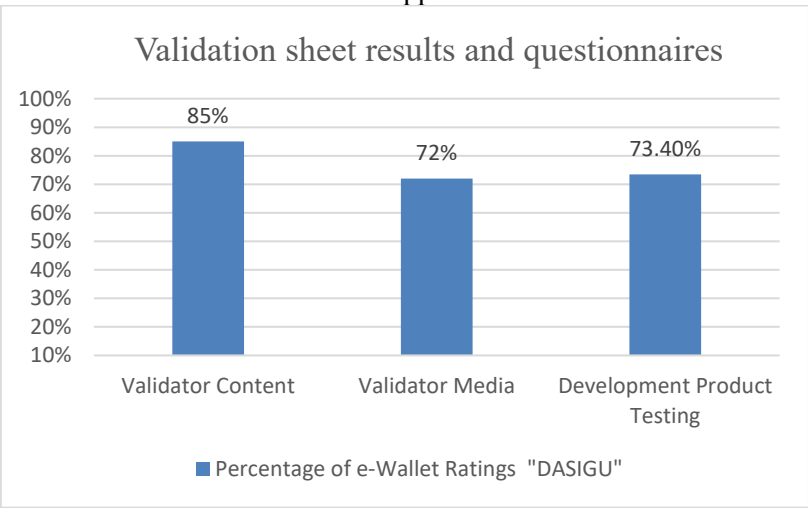

Figure 7. Percentage of e-Wallet Ratings "DASIGU"

Dissemination

The dissemination stage is the last in the research and development model of 4D development. This stage is divided into three stages of the process related to disseminating the e-wallet product "DASIGU" to the target market share, that is, all residents of SMK YPM 3 Taman ranging from educators and students. The stages in the dissemination process are validation testing, packaging, and diffusion and adoption.

Validation Testing

Based on the results of product development trials, it is necessary to revise the weaknesses in the e-wallet application. Improvements were made regarding the level of difficulty in learning the concept of non-cash transactions through the "DASIGU" e-wallet application, namely by making a guide in the form of graphic images presented on the initial appearance of the e-wallet web application. The next plan in this development is to include a video guide for using the e-wallet application. After several revisions, the "DASIGU" e-wallet application product is ready to be disseminated to users/application users, namely all teachers and students of SMK YPM 3 Taman Sidoarjo.

Packaging

Packaging is crucial to attracting consumers to use digital wallets or e-wallet applications for transactions. This packaging is related to the socialization and introduction of the e-wallet product "DASIGU." Product socialization and introduction are divided into two activities: launching and socialization. The launch or introduction of the "DASIGU" digital wallet application was attended by the Chairperson of the YPM Sidoarjo Foundation, Principals of schools around the entire YPM complex, teachers, and teaching staff at SMK YPM 3 Taman Sidoarjo.

The second event was disseminating the e-wallet application to YPM 3 Taman SMK students, carried out in each class by the application development team. Outreach to students is carried out by explaining the various functions of the e-wallet application and monitoring students to register for the "DASIGU" e-wallet application. This socialization and introduction are expected

to optimize the use of applications in non-cash transactions. At SMK YPN 3 Taman, students must have and register their account with this e-wallet.

Figure 8. Transaction Process Through QR Code and Products Produced by Students

Difussion and Adoption

During the validation and packaging process, it is hoped that the e-wallet application can be absorbed (diffusion) and understood by all SMK YPM 3 Taman residents so that the e-wallet application can be used (adapted) for non-cashless. In addition to attracting the interest of SMK YPM 3 Taman residents in using e-wallet applications as a means of non-cash payment, the school made the policy in question to develop and advance school-owned business entities, among others: (1) A 5% discount for teachers and education staff are included in the balance of the e-wallet application so that teachers and education staff do not need to top up funds and can use the balance to make purchases at the S-MART SMK YPM 3 Taman minimarket; (2) Top-up obligations for SMK YPM 3 Taman students are at least 10 thousand Rupiah on each e-wallet application account. It is hoped that through this obligation, students can learn about how to system non-cash transactions through the e-wallet "DASIGU."; and (3) Giving special discounts and cashback on purchase transactions using the e-wallet application "DASIGU."

CONCLUSION

The school engaged in vocational expertise, SMK YPM 3 Taman Sidoarjo, has a business entity owned by a teaching factory-based school that is UPJ (unit service), Banking laboratory, and S-MART is a school mini market. The development of an e-wallet integrated into the teaching factory will facilitate every transaction. In addition, it will encourage the digitization of the school s financial system to be more transparent and accurate. This research includes a type of research and development using 4D development models. The stages in the development model include: defining, designing, developing, and disseminating. The e-wallet app "DASIGU" can be accessed via the web, android, and iOS-based mobile apps. We provide payment methods and bookings through QR code scans but a "Transfer" menu to facilitate mobile phones that do not yet support barcode scan payment systems. Charging funds on the e-wallet application "DASIGU" or top-up can be done at the banking laboratory of SMK YPM 3 Taman. The minimum money for top-up transactions on e-wallet applications is 10 thousand Rupiah. The product trial was conducted for a whole month on 173 selected samples by requiring students who were designated as samples to fill the balance on the e-wallet application and must use the balance to make purchase transactions in S-MART mini market SMK YPM 3 Taman that has integrated a non-cash payment system through the e-wallet application "DASIGU." The percentage of scores generated from questionnaires filled by 173 samples with 26

user experience indicators resulted in a figure of 73,4%. Based on the interval scale Likert, the number falls into the category of "Worth" use.

REFERENCES

Andri, A., Robin, R., & Ridho, M. (2019). Pengembangan aplikasi e-kantin berbasis mobile dan web. *Jurnal Mahajana Informasi*, *4*(2), 43–49. https://doi.org/10.51544/jurnalmi.v4i2.962

Anggraeni, L. (2019). *Go-Pay jadi dompet digital paling populer di Indonesia*. Medcom.Id. https://www.medcom.id/teknologi/news-teknologi/0Kv9o5pk-go-pay-jadi-dompet-digital-paling-populer-di-indonesia

Austin, A., Langer, A., Salam, R. A., Lassi, Z. S., Das, J. K., & Bhutta, Z. A. (2014). Approaches to improve the quality of maternal and newborn health care: an overview of the evidence. *Reproductive Health*, *11*(S2), 1–9. https://doi.org/10.1186/1742-4755-11-S2-S1

Budiaji, W. (2013). Skala pengukuran dan jumlah respon skala likert. *Jurnal Imu Pertanian Dan Perikanan*, *2*(2), 127–133. https://weksi-budiaji.github.io/publikasi/2013-12-01-skala-likert/

Fajaryati, N. (2012). Evaluasi pelaksanaan teaching factory SMK di Surakarta. *Jurnal Pendidikan Vokasi*, *2*(3), 325–337. https://doi.org/10.21831/jpv.v2i3.1040

Fitria, T. N., Paravasanti, Y. A., & Prastiwi, I. E. (2022). Transactions using e-wallets: How is the perspective of Islamic Economics? *Jurnal Ilmiah Ekonomi Islam*, *8*(2), 1816–1822. https://doi.org/10.29040/jiei.v8i2.2857

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Hamid, A., & Sudira, P. (2013). Penanaman nilai-nilai karakter siswa SMK Salafiyah Prodi TKJ Kajen Margoyoso Pati Jawa Tengah. *Jurnal Pendidikan Vokasi*, *3*(2), 139–152. https://doi.org/10.21831/jpv.v3i2.1592

Hanafi, R. H. (2019). Desain media pembelajaran pendidikan Agama Islam berbasis aplikasi Android pada siswa kelas XI PS dan XI TN SMK Muhammadiyah Somagede-Banyumas. *Atthulab: Islamic Religion Teaching and Learning Journal*, *4*(1), 88–104. https://doi.org/10.15575/ath.v4i1.3096

Herdiansyah, H. (2019). *Metodologi penelitian kualitatif untuk ilmu-ilmu sosial: Perspektif konvensional dan kontemporer* (2nd ed.). Salemba Humanika.

Kalyani, P. (2016). An empirical study about the awareness of paperless e-currency transaction like e-wallet using ICT in the youth of India. *Journal of Management Engineering and Information Technology (JMEIT)*, *3*(3), 18–41. https://www.researchgate.net/profile/Pawan-Kalyani/publication/304697020_An_Empirical_Study_about_the_Awareness_of_Paperless_E-Currency_Transaction_like_E-Wallet_Using_ICT_in_the_Youth_of_India/links/577752e108ae1b18a7e1b94d/An-Empirical-Study-about-the-Awareness-of-Paperless-E-Currency-Transaction-like-E-Wallet-Using-ICT-in-the-Youth-of-India.pdf

Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2012). *Panduan pelaksanaan tahun 2012: Bantuan pengembangan kewirausahaan SMK/teaching industry*. Direktorat Pembinaan SMK, Direktorat Jenderal Pendidikan Menengah, Kementerian Pendidikan dan Kebudayaan Republik Indonesia. https://www.academia.edu/11648335/02_Panlak_Bantuan_Pembelajaran_Kewirausahaan_SMK_Teaching_Industry_2012

Khotima, D. A., Su'ad, S., Santoso, S., & Pratama, H. (2022). The effectiveness of Android-based science learning model to increase student learning outcomes. *Asian Pendidikan*, *2*(1), 33–41. https://doi.org/10.53797/aspen.v2i1.5.2022

Likert, R. (1932). *A technique for the measurement of attitudes*. Archives of Psychology. https://legacy.voteview.com/pdf/Likert_1932.pdf

Mulyana, A., & Wijaya, H. (2018). Perancangan e-payment system pada e-wallet menggunakan kode QR berbasis Android. *Komputika : Jurnal Sistem Komputer*, *7*(2), 63–69. https://doi.org/10.34010/komputika.v7i2.1511

Puspita, D. A., Muchlas, M., & Kuat, T. (2020). The implementation of teaching factory to improve student interest in entrepreneurship at multimedia competencies. *Journal of Technology and Humanities*, *1*(2), 42–50. https://doi.org/10.53797/jthkkss.v1i2.5.2020

Rosmayanti, R. (2019). *Apa itu dompet digital?* Warta Ekonomi. https://wartaekonomi.co.id/read212834/apa-itu-dompet-digital.html

Safarudin, A., Kusdibyo, L., & Senalasari, W. (2020). Faktor-faktor pembentuk loyalitas generasi z dalam menggunakan financial technology e-wallet. *Prosiding 11th Industrial Research Workshop and National Seminar (IRWNS)*, *11*(1), 1073–1078. https://doi.org/10.35313/irwns.v11i1.2166

Sari, M. A., Listiawati, R., Novitasari, N., & Vidyasari, R. (2019). Analisa pengaruh daya tarik promosi, persepsi kemudahan, persepsi manfaat, persepsi keamanan terhadap minat pengguna e-wallet (studi kasus produk Gopay dan Link Aja pada masyarakat pengguna di wilayah JABODETABEK). *JURNAL EKONOMI & BISNIS*, *18*(2), 126–134. https://sisdam.univpancasila.ac.id/uploads/berkas/penelitian/Jurnal_Nasional_08112021181426.pdf#page=47

Shetty, S., Shetty, T., & Amale, R. (2014). QR-Code based digital wallet. *International Journal of Advanced Research in Computer Science*, *5*(7), 105–109. http://www.ijarcs.info/index.php/Ijarcs/article/view/2264

Tasci, A. D. A. (2017). A quest for destination loyalty by profiling loyal travelers. *Journal of Destination Marketing & Management*, *6*(3), 207–220. https://doi.org/10.1016/j.jdmm.2016.04.001

Tendra, G., & Suwarti, S. (2020). Aplikasi dompet digital berbasis Android pada Bus Transmetri Kota Pekanbaru. *Jurnal Komputer Dan Informatika*, *8*(2), 86–95. https://doi.org/10.35508/jicon.v8i2.2717

Thiagarajan, S. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. https://files.eric.ed.gov/fulltext/ED090725.pdf

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. National Center for Improvement Educational System.

