ISSN 2963-7511
Journal of Engineering Researcher and Lecturer, Vol. 2, No. 1, pp. 9-17, 2023

Work-based learning for the engineering field in vocational education: Understanding concepts, principles and best practices

Nizwardi Jalinus[1], Syahril[1], Syaiful Haq[1*] and Gulzhaina Kuralbayevna Kassymova[2]

[1] Vocational Research Centre, Universitas Negeri Padang, **INDONESIA**
[2] Institute of Metallurgy and Ore Beneficiation, Satbayev University, **KAZAKHSTAN**

Abstract: Various learning models have been developed and implemented in vocational education in the engineering field, but still have weaknesses, especially in basic matters such as one-sided learning and lack of direct industrial involvement. Moreover, learning in educational institutions is not supported by facilities that match those in the industry, but only simulation tools. Additionally, the media used in educational institutions is not as sophisticated as that used in the industry. This study is a literature review on Work-based Learning (WBL) and the formulation of WBL concepts suitable for vocational education in the engineering field. The results of the literature review showed that the implementation of WBL in various developing and advanced countries is very effective in developing students' competencies. Educational institutions and industries work together to improve the quality of learning to produce job-ready graduates. Industries benefit from the availability of competent and professional workforce who can develop their business for global competition. There are three WBL model concepts that can be applied to vocational education in the engineering field, including integrated student work, teaching factory, and industrial internship. The formation of student competencies can be carried out through a structured program, where students will gain experience and opportunities to gradually sharpen their competencies.

Keywords: WBL, Integrated students work, Teaching factory, Industrial Internship

*Corresponding Author: syahifulhaq@ft.unp.ac.id
Received February 13rd 2023; Revised: March 05th 2023; Accepted: March 19th, 2023
https://doi.org/10.58712/jerel.v2i1.22

Reference to this paper should be made as follows: Jalinus, N., Syahril, Haq, S., & Kassymova, G. K. Work-based learning for the engineering field in vocational education: Understanding concepts, principles, and best practices. *Journal of Engineering Researcher and Lecturer*, 2(1), 9–17. https://doi.org/10.58712/jerel.v2i1.22

1. Introduction

Vocational education is an educational program designed to provide students with competencies that are in line with the needs of the workforce (UNESCO, 2011). Vocational education is education that provides learning on how to work effectively, preparing individuals to become professional workers (Billett, 2011). Based on the meaning of vocational education that has been widely explained by experts, the learning process in vocational education must be carried out in accordance with that meaning, so that the purpose and objectives of providing vocational education can be achieved.

Various learning models for vocational education have been developed, such as project-based learning, problem-based learning, case study, contextual instruction, and inquiry. These learning models have been implemented in learning activities, but there are some fundamental weaknesses in the models, namely: one-way learning, very rare or even no involvement of industry or workplace parties in learning activities, generally learning facilities available in education are simulation tools (training units), not as advanced as the technology used in the industry (production units), and limited variation of learning media. Learning in vocational education needs to be designed to provide as much direct experience as possible to learners

in the real world. Essentially, the real world needs to be brought into the classroom and vice versa, and the classroom needs to be taken to the real world. On the other hand, it is stated that learning in vocational education should be more dominant towards practical learning and directing students' practicum topics towards creating real-world products or services (Jalinus et al., 2019). The realization of this can be achieved by creating mutually beneficial relationships between educational institutions and the industry or the world of work.

The learning model that creates a connection between classroom learning activities and the world of work or industry is the work-based learning (WBL) model. WBL is very suitable for technical education and vocational education (Stones, 1994). When the program's goals, curriculum, and workplace-based experience are designed and applied with adequate staff support and evaluated properly, the program will have a positive impact (Fallows & Weller, 2000; Halimah & Syaddad, 2020).

This article aims to discuss the conceptual framework and principles of the WBL model for vocational education. The existence of a conceptual framework, principles, and practical application of the WBL model is expected to serve as a reference for further research to reveal the effectiveness of the model in student competence and as a guide for teachers or lecturers in implementing learning with the WBL model. This article is a literature review, which studies books, articles, or proceedings about WBL. After that, an analysis is carried out in developing arguments to define each element of WBL.