Widiyati, D., & Hasanah, N. (2020). Factors affecting the use of e-money (study on e-money user in City of South Tangerang). *ACCOUNTABILITY*, *9*(1), 36–45. https://doi.org/10.32400/ja.28881.9.1.2020.36-45

Wong, J. K. W., & Li, H. (2010). Construction, application and validation of Selection Evaluation Model (SEM) for intelligent HVAC control system. *Automation in Construction*, *19*(2), 261–269. https://doi.org/10.1016/j.autcon.2009.10.002

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The effectiveness of media on distance learning based on Merrill's Taxonomy and CASR 147

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ABSTRACT

According to Merrill, there are two dimensions of learning objectives: content and performance. For learning to achieve its goals, suitable media is needed. Moreover, the Covid-19 pandemic situation since 2019 requires learning to be distanced. Teachers and students must work together to achieve learning objectives. Several media can support learning, including text formats, audio/video tutorials, interactive multimedia, and simulator software. Especially for Aviation Vocational education which has a learning level guide at CASR 147, further analysis is needed on how these media can effectively achieve learning objectives. So, this study aims to analyze the effectiveness of media in distance learning based on Merrill's Taxonomy and CASR 147. Quantitative research methods are used with data from questionnaires and several interviews for data triangulation needs. Based on its effectiveness, the following are suggestions of learning media that can be used: audio/video tutorials, simulators, interactive multimedia, and text formats. Furthermore, it is necessary to conduct research that discusses media preferences based on students' learning styles to know the reasons for the results of media selection by students through questionnaires.

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INTRODUCTION

Since 2019, human activities have begun to be limited, especially those involving physical contact. This is done to suppress the broader spread of the Covid-19 virus. This pandemic has significantly impacted various factors, especially the world of education (Agu et al., 2021; Buheji et al., 2020; Fegert et al., 2020; Toquero, 2020). Onsite learning must be replaced with a distance learning mode so that schools do not become clusters of spreading viruses (Ali, 2020; Mulenga & Marbán, 2020; Simamora, 2020; Yulia, 2020). The challenge of this learning mode is how to create an effective learning system (achieving learning objectives), but an onsite activity must be implemented. Learning effectiveness factors include literacy, motivation, learning tools, and learning systems. However, the main factor that has the most influence is motivation (teachers and students have the same vision, namely knowledge transfer) (Ferri et al., 2020; Garrison, 1993; McConnell et al., 2013; Simonson et al., 2019).

From the side of students, as learners, must have a strong enough motivation to be able to learn independently. Strong motivation is needed to survive various kinds of online learning concentration disorders (Patricia, 2020; Wijaya et al., 2020). For example, signal interference, social

media, home environment, etc. From the side of the teacher/lecturer, there must also be enough ammunition to be able to inspire because the task of the teacher/lecturer is to facilitate students' independent learning (Aston et al., 2000; Bank & Bank, 2014; du Toit-Brits & van Zyl, 2017; Rahmawan, 2020). Facilitating means providing facilities (a good learning environment) so that it is sufficient to be able to transfer knowledge. For example, to study Social Arithmetic material, an online space is needed for students to apply the buying and selling process and calculate profit and loss.

According to Circular No. 15 of 2020 of the Ministry of Education and Culture of the Republic of Indonesia, there are several kinds of learning media, including text formats, audio/video tutorials, interactive multimedia, and simulator software. In their use, these media have advantages and disadvantages. Selecting suitable media will lead to the success of the learning process (Gagne, 1970; Omenge & Priscah, 2016; Peery, 2016). Learning media can aim to understand concepts or apply concepts. The suitable media is media that support cognitive and psychomotor learning objectives.

Learning objectives can essentially be synthesized into a two-dimensional matrix, namely the content dimension (what is being studied) and the performance dimension (what is being done) (Merrill, 1983). Content can be divided into four types: facts, concepts, procedures, and principles. The performance can be divided into three levels: remembering, using, and finding. According to Merrill (1983), the content and learning objectives dimensions can be seen in Figure 1.

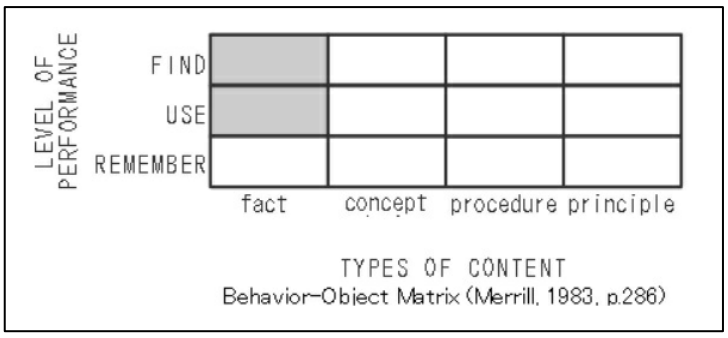
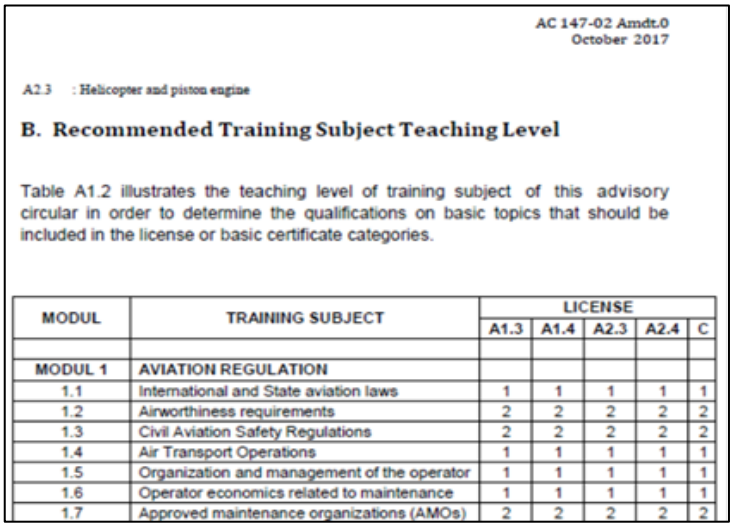


Figure 1. Behavior-Object Matrix of Merrill's

Aviation vocational education (with learning outcomes) can produce graduates who are competent in carrying out aircraft maintenance and repairs following predetermined procedures with Diploma level 3 guided by Civil Aviation Safety Regulation (CASR) 147 (Advisory Circular, 2017). The designed learning levels have a difficulty level, namely level 1, level 2, and level 3.

Level 1 includes knowledge of general principles (no practical application), no skill development, and instruction is done by lecture, demonstration, and discussion methods. Level 2 includes knowledge of general principles, limited practical application, skill development for basic operations, and instruction by lecture, demonstration, and discussion. Level 3 includes knowledge of general principles, the performance of high-level practical applications, the development of skills sufficient to simulate the acquired knowledge, and instruction using lectures, demonstration, discussion, and high-level practical application methods.

CASR 147 advisory circular 147-02 Basic Certificate Curriculum and Syllabus Development describe the depth of learning achievement in each subject (starting now referred to as teaching level) as shown in Figure 2. However, the CASR 147 document does not address the content dimension (what is learned) and the performance dimension (what is done), as categorized by Merrill in his taxonomy. Thus, this study aims to analyze the effectiveness of the media used in distance learning and compare it to onsite learning. Assessment of effectiveness based on learning objectives according to CARS 147 and Merrill's Taxonomy (since Component Display Theory is very close to the effectiveness of instructional media).



AC 147-02 Amdt.0
October 2017

A2.3 : Helicopter and piston engine

B. Recommended Training Subject Teaching Level

Table A1.2 illustrates the teaching level of training subject of this advisory circular in order to determine the qualifications on basic topics that should be included in the license or basic certificate categories.

MODUL	TRAINING SUBJECT	LICENSE				
		A1.3	A1.4	A2.3	A2.4	C
MODUL 1	AVIATION REGULATION					
1.1	International and State aviation laws	1	1	1	1	1
1.2	Airworthiness requirements	2	2	2	2	2
1.3	Civil Aviation Safety Regulations	2	2	2	2	2
1.4	Air Transport Operations	1	1	1	1	1
1.5	Organization and management of the operator	1	1	1	1	1
1.6	Operator economics related to maintenance	1	1	1	1	1
1.7	Approved maintenance organizations (AMOs)	2	2	2	2	2

Figure 2. Teaching Level in CASR 147

RESEARCH METHOD

This research is quantitative descriptive research. The data collection technique was carried out using 45 closed questions in the form of a questionnaire developed with Google Forms. The sampling technique in this study was random sampling, where the number of respondents in this study was 925 cadets spread from various departments at the Surabaya Aviation Polytechnic. These departments are Air Traffic Controller, Aviation Communication, Air Transportation Management, Airport Electrical Engineering, Aviation Navigation Engineering, Building and Airport Engineering, and Aircraft Maintenance Engineering. Data triangulation was conducted through interviews with selected respondents using purposive sampling. The research instruments (questionnaires and interviews) were validated by learning expert lecturers. Data analysis was carried out with the help of Microsoft Excel software which was carried out to process quantitative data and make the presentation of research results more interesting.