2. Definition of WBL

Many experts and researchers in the field of education define the WBL model. The results of research on the implementation and development of WBL models produce diverse definitions. Other opinions state that WBL is an educational learning program that is carried out in the workplace or industry (Bragg et al., 1995). WBL is a form of learning related to all fields of work, work-based learning, learning in the workplace, and learning through work (Seagraves et al., 1996). WBL adheres to constructivism theory, has been widely practiced in the world of education, and is an active and dynamic form of learning that will continue to evolve. WBL is different from conventional training, where in WBL, students are directly involved in work and gain real-life experience in the workplace (Seufert, 2000). WBL is a term used to describe learning activities that combine classroom learning with learning in the world of work (Boud & Solomon, 2001). WBL is a learning model that provides learning experiences to students in a real working environment, and WBL is a process of recognizing and applying knowledge through learning in the workplace, where workplace learning (WBL) is part of course credit (Becker, 2007).

WBL is part of experiential learning based on real work experiences through the production of goods and services that occur in the workplace (UNESCO-UNEVOC, 2013). WBL is a learning process that uses the workplace as a student learning environment (Ismail et al., 2015). WBL is a teaching and learning method that requires learners to undergo training in the industry, where employers are responsible for teaching and evaluating learners (Gilbert & Blackwell, 2007).

3. The implementation of WBL in various countries

China is well-known as a supplier of products worldwide, almost all types of tools (products) have been manufactured and marketed, and the Chinese government has even launched a national strategic plan and industry policy known as "Made in China 2025." To improve the manufacturing capabilities of China's industries, companies are very concerned with the readiness of skilled labour. Established industries with good infrastructure in some provinces

ISSN 2963-7511

have already been integrated with vocational schools (Deitmer et al., 2013). The are two reform concepts being implemented, namely:

1. Vocational schools as integrated production areas or also known as "production schools". Companies support the development of production areas within schools and students learn through the concept of work-based learning
2. Practice firms. Vocational schools establish artificial companies, where the environment and equipment used are simulated realistically. During the working process, teachers act as project managers, in other words as company managers. Didactics are process-oriented and integrated. Through this, students can gain a deeper understanding of issues related to the work environment and work processes.

In Malaysia, the implementation of WBL has been carried out by several companies in collaboration with educational institutions there (Ismail et al., 2015). One of them is the Proton company and the Ministry of Higher Education. The win-win concept applied has made this collaboration successful. Proton, as an industry, provides/ prepares machinery, equipment, and new equipment in educational institutions. In practice, the lessons are guided at the Proton Training Center (PTC) by teachers, taught in the classroom 25%, and trained at the Proton workplace 75%.

In Romania, the implementation of WBL is included in national law as a cross-sectoral subject. WBL is referred to as an apprenticeship which thoroughly prepares the learners for work and even employs them as actual workers under a contract. The time for theoretical training of apprentices is included in their regular working hours. The monthly salary provided by the apprenticeship contract is at least equal to the national gross minimum wage. The work program is 8 working hours per day, 40 hours per week, while for participants under 18 years old, the work program is 6 working hours per day, 30 hours per week (Cerkez et al., 2016)

In Poland, WBL is mandated by national law as a core component of vocational education (Chłoń-Domińczak et al., 2016). Vocational schools in Poland are divided into two types: basic vocational schools and technical secondary schools. The practical component of vocational education can be delivered through work-based learning (in school workshops, continuing education centres, practical training centres, or with employers) or on-the-job training (which is mandatory for technical secondary schools and post-secondary vocational schools) - a secondary program that lasts from 4 to 12 weeks, depending on the type of work performed [28]. Similar to Romania, trainees must sign a contract with the industry. There are two types of contracts: a work contract for vocational training, signed between the trainee and the employer, and an internship contract agreed between the school principal and the host employer of the student on the internship. During practical training, vocational school students in the dual system are considered teenage workers. As a result, there is a special type of practical training that is work for teenagers to provide vocational training for young people between 16-17 years old with lower secondary education. Since 2014, employers have also been allowed to use the National Training Fund, which is part of the Labor Fund to finance training for their employees, and in some cases