RESULT AND DISCUSSION

CASR 147 divides the level of mastery of learning competencies into three categories of teaching level. Each category contains cognitive and psychomotor elements that cadets must master in each subject matter. This learning achievement does not refer directly to the level of performance and detailed learning content. Therefore, it is necessary to develop an integrated assessment of learning achievement according to CASR 147 combined with Merrill's learning theory. After analyzing each item in the Merrill Taxonomy and the difficulty level of CASR 147, the integration results can be seen in Table 1.

Table 1. Integration of Merrill's Taxonomy and CASR 147

Type of Content	CASR 147		
	Teaching level 1	Teaching level 2	Teaching level 3
	- Knowledge of general principles, but no practical application. - No Development of skill.	- Knowledge of general principles, and limited practical application. - Development of sufficient skill to perform basic operations.	- Knowledge of general principles, and performance of a high degree of practical application. - Development of sufficient skills to simulate return to service.
Principle			√
Procedure		√	√
Concept	√	√	√
Fact	√ √	√	

	Remember	Use	Find	Remember	Use	Find	Remember	Use	Find

Based on Table 1, teaching level 1 can be achieved when remembering facts, using facts, and remembering concepts have been fulfilled. Teaching level 2 can be achieved when finding facts, using concepts, and remembering procedures have been fulfilled while teaching level 3 can be achieved when the activities of finding concepts, using procedures, and remembering principles have been fulfilled. Teaching levels are in the form of stages that must be passed sequentially. It means that level 1 and level 2 are prerequisites for level 3.

To obtain data on the effectiveness of media in online and onsite learning, a questionnaire was compiled that explores the role of media in supporting learning objectives at each level of teaching according to the cadets' perceptions. Closed questions that are arranged provide three answer choices, namely low, medium, and high. The answers from each cadet will be grouped according to their teaching level and Merrill's taxonomy. Table 2 is a recapitulation of the effectiveness of media in learning at each level according to cadets' perceptions.

Table 2. Data Recapitulation

Media	Effective-ness	Teaching Level 1			Teaching Level 2			Teaching Level 3		
		Remem-ber Fact	Use Fact	Remember Concept	Find Fact	Use Concept	Remember Procedure	Find Concept	Use Procedure	Remember Principle
Hands on	Low	22	17	16	17	19	15	16	15	17
	Med	419	425	417	422	429	410	424	417	429
	High	484	483	492	486	477	500	485	493	479
Siulator	Low	16	22	16	21	16	15	19	15	18
	Med	464	446	456	459	445	464	446	473	463
	High	445	457	453	445	464	446	460	437	444
Interactive multimedia	Low	23	25	16	20	22	19	25	20	23
	Med	441	460	474	468	478	479	474	481	478
	High	461	440	435	437	425	427	426	424	424
Audio/video tutorial	Low	20	16	21	18	19	18	19	20	14
	Med	421	446	456	441	444	462	442	445	486
	High	484	463	448	466	462	447	464	460	425
Format text	Low	50	39	42	46	47	40	36	43	37
	Med	597	582	553	559	581	551	583	551	557
	High	278	304	330	320	297	334	306	331	331

Based on Table 2, it is then changed into low, medium, and high categories by using the mode (a statistical measure of central tendency) for each item. If the number of cadets who choose the medium category is more than those who choose the low and high categories, then the data is grouped into the medium category. Based on this approach, conversion data is obtained, as shown in Table 3.

Table 3. Data Conversion

Media	Teaching Level 1			Teaching Level 2			Teaching Level 3		
	Remem-ber Fact	Use Fact	Remember Concept	Find Fact	Use Concept	Remember Procedure	Find Concept	Use Procedure	Remember Principle
Hands on	High	High	High	High	High	High	High	High	High
Simulators	Med	High	High	Med	High	Med	High	Med	Med
Interactive multimedia	High	Med	Med	Med	Med	Med	Med	Med	Med
Audio/video tutorials	High	High	Med	High	High	Med	High	High	Med
Text formats	Med	Med	Med	Med	Med	Med	Med	Med	Med

Based on the results of filling out the questionnaire on the Google form and the interview session, the results were obtained, as can be seen in Figure 3, Figure 4, and Figure 5. In Figure 3, it can be seen that hands-on activities are still the favorite choice to reach teaching level 1 (remember the fact, use fact, and remember the concept). However, if distance learning is required, media with text format is sufficient in moderate portions, while media simulators, multimedia interactive, and audio/video tutorials can be medium to high.

Therefore, it is recommended when distance learning that material with learning outcomes in the use of facts and remembering concepts should use simulator media. Interactive multimedia

should be used for material with learning outcomes in remembering the fact. Meanwhile, for material with learning outcomes in remembering facts and using facts, it is recommended to use audio/video tutorial media.

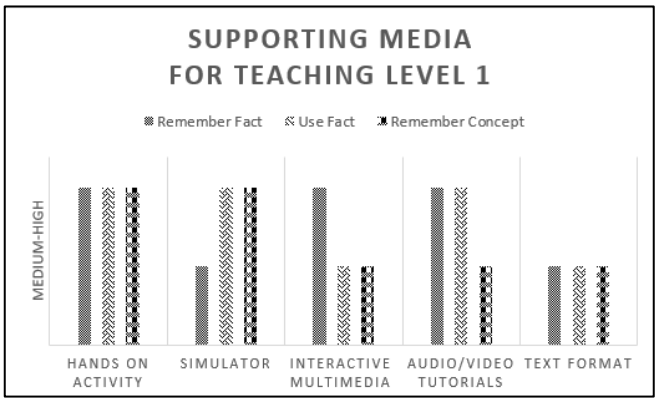


Figure 3. Supporting Media for Teaching Level 1

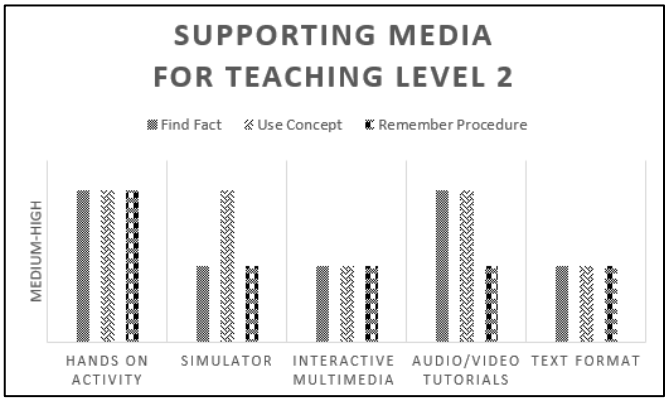


Figure 4. Supporting Media for Teaching Level 2

In Figure 4, hands-on activity remains the favorite choice to reach teaching level 2 (find facts, use concepts, and remember procedure). If distance learning is carried out, the media with text format is sufficient in medium portions, while the simulator media, interactive multimedia, and audio/video tutorials can be in the medium to high portions. Therefore, it is recommended that distance learning be more effective if the material with concept learning outcomes uses simulator media, and material with finding facts and use concept learning outcomes should use audio/video tutorial media.

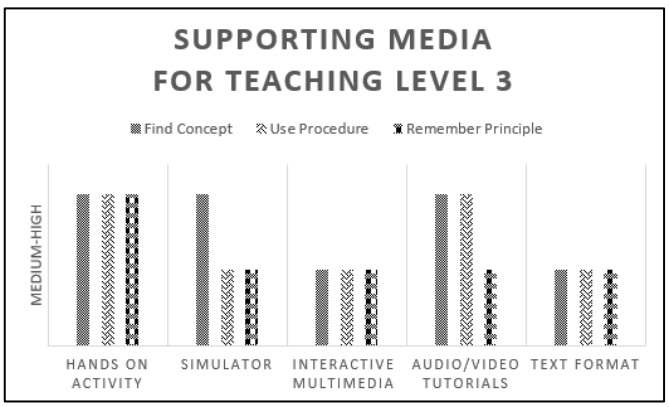


Figure 5. Supporting Media for Teaching Level 3

In Figure 5, hands-on activity is still the favorite choice to reach teaching level 3 (find the concept, use the procedure, and remember the principle). However, if distance learning is necessary, media with text format is sufficient in moderate portions, while simulator media, interactive multimedia, and audio/video tutorials can be in medium to high portions. Distance learning will be more effective if the material with the learning outcomes of finding concepts uses simulator media or audio/video tutorials. Meanwhile, for materials with learning outcomes, use procedure is recommended to use audio/video tutorial media.

From the three reviews above, onsite learning (hands-on activity) is the favorite choice of cadets. This is in line with research (Anggrawan & Jihadil, 2018; Bali & Liu, 2018; Gherheș et al., 2021; Louis-Jean & Cenat, 2020) that onsite learning is still more effective than online learning. There are difficulties in its application, especially on campuses that incidentally are vocational education that requires field practice. When field practice is replaced with simulation activities, the results will not be as good as if carried out directly. If directly, all limbs can help in remembering the procedures/concepts being taught. As John Dewey said, learning will bring more understanding or learning by doing (Ord, 2012).

If learning must be carried out online, it is necessary to pay attention to the following composition: media with text format is sufficient to use in moderate portions, while media simulators, multimedia interactive, and audio/video tutorials can be used with medium to high portions. If the portion is too much, text format media will make students bored (Ismaili, 2013; Martin & Bolliger, 2018; Mayer, 1997), in contrast to multimedia. Meanwhile, other media, such as simulators, interactive multimedia, and audio/video tutorials, can be used according to the character of facts, concepts, procedures, and principles of the type of subject to be taught. This is in line with Wiana et al. (2018) and Apoki et al. (2020) because selecting suitable media will lead to successful learning.

Another point of view, content, and performance can be interpreted as follows: Audio/video tutorials are practical for learning to remember, use, and find facts. This is in line with Turner et al. (2015) and Torfi et al. (2017) that to teach concepts (remember, use, and discover), simulators and audio/video tutorials can be used. This fact follows Ibáñez and Delgado-Kloos (2018) and Laurillard (1995), who revealed that procedures and principles would be more effective if taught directly. This is also in line with previous research by Rayner et al. (2001) and Kong et al. (2017).

CONCLUSION

Based on this study, onsite learning has higher effectiveness than distance learning. However, if conditions are not possible, distance learning needs to be implemented with the following instructional media suggestions: audio/video tutorials, simulators, interactive multimedia, and text formats. In the learning process, media with text format should be used in moderate portions. In contrast, simulator media, interactive multimedia, and audio/video tutorials can be used in medium to high portions. It can help achieve teaching levels 1, 2, and 3 in Merrill's Taxonomy and CASR 147.

REFERENCES

Agu, C. F., Stewart, J., McFarlane-Stewart, N., & Rae, T. (2021). COVID-19 pandemic effects on nursing education: Looking through the lens of a developing country. *International Nursing Review*, *68*(2), 153–158. https://doi.org/10.1111/inr.12663

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 Pandemic. *Higher Education Studies*, *10*(3), 16–25. https://doi.org/10.5539/hes.v10n3p16

Anggrawan, A., & Jihadil, Q. S. (2018). Comparative analysis of online e-learning and face to face learning: An experimental study. *2018 Third International Conference on Informatics and Computing (ICIC)*, 1–4. https://doi.org/10.1109/IAC.2018.8780495

Apoki, U. C., Al-Chalabi, H. K. M., & Crisan, G. C. (2020). From digital learning resources to adaptive learning objects: An overview. In D. Simian & L. F. Stoica (Eds.), *Modelling and*

development of intelligent systems (pp. 18–32). Springer Cham. https://doi.org/10.1007/978-3-030-39237-6_2

Aston, L., Mallik, M., Day, C., & Fraser, D. (2000). An exploration into the role of the teacher/lecturer in practice: findings from a case study in adult nursing. *Nurse Education Today*, *20*(3), 178–188. https://doi.org/10.1054/nedt.1999.0455

Bali, S., & Liu, M. C. (2018). Students' perceptions toward online learning and face-to-face learning courses. *Journal of Physics: Conference Series*, *1108*, 012094. https://doi.org/10.1088/1742-6596/1108/1/012094

Bank, C. M. Van Der, & Bank, M. Van Der. (2014). Learning centred environments supporting the environment of e-learning in South Africa in law class. *Humanities and Social Sciences Letters*, *2*(2), 93–107. https://archive.conscientiabeam.com/index.php/73/article/view/746/1058

Buheji, M., Cunha, K. da C., Beka, G., Mavrić, B., Souza, Y. L. do C. de, Silva, S. S. da C., Hanafi, M., & Yein, T. C. (2020). The extent of COVID-19 Pandemic socio-economic impact on global poverty. A global integrative multidisciplinary review. *American Journal of Economics*, *10*(4), 213–224. https://doi.org/10.5923/j.economics.20201004.02

du Toit-Brits, C., & van Zyl, C.-M. (2017). Embedding motivation in the self-directedness of first-year teacher students. *South African Journal of Higher Education*, *31*(1), 50–65. https://doi.org/10.20853/31-1-824

Fegert, J. M., Vitiello, B., Plener, P. L., & Clemens, V. (2020). Challenges and burden of the Coronavirus 2019 (COVID-19) pandemic for child and adolescent mental health: A narrative review to highlight clinical and research needs in the acute phase and the long return to normality. *Child and Adolescent Psychiatry and Mental Health*, *14*(1), 20. https://doi.org/10.1186/s13034-020-00329-3

Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online learning and emergency remote teaching: opportunities and challenges in emergency situations. *Societies*, *10*(4), 86. https://doi.org/10.3390/soc10040086

Gagne, R. M. (1970). *Learning theory, educational media, and individualized instruction*. https://files.eric.ed.gov/fulltext/ED039752.pdf

Garrison, D. R. (1993). A cognitive constructivist view of distance education: An analysis of teaching-learning assumptions. *Distance Education*, *14*(2), 199–211. https://doi.org/10.1080/0158791930140204

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

Ibáñez, M.-B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. *Computers & Education*, *123*, 109–123. https://doi.org/10.1016/j.compedu.2018.05.002

Ismaili, M. (2013). The effectiveness of using movies in the EFL classroom – A study conducted at South East European University. *Academic Journal of Interdisciplinary Studies*, *2*(4), 121–132. https://doi.org/10.5901/ajis.2012.v2n4p121

Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2020). *Surat Edaran Nomor 15 Tahun 2020 tentang Pedoman Penyelenggaraan Belajar dari Rumah dalam Masa Darurat Penyebaran Corona Virus Disease (Covid-19)*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia. https://www.kemdikbud.go.id/main/files/download/27bdb5850ac3939

Kong, X. T. R., Chen, G. W., Huang, G. Q., & Luo, H. (2017). Ubiquitous auction learning system with TELD (Teaching by Examples and Learning by Doing) approach: A quasi-experimental

study. *Computers & Education*, *111*, 144–157. https://doi.org/10.1016/j.compedu.2017.04.009

Laurillard, D. (1995). Multimedia and the changing experience of the learner. *British Journal of Educational Technology*, *26*(3), 179–189. https://doi.org/10.1111/j.1467-8535.1995.tb00340.x

Louis-Jean, J., & Cenat, K. (2020). Beyond the face-to-face learning: A contextual analysis. *Pedagogical Research*, *5*(4), em0077. https://doi.org/10.29333/pr/8466

Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning*, *22*(1), 205–222. https://doi.org/10.24059/olj.v22i1.1092

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist*, *32*(1), 1–19. https://doi.org/10.1207/s15326985ep3201_1

McConnell, T. J., Parker, J. M., Eberhardt, J., Koehler, M. J., & Lundeberg, M. A. (2013). Virtual professional learning communities: Teachers' perceptions of virtual versus face-to-face professional development. *Journal of Science Education and Technology*, *22*(3), 267–277. https://doi.org/10.1007/s10956-012-9391-y

Merrill, D. (1983). Component display theory. In C. M. Reigeluth & A. A. Carr-Chellman (Eds.), *Instructional-design Theories and Models: An overview of their current status* (1st ed.). Psychology Press.

Mulenga, E. M., & Marbán, J. M. (2020). Prospective teachers' online learning mathematics activities in the age of COVID-19: A cluster analysis approach. *Eurasia Journal of Mathematics, Science and Technology Education*, *16*(9), em1872. https://doi.org/10.29333/ejmste/8345

Omenge, O. R., & Priscah, M. J. (2016). Understanding the utilization of instructional media in training health professionals. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, *5*(3), 1–8. http://www.iosrjournals.org/iosr-jnhs/papers/vol5-issue3/Version-3/A0503030108.pdf

Ord, J. (2012). John Dewy and experiential learning: Developing the theory of youth work. *Youth & Policy*, *108*(1), 55–72. https://www.youthandpolicy.org/wp-content/uploads/2017/06/ord-yandp108.pdf

Patricia, A. (2020). College students' use and acceptance of emergency online learning due to COVID-19. *International Journal of Educational Research Open*, *1*, 100011. https://doi.org/10.1016/j.ijedro.2020.100011

Peery, J. (2016). Questions for serious game development for success. *2016 IEEE International Conference on Serious Games and Applications for Health (SeGAH)*, 1–4. https://doi.org/10.1109/SeGAH.2016.7586227

Rahmawan, A. D. (2020). Students' obstacles on autonomous English learning. *ELTICS : Journal of English Language Teaching and English Linguistics*, *5*(1). https://doi.org/10.31316/eltics.v5i1.527

Rayner, K., Foorman, B. R., Perfetti, C. A., Pesetsky, D., & Seidenberg, M. S. (2001). How psychological science informs the teaching of reading. *Psychological Science in the Public Interest*, *2*(2), 31–74. https://doi.org/10.1111/1529-1006.00004

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

Simonson, M., Zvacek, S. M., & Smaldino, S. (2019). *Teaching and learning at a distance: Foundations of distance education seventh edition* (7th ed.). Information Age Publishing.

Toquero, C. M. (2020). Challenges and opportunities for higher education amid the COVID-19 Pandemic: The Philippine context. *Pedagogical Research*, *5*(4), em0063. https://doi.org/10.29333/pr/7947

Torfi, A., Iranmanesh, S. M., Nasrabadi, N., & Dawson, J. (2017). 3D convolutional neural networks for cross audio-visual matching recognition. *IEEE Access*, *5*, 22081–22091. https://doi.org/10.1109/ACCESS.2017.2761539

Turner, B., Fuchs, C., & Todman, A. (2015). Static vs. dynamic tutorials: Applying usability principles to evaluate online point-of-need instruction. *Information Technology and Libraries*, *34*(4), 30–54. https://doi.org/10.6017/ital.v34i4.5831

Wiana, W., Barliana, M. S., & Riyanto, A. A. (2018). The effectiveness of using interactive multimedia based on motion graphic in concept mastering enhancement and fashion designing skill in digital format. *International Journal of Emerging Technologies in Learning (IJET)*, *13*(02), 4. https://doi.org/10.3991/ijet.v13i02.7830

Wijaya, T. T., Zhou, Y., Purnama, A., & Hermita, N. (2020). Indonesian students learning attitude towards online learning during the coronavirus pandemic. *Psychology, Evaluation, and Technology in Educational Research*, *3*(1), 17–25. https://doi.org/10.33292/petier.v3i1.56

Yulia, H. (2020). Online learning to prevent the spread of Pandemic Corona Virus in Indonesia. *ETERNAL (English Teaching Journal)*, *11*(1), 48–56. https://doi.org/10.26877/eternal.v11i1.6068

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Blended learning model in Seafarers Training Program for level II technical expert based on the needs of the shipping industry

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ABSTRACT

Nowadays, the Level II Technical Expert Seafarers' Training Program learning is conventional. This is burdensome for students due to the increased cost of living for students and needs to be revised. The coronavirus pandemic also limits direct learning. This article discusses the blended learning model for Seafarers Training Program for Level II Technical Experts. This research uses mixed methods. Quantitative methods are used to determine student responses to learning conditions. Student response data was taken using a questionnaire filled in by 41 students. Qualitative methods are used in finding the Blended Learning Model in the Level II Technical Seafarers Training Program Based on the needs of the Shipping Industry. In preparing the data model, the literature review includes blended learning, e-modules, and problem-based learning. The learning model is based on a literature review using the principles of education management. The descriptive analysis describes the model findings of Blended learning at Level II Technical Seafarers' Training. The findings in this article are that The MixPAM (Mixture Blended Problem-based And e-Module) model is a mixture of blended learning and problem-based learning e-module. The results show that the MixPAM model is hypothetically effective and efficient in improving student skills according to industry needs. Professional skills include ship engine repair maintenance (according to industry requirements), ship electrical, control, and ship management systems. Interpersonal skills include communication, teamwork, responsibility, and critical thinking.

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INTRODUCTION

Indonesia is an archipelago consisting of several islands separated by oceans and oceans. As an archipelagic country, Indonesia consists of land and sea areas. The number of islands in Indonesia, both large and small, reach 17,508 islands (Saksono, 2013). This potential is enormous for the shipping industry. The Indonesian government strives to meet the population's needs from Sabang to Merauke quickly and optimally. In addition, the development of the shipping industry in Indonesia has also increased quite rapidly to increase competitiveness with the global market (Wahidi et al., 2021). The activity of transporting goods to fulfill the needs of people separated by oceans and oceans can be carried out by the sea.

Transporting sea routes from one port to another is called shipping. Shipping is one of the government's efforts to accelerate economic growth in Indonesia (Nugroho et al., 2018). The shipping industry has a vital role in national and international trade which contains a high economic value (Frasyniuk & Primachova, 2018). The shipping industry is vital to the nation's economic growth (Kalgora & Christian, 2016). The shipping industry continues to contribute to providing quality national sea transportation. Quality sea transportation can be fulfilled if the human resources of the seafarers are also qualified.

Some of the optimization factors in the shipping industry in global economic growth, according to Frasyniuk and Primachova (2018), include (1) economic goals and strategies in certain countries, (2) differentiation of predetermined system development with decisions and approaches based on regulatory principles, standardization, and limitations, and (3) shipping technology. Its relationship with shipping technology requires human resources to increase industrial growth. One of them is through vocational education in the shipping sector. Indonesia has a problem with the gap in university graduates that needs to be in line with the needs of the world of work. The gap between the needs of the shipping industry and graduates produced by related institutions.

Nowadays, the Industry 4.0 era makes educational institutions catch up with technology in the teaching and learning process to produce competent and relevant graduates for the industrial world. The gap between the world of vocational education as the primary source of producing human resources for the shipping industry is that educational institutions have yet to produce graduates who are in line with the needs of the shipping industry.

Vocational education has a leading role in economic development if it is continuously pursued in harmony with the world of work around it, both in quantity and quality. The current industrial era 4.0 makes the shipping industry change from manual to digital and even automation. Goods and port shipping services are online and one-stop based on the context of effectiveness and efficiency of shipping costs towards sustainable competitiveness (Sari, 2019). Expert seafarers are excellent, professional, and ethical seafarers. These professional seafarers must be kept from the role of educational institutions.

Professional seafarers come from universities that provide vocational education in the shipping sector. Shipping Science Polytechnic Semarang is a higher education institution providing vocational education in the shipping sector. The Polytechnic of Shipping Science Semarang always strives to improve the quality of education so that it can produce professional graduates who meet national and international standards and compete in the global market. The condition of students has various characteristics. In this case, a sailor who wants to improve higher education while working has the same right to learn quickly. Seafarers' activities that are dense with a high workload for which they are responsible make it impossible for seafarers to carry out face-to-face/conventional learning.

However, seafarers need to increase their competence to facilitate their work on the ship and to get an increase in income. Seafarers need a non-conventional learning model that can be done anywhere to be more time and cost-efficient. Apart from these conditions, there are new problems with the spread of the coronavirus. Indonesia and the world are being hit by a major disaster in the health sector, namely the 2019 Corona Diseases Virus (Covid-19).

The wide spread of Covid-19 has made the government and stakeholders think hard in handling this case. Until now, the government has not taken any repressive steps such as strict territorial restrictions or lockdowns but has only implemented social distancing regulations. This is regulated in Law no. 6 of 2018 concerning Health Quarantine, later confirmed by Government Regulation No. 21 of 2020 and Minister of Health of the Republic of Indonesia No. 9 of 2020 concerning Large-Scale Social Distancing. The government firmly encourages working from home, learning from home, and worshiping from home. This has made our education world turn 180 degrees. The pandemic forces learning to be done online (e-learning). Efforts that can be made are learning blended learning (Alsarayreh, 2020).

Blended learning is a learning model that combines face-to-face learning in the classroom with e-learning (Lalima & Dangwal, 2017). Blended learning arises because of weaknesses in the face-to-face or conventional learning process, which tends to be boring, reducing students' motivation and some areas for improvement in e-learning learning. The combination of learning in blended learning becomes its attraction because face-to-face learning becomes a solution if there is

a miss of communication during e-learning. Blended learning will be more effective if students are highly aware of the meaning of learning.

For that, it is necessary to make an appropriate approach. The transformation of the learning method combined with the approach of students is carried out so that the teaching and learning process is more effective. Distance learning also needs special attention in several ways, including the inconsistency of students with learning hours, delays in capturing material, and other problems in the learning process, such as internet disruptions and power outages (Prawiyogi et al., 2020). Thus, the learning model in distance learning should not only be e-learning or online only but must also be combined with face-to-face (offline) meetings. This can help solve problems in online learning or distance learning.

Implementing blended learning online requires an online module or e-module (Cahyono et al., 2019). Implementing blended learning with modules is a solution when students carry out an internship program. The modules that are made can be in the form of web-based or android-based modules (Panyahuti et al., 2018). E-module is included in superior multimedia when implemented in online learning (Yulando et al., 2019). For graduates of the Seafarers' Training Program for Level II Technicians (ATT II Program) to suit industry needs, e-modules are designed according to needs. Nowadays, the competencies needed include technical competence, technology awareness, team-work, communication, responsibility, and critical thinking (Cicek et al., 2019).

For this reason, the approach that can be taken is problem-based learning. Problem-based learning (PBL) has been widely adopted in various fields and educational contexts to promote critical thinking and problem-solving in authentic learning situations. PBL is a pedagogical approach that allows students to learn while actively engaging with significant problems. Students are allowed to solve problems in a collaborative environment (Yew & Goh, 2016). Collaboration can be done when students take sailing practice (internship or work but studying higher education).

This pandemic is one of the crucial reasons e-learning learning needs to be activated as early as possible so that students can still carry out learning optimally in any condition. This is in line with expanding access to education services through e-learning to make it easier for students constrained by distance and time. The application of e-learning with the blended learning model is exciting for seafarers who must update their maritime education through education and training programs held by vocational education institutions such as PIP Semarang. For this reason, the researcher intends to develop a blended learning model for the Level II Technical Expert Seafarers' Training Program (ATT II) at PIP Semarang based on the needs of the shipping industry aimed at lecturers and training participants or student officers.

Blended learning (BL) is a new normal in learning and requires communication technology to implement. BL is learning conducted face-to-face and online (Dziuban et al., 2018; Sukardjo et al., 2020). The use of the blended learning strategy affects students' science process skills. BL is significantly more effective in improving science process skills when compared to conventional learning strategies (Harahap et al., 2019). Assessment is considered an effective tool in determining the acquisition of student knowledge in the particular subject that students take. There are various ways of assessing, some are formal, and some are informal. Under the formal grading category, a teacher usually assesses students' knowledge for courses using quizzes, practice exams, tests, viva, projects, homework, and exams (Khan et al., 2012).

The benefits of blended learning, according to Jerry and Yunus (2021), are to enrich and increase teacher knowledge in various aspects, such as:

> *(1) increasing pedagogical knowledge and digital competence, (2) training skills in using information technology for future generations, (3) learning and teaching time becomes more effective and organized, (4) saves budget, (5) increases student participation and involvement in class, (6) increases communication and collaboration inside and outside the classroom between students and teachers, and (7) improve language and communication skills.*

Blended learning will only be realized when the various engagement opportunities the two contexts provide are developed to present students with various experiences, individually and collaboratively. An essential aspect of this development is the integration of online and classroom components (Jeffrey et al., 2014). Among the design features, technology quality, online tools, and

face-to-face support are predictors of learner satisfaction. In contrast, learner characteristics of self-regulation and attitudes toward BL are predictors of satisfaction (Kintu et al., 2017). In implementing BL, the educator must provide a course-level mixed-learning environment. Practical teaching courses, which are the subject for study, are organized as a combination of face-to-face and online teaching activities.

For example, classes meet face-to-face once weekly for 2 hours on campus, and the rest is online. Participants must also teach at the participating schools for 6 hours per week. The face-to-face section in the field includes a discussion of lesson plans in other aspects of the teaching practice provided on the course Web page. Some features required in an online learning environment include additional content modules, lesson plans, discussions, methodology notes, teaching practices (videos), email, supplementary material, chats, and tips (Caner, 2010). The factors that influence the effect of BL should be addressed.

Examples are computer use, the efficiency of online tools, familiarity with technology, and student satisfaction with BL, among which student satisfaction plays an increasingly important role. Performance expectations, systaem functionality, content features, interactions, and the learning climate are claimed to be significant determinants of student satisfaction with mixed learning (Zhonggen, 2015). Figure 1 shows the factors that influence the choice of a blended learning design approach, according to Alammary et al. (2014).

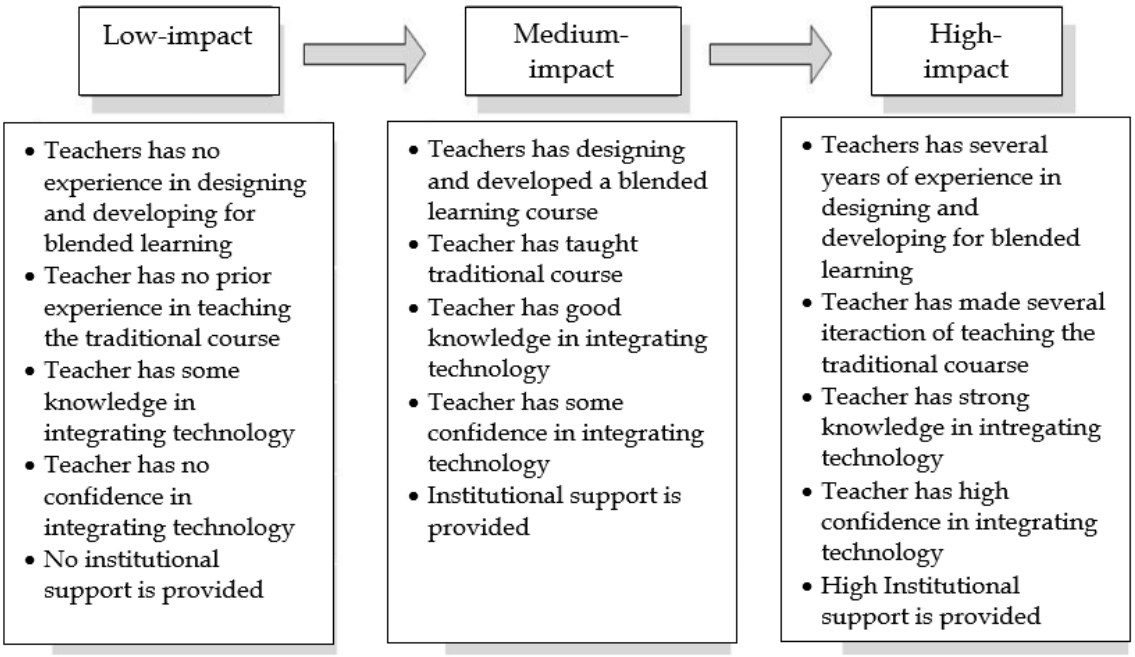

Figure 1. Factors that Influence the Choice of a Blended Learning Design Approach

One of the media and learning models that can be used in learning is an e-module based on problem-based learning. Applying problem-based learning e-modules can support learning effectiveness so that the learning atmosphere becomes attractive and students become motivated (Jaenudin et al., 2017). The e-module significantly improves learning outcomes and increases teacher motivation (Sugiani et al., 2019). E-modules are multimedia and interactive tools in an e-learning environment. This is very important to increase the transfer of knowledge and skills to users from the online platform (Wahidah et al., 2019).

Using e-modules is effective in practical learning (Astalini et al., 2019). E-module based on Problem-Based Learning (PBL) provides a variety of animated displays and simulations that students can run to facilitate students' understanding of the material presented. E-module based on PBL can improve students' science process skills (Serevina et al., 2018). Using e-modules can also improve critical thinking skills (Seruni et al., 2020).

PBL used problems as a context for students to learn problem-solving skills and acquire knowledge of basic and clinical sciences. PBL is based on adult learning principles. PBL does not require expensive resources and the latest technology (Shankar, 2010). PBL is a comprehensive approach, and the scope of its application depends on various individual, social, and institutional factors (Simone, 2014). PBL is an effective teaching and learning approach, primarily when evaluated for long-term knowledge retention and application (Yew & Goh, 2016). In implementing PBL, the evaluation includes curriculum, facilities, facilitation, student experience, and learning effectiveness for consideration (Gibbon & Marcangelo, 2012).

PBL has advantages, including (1) improved problem-solving skills, but student motivation remains, (2) more effective than conventional teaching methods, and (3) there is no gender difference in learning effectiveness (Argaw et al., 2016). As an application-focused discipline, Engineering is well suited for achieving pedagogic benefits through PBL in course design. With Teknik, there may be confusion around abbreviations, as 'PBL' can refer to 'project-based learning,' which often involves similar practices to problem-based learning (Lambert & Ashwin, 2021).

The implementation of conventional methods to PBL takes time. A model that can be done is a short workshop at the Faculty. Effective PBL tutors are: (1) able to know the subject matter and can communicate their knowledge in a way that students easily understand; (2) can assess when and how far they intervene in student learning; and (3) able to develop students' understanding of knowledge according to predetermined objectives (Williams & Paltridge, 2017). Based on the background, what is the Blended Learning Model in Seafarers Training Program for Level II Technical Experts Based on?

RESEARCH METHOD

This research uses mixed methods. Quantitative methods are used to determine student responses to learning conditions. Student response data was taken using a questionnaire filled in by 41 students. Qualitative methods are used in finding the Blended Learning Model in the Level II Technical Seafarers Training Program Based on the needs of the Shipping Industry. In preparing the data model, the literature review includes blended learning, e-modules, and problem-based learning. The learning model is based on a literature review using the principles of education management. The descriptive analysis used to describe the model findings of Blended learning at Level II Technical Seafarers' Training.

RESULT AND DISCUSSION

The current educational process is carried out face-to-face so that instructors or lecturers provide material to student officers so they can gain knowledge from the campus. The existence of the educational process requires input in the form of student officers and lecturers or instructors to be on campus so that the material is delivered directly through the laboratory so that student officers can gain more profound knowledge. The process is done by showing the existing laboratory so student officers can practice with the available equipment. The expected output is the creation of competencies that student officers expect to be able to have the expected competencies. In this learning process, there is no BL, so all lecture activities are carried out on campus. However, several things can be used as an evaluation because of constructive input and suggestions from student officers to carry out the lecture process using BL. The existing model is shown in Figure 2.

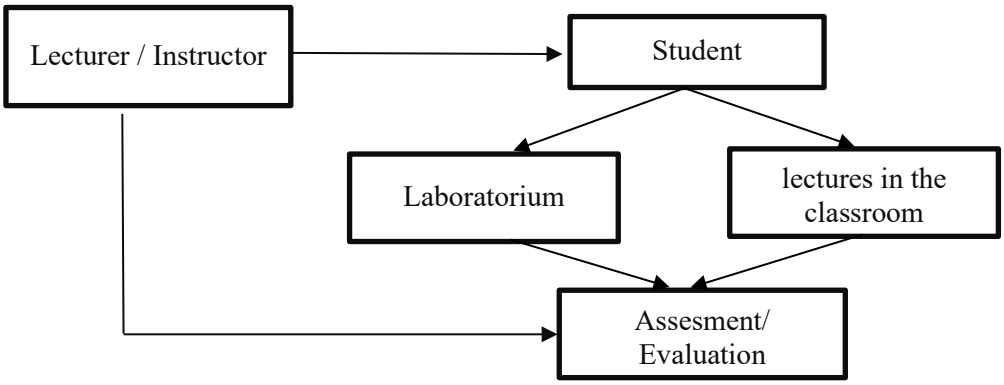

Figure 2. Existing Model ATT II Program

Based on the fact analysis in the field, there is the fact that the two-semester lectures held on campus are burdensome for the cost of living. During the learning process, student officers do not receive a salary. This is because students only work while attending lectures. The existing learning model has several weaknesses, including the implementation of lectures required face-to-face at the campus, the income of officers being reduced due to unemployment, and the burden of living costs increasing. Concerning the coronavirus pandemic, it is not recommended because it can cause virus transmission.

Initial research was conducted by conducting interviews with students. This is to determine conditions in the field and student perspectives. The literature review that has been carried out and the initial research can be used as a reference in developing the model. The existing condition shows that on-campus lectures could be more financially manageable for students. The results of data retrieval are based on a questionnaire to the students. As many as 61% of learning is currently burdensome for students financially. The graph of the questionnaire results is shown in Figure 3.

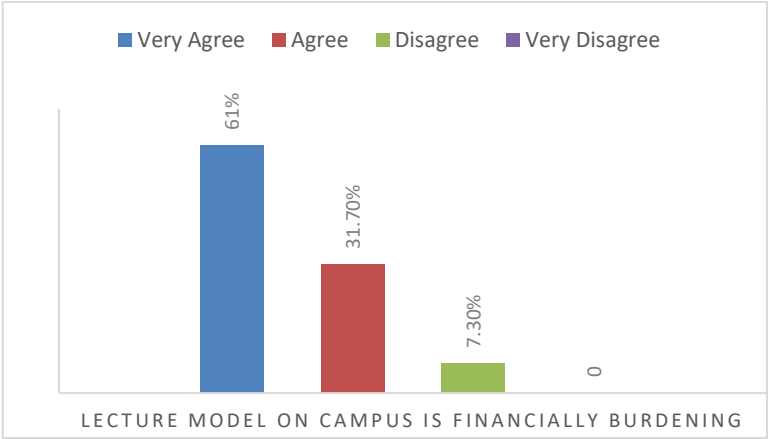

Figure 3. Lecture Model on Campus is Financially Burdening

Figure 3 shows that most of the respondents, namely as deep as 61%, stated that they strongly agreed that studying on campus could be burdensome for the cost of living. This cost of living is due to the necessities needed to fulfill lecture activities and the life needed while in Semarang. The existing learning model uses a face-to-face system, meaning that student officers must meet in a room or class to gain knowledge orally or directly from the instructor. Therefore, a flexible process of both time and energy is needed.

On the other hand, there are tuition fees that are considered high enough by student officers, so it takes time to consider further education. In increasing the competency needs in the shipping industry, experience in the industry is needed, namely sailing experience. The average sailing

experience carried out by the respondents is around 4-5 years. The sailing experience is shown in Figure 4.

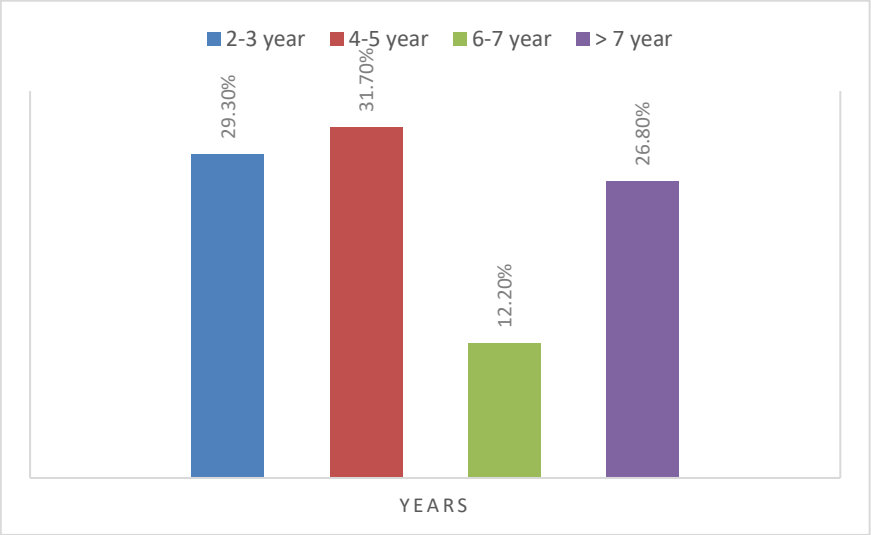

Figure 4. Long Student Sailing Experience

Based on the research results, it was found that practical lectures on campus could not be implemented optimally due to the limited study time. Respondents answered by agreeing that practical lectures could not be implemented optimally, this was due to the limited time. This limitation led to the delivery of material that student officers did not fully accept based on the delivery carried out on-campus face-to-face, so this could lead to a lack of ability for student officers to get the material thoroughly and comprehensively reduce understanding.

The majority of respondents stated that campuses have yet to be able to provide optimal learning experiences. Therefore, there are still obstacles that need to be addressed when face-to-face meetings or classes. Because there is still a gap that needs to be repaired and bridged between the reality on the ground and lecture practice, an adjustment or strategy is needed so that education on campus can approach reality, especially in terms of mechanical aspects.

The majority of respondents stated that they strongly agreed with this statement, this indicated that there needed to be an improvisation carried out by the Semarang Shipping Science Polytechnic so that student officers who were studying could get an education that was close to the existing reality.

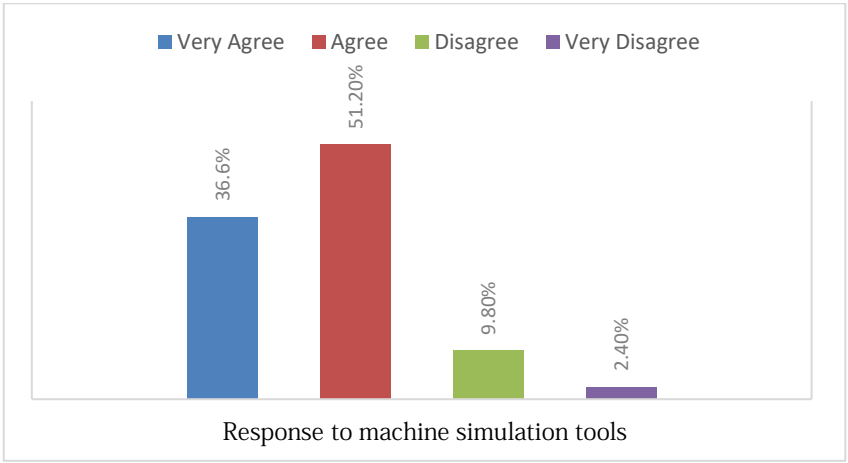

Figure 5. Response to Machine Simulation Tools

Based on the research results, the respondents answered that practical learning on the ship could be carried out more effectively. This effectiveness is because student officers can face

conditions that match reality. Based on the results of distributing questionnaires and answers from respondents who are student officers, studying for two semesters can be burdensome for the cost of living for student officers.

In addition, blended learning can be pursued in addition to sailing experience so that student officers not only get theoretical material but obtain a combination of time flexibility and hands-on learning experience on board. This learning experience can increase the competence of student officers to obtain training certificates for two engine simulation tools that are on board at the lecture location does not necessarily match the actual conditions. Blended learning can encourage better knowledge and skills when compared to offline lectures.

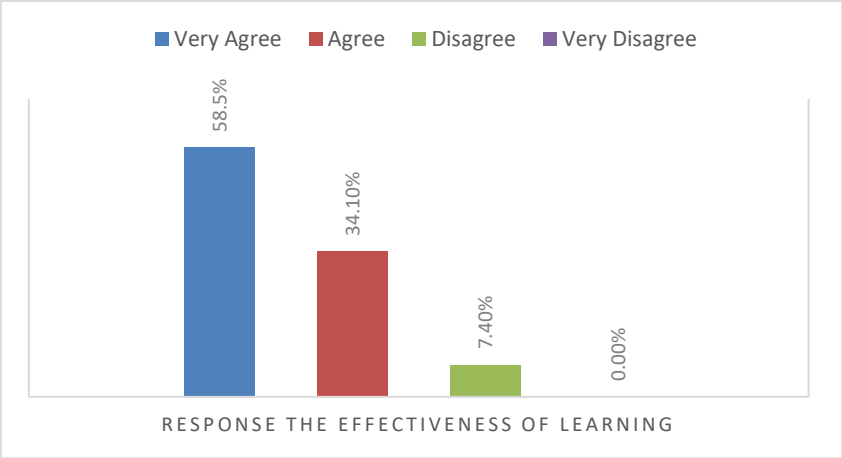

Figure 6. Response to the Effectiveness of Learning

Learning is an interactive process between students and educators and learning resources in a learning environment. Learning is assistance provided by educators so that the process of acquiring knowledge and knowledge can occur, mastery of skills and character, and the formation of attitudes and beliefs in students. In other words, learning is a process to help students learn well. The success of the learning process is determined by the strategy and learning model used. The results obtained from the expected learning are suitable to the needs of the industry.

We have entered the industrial era 4.0, where soft skills are needed, including communication, teamwork, responsibility, and critical thinking (Grzybowska & Łupicka, 2017; Maisiri et al., 2019). Critical thinking skills will be needed for problem-solving (Ulger, 2018). In addition, professional skills such as occupational health and safety (BAST), ship engine repair maintenance (according to industry needs), ship electrical systems, control systems, and ship management systems are also needed (Ahluwalia & Pinha, 2014; Bozorgpour et al., 2017; Turan & Asar, 2020). The practical learning model is blended learning. This model uses two implementations, namely face-to-face and online.

Based on educational management principles, some stage needs attention, namely planning, organization, actuating, controlling, and evaluating. In the planning stage of industrial needs analysis, nowadays, the competencies needed include technical competence, technology awareness, teamwork, communication, responsibility, and critical thinking (Cicek et al., 2019). This competence needs to be designed in the curriculum.

The curriculum must ensure that at the end of the teaching period, students must be able to (1) use technology, (2) think creatively and independently, (3) develop and communicate their own beliefs and views about the world, (4) achieve success in various fields of activity, (5) developed knowledge and understanding, (6) make informed choices and decisions, (7) communicate in different ways and different settings, and (8) work in partnerships and teams (Mouzakitis, 2010). Besides the curriculum, the learning planning needs to be designed for its implementation in the semester learning plan. Then the preparation of teaching materials (online module based on web/Android mobile).

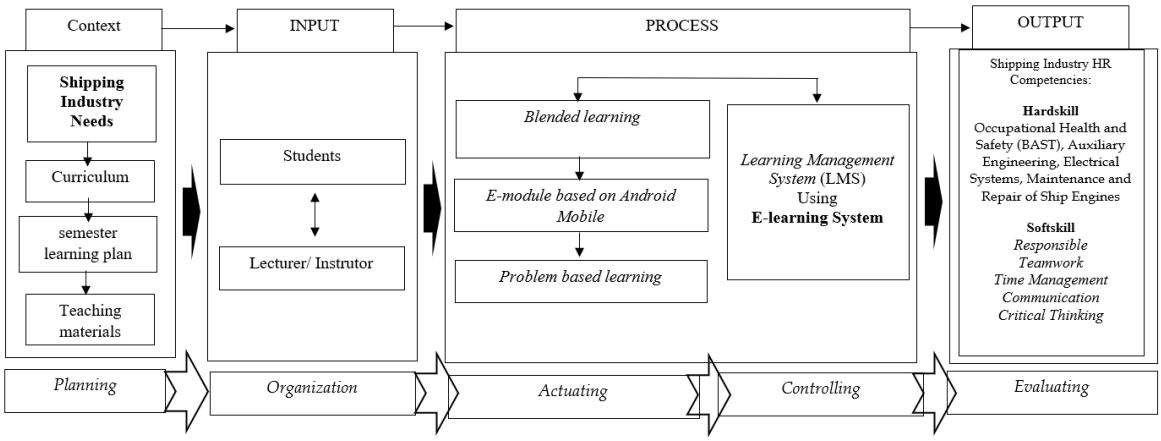

Figure 7. The Model of Blended Learning in the Level II Technical (ATT II) Expert Seafarers' Training Program at PIP Semarang is Based on the needs of the Shipping Industry

Organizing the learning model of students and educators needs to be considered. In implementing blended learning, habituation is required from conventional learning to blended learning. Organizing students is necessary to determine the competencies to be achieved. Besides that, discipline in implementing blended learning, mastery of technology, or web learning is also needed.

Educators are advised to have competence in technology and management of learning management systems (LMS). It takes a short course to organize the implementation of the blended learning model. In the implementation of learning, the findings in this study were the MixPAM learning model in learning at the Level II Technical Expert Seafarers' Training Program (ATT II) at PIP Semarang based on the needs of the shipping industry. The MixPAM (Mixture of Blended Problem-based and e-Module) model combines blended and problem-based learning e-module.

The findings show that the MixPAM model is hypothetically effective and efficient in improving student skills according to industry needs. Professional skills include ship engine repair maintenance (according to industry requirements), ship electrical, control, and ship management systems. Interpersonal skills include communication, teamwork, responsibility, and critical thinking.

CONCLUSION

Based on the results of the study shows that in the learning process of the Level II Seafarers' Training Program for Technicians, it is necessary to plan to improve student skills that are needed by the industry in curriculum design. The application of the blended model in the curriculum is designed to be a maximum of 80% of the total. Then the lecturer prepares a semester learning plan. Furthermore, blended learning is carried out using an e-module based on problem-based learning. E-modules should be designed based on Android to make it easier for students to learn anytime and anywhere while sailing. Learning control for the Level II Seafarers' Training and Education program is carried out using a Learning Management System. Lecturers are expected to have Information and communications technology (ICT) skills. Lecturers are suggested to create an interactive learning environment so that students feel satisfied and motivated in its implementation. In implementing blended learning, students need to be disciplined when meeting face-to-face and online learning to achieve learning objectives. Future implications indicate that blended learning will often be used in learning. Future research requires limited trials in the control class and experimental class and expanded trials to ensure the effectiveness of the conceptual learning model developed. Furthermore, to find the effect of increasing students' hard and soft skills using the MixPAM learning model.

REFERENCES

Ahluwalia, R., & Pinha, D. (2014). Decision support system for production planning in the ship repair industry. *Industrial and Systems Engineering Review*, *2*(1), 52–61. https://doi.org/10.37266/ISER.2014v2i1.pp52-61

Alammary, A., Sheard, J., & Carbone, A. (2014). Blended learning in higher education: Three different design approaches. *Australasian Journal of Educational Technology*, *30*(4), 440–454. https://doi.org/10.14742/ajet.693

Alsarayreh, R. (2020). Using blended learning during COVID-19. *Cypriot Journal of Educational Sciences*, *15*(6), 1544–1556. https://doi.org/10.18844/cjes.v15i6.5298

Argaw, A. S., Haile, B. B., Ayalew, B. T., & Kuma, S. G. (2016). The effect of Problem Based Learning (PBL) instruction on students' motivation and problem solving skills of physics. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(3), 857–871. https://doi.org/10.12973/eurasia.2017.00647a

Astalini, A., Darmaji, D., Kurniawan, W., Anwar, K., & Kurniawan, D. A. (2019). Effectivenes of using e-module and e-assessment. *International Journal of Interactive Mobile Technologies (IJIM)*, *13*(9), 21–39. https://doi.org/10.3991/ijim.v13i09.11016

Bozorgpour, R., Omaraee, B., & Asadi, M. V. Z. (2017). Study and analysis of obstacles and challenges facing ship-repair industry in Iran. *Open Journal of Marine Science*, *7*(4), 485–493. https://doi.org/10.4236/ojms.2017.74034

Cahyono, A. N., Zaenuri, Z., & Subagja, M. (2019). The design of blended learning modules for higher education. *Journal of Physics: Conference Series*, *1387*(1), 012121. https://doi.org/10.1088/1742-6596/1387/1/012121

Caner, M. (2010). A blended learning model for teaching practice course. *Turkish Online Journal of Distance Education*, *11*(3), 78–97. https://dergipark.org.tr/en/pub/tojde/issue/16909/176358

Cicek, K., Akyuz, E., & Celik, M. (2019). Future skills requirements analysis in maritime industry. *Procedia Computer Science*, *158*, 270–274. https://doi.org/10.1016/j.procs.2019.09.051

Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: The new normal and emerging technologies. *International Journal of Educational Technology in Higher Education*, *15*(1), 3. https://doi.org/10.1186/s41239-017-0087-5

Frasyniuk, T., & Primachova, N. (2018). Marine shipping industry within the system of global economic relations sustainability. *International Journal of Engineering & Technology*, *7*(4.3), 451. https://doi.org/10.14419/ijet.v7i4.3.19914

Gibbon, C., & Marcangelo, C. (2012). A PBL evaluation toolkit: Building the evidence-base to understand effective practices. *Procedia - Social and Behavioral Sciences*, *47*, 1686–1691. https://doi.org/10.1016/j.sbspro.2012.06.883

Grzybowska, K., & Łupicka, A. (2017). Key competencies for Industry 4.0. *Economics & Management Innovations*, 250–253. https://doi.org/10.26480/icemi.01.2017.250.253

Harahap, F., Nasution, N. E. A., & Manurung, B. (2019). The effect of blended learning on student's learning achievement and science process skills in plant tissue culture course. *International Journal of Instruction*, *12*(1), 521–538. https://doi.org/10.29333/iji.2019.12134a

Jaenudin, A., Baedhowi, P., & Murwaningsih, T. (2017). The effectiveness of the e-module of economics learning on problem-based learning used to improve students' learning outcomes. *Proceedings of the International Conference on Teacher Training and Education 2017 (ICTTE 2017)*, 30–36. https://doi.org/10.2991/ictte-17.2017.32

Jeffrey, L., Milne, J., Suddaby, G., & Higgins, A. (2014). Blended learning: How teachers balance the blend of online and classroom components. *Journal of Information Technology Education: Research*, *13*, 121–140. https://doi.org/10.28945/1968

Jerry, M., & Yunus, M. M. (2021). Blended learning in rural primary ESL classroom: Do or don't. *International Journal of Learning, Teaching and Educational Research*, *20*(2), 152–173. https://doi.org/10.26803/ijlter.20.2.9

Kalgora, B., & Christian, T. M. (2016). The financial and economic crisis, its Impacts on the shipping industry, lessons to learn: The container-ships market analysis. *Open Journal of Social Sciences*, *4*(1), 38–44. https://doi.org/10.4236/jss.2016.41005

Khan, A. I., Qayyum, N., Shaik, M. S., Ali, A. M., & Bebi, C. V. (2012). Study of blended learning process in education context. *International Journal of Modern Education and Computer Science*, *4*(9), 23–29. https://doi.org/10.5815/ijmecs.2012.09.03

Kintu, M. J., Zhu, C., & Kagambe, E. (2017). Blended learning effectiveness: the relationship between student characteristics, design features and outcomes. *International Journal of Educational Technology in Higher Education*, *14*(1). https://doi.org/10.1186/s41239-017-0043-4

Lalima, L., & Dangwal, K. L. (2017). Blended learning: An innovative approach. *Universal Journal of Educational Research*, *5*(1), 129–136. https://doi.org/10.13189/ujer.2017.050116

Lambert, C., & Ashwin, P. (2021). Using student feedback to reflect on authentic PBL (aPBL) in undergraduate engineering education. *Journal of Problem-Based Learning*, *8*(1), 4–12. https://doi.org/10.24313/jpbl.2020.00311

Maisiri, W., Darwish, H., & van Dyk, L. (2019). An investigation of industry 4.0 skills requirements. *South African Journal of Industrial Engineering*, *30*(3), 90–105. https://doi.org/10.7166/30-3-2230

Mouzakitis, G. S. (2010). The role of vocational education and training curricula in economic development. *Procedia - Social and Behavioral Sciences*, *2*(2), 3914–3920. https://doi.org/10.1016/j.sbspro.2010.03.616

Nugroho, A. W., Baga, L. M., & Iskandar, B. H. (2018). Strategi pengembangan bisnis PT Pelayaran Bahtera Adhiguna dalam industri pelayaran. *ALBACORE Jurnal Penelitian Perikanan Laut*, *1*(3), 321–336. https://doi.org/10.29244/core.1.3.321-336

Panyahuti, P., Rukun, K., & Waskito, W. (2018). Development of learning module based on blended learning in network design lesson. *Proceedings of the International Conferences on Educational, Social Sciences and Technology - ICESST 2018*, 467–471. https://doi.org/10.29210/2018168

Prawiyogi, A. G., Purwanugraha, A., Fakhry, G., & Firmansyah, M. (2020). Strategi pengembangan bisnis PT Pelayaran Bahtera Adhiguna dalam industri pelayaran. *Jurnal Pendidikan Dasar*, *11*(1), 94–101. https://doi.org/10.21009/JPD.081

Saksono, H. (2013). Ekonomi biru: Solusi pembangunan daerah berciri kepulauan studi kasus Kabupaten Kepulauan Anambas. *Jurnal Bina Praja*, *5*(1), 1–12. https://jurnal.kemendagri.go.id/index.php/jbp/article/view/82/79

Sari, D. I. (2019). Centre of technology sebagai model praktis industri pelayaran untuk kompetensi lulusan jurusan ketatalaksanaan pelayaran niaga pada perguruan tinggi vokasi maritim di Indonesia. *Prosiding Industrial Research Workshop and National Seminar*, *10*(1), 1257–1263. https://doi.org/10.35313/irwns.v10i1.1405

Serevina, V., Sunaryo, S., Raihanati, R., Astra, I. M., & Sari, I. J. (2018). Development of e-module based on Problem Based Learning (PBL) on heat and temperature to improve student's

science process skill. *TOJET: The Turkish Online Journal of Educational Technology*, *17*(3), 26–36. https://files.eric.ed.gov/fulltext/EJ1184205.pdf

Seruni, R., Munawaroh, S., Kurniadewi, F., & Nurjayadi, M. (2020). Implementation of e-module flip PDF professional to improve students' critical thinking skills through problem based learning. *Journal of Physics: Conference Series*, *1521*(4), 042085. https://doi.org/10.1088/1742-6596/1521/4/042085

Shankar, P. R. (2010). Problem-based learning: A review. *Journal of Clinical and Diagnostic Research*, *4*(5), 3249–3254. https://www.researchgate.net/publication/271529658_Problem-based_learning_-_A_Review

Simone, C. De. (2014). Problem-based learning in teacher education: Trajectories of change. *International Journal of Humanities and Social Science*, *4*(12), 17–29. https://www.ijhssnet.com/journals/Vol_4_No_12_October_2014/3.pdf

Sugiani, K. A., Degeng, I. N. S., Setyosari, P., & Sulton, S. (2019). The effects of electronic modules in constructivist blended learning approaches to improve learning independence. *International Journal of Innovation, Creativity and Change*, *9*(10), 82–93. https://www.ijicc.net/images/vol9iss10/91014_Sugiani_2019_E_R.pdf

Sukardjo, M., Ibrahim, N., Ningsih, H. P., Widodo, A., & Nugroho. (2020). Implementation-blended learning in Indonesian Open Junior High School. *International Journal of Innovation, Creativity and Change*, *10*(12), 638–654. https://www.researchgate.net/profile/Arif-Nugroho-6/publication/342216039_Implementation-Blended_Learning_in_Indonesian_Open_Junior_High_School/links/5ee9271a299bf1faac5c6b2a/Implementation-Blended-Learning-in-Indonesian-Open-Junior-High-School.pdf

Turan, E., & Asar, R. (2020). Ship repair and maintenance management: Application of PERT analysis on a tanker vessel. *Journal of Ship Production and Design*, *36*(3), 181–188. https://doi.org/10.5957/JSPD.07190044

Ulger, K. (2018). The effect of problem-based learning on the creative thinking and critical thinking disposition of students in visual arts education. *Interdisciplinary Journal of Problem-Based Learning*, *12*(1). https://doi.org/10.7771/1541-5015.1649

Wahidah, N. I., Ibrahim, N., & Muslim, S. (2019). E-module: Design a learning material with Rowntree and Hannafin Model for higher education. *International Journal of Scientific Engineering and Research (IJSER)*, *8*(12), 3373–3376. https://www.ijstr.org/final-print/dec2019/E-module-Design-A-Learning-Material-With-Rowntree-And-Hannafin-Model-For-Higher-Education-.pdf

Wahidi, S. I., Virmansyah, V. M., & Pribadi, T. W. (2021). Study on implementation of Activity-Based Costing (ABC) system on determination of indirect costs in ship production. *Kapal: Jurnal Ilmu Pengetahuan Dan Teknologi Kelautan*, *18*(1), 1–7. https://doi.org/10.14710/kapal.v18i1.33000

Williams, J. C., & Paltridge, D. J. (2017). What we think we know about the tutor in problem-based learning. *Health Professions Education*, *3*(1), 26–31. https://doi.org/10.1016/j.hpe.2016.05.001

Yew, E. H. J., & Goh, K. (2016). Problem-based learning: An overview of its process and impact on learning. *Health Professions Education*, *2*(2), 75–79. https://doi.org/10.1016/j.hpe.2016.01.004

Yulando, S., Sutopo, S., & Chi, T. F. (2019). Electronic module design and development: An interactive learning. *American Journal of Educational Research*, *7*(10), 694–698. https://doi.org/10.12691/education-7-10-4

Zhonggen, Y. (2015). Blended learning over two decades. *International Journal of Information and Communication Technology Education*, *11*(3), 1–19. https://doi.org/10.4018/IJICTE.2015070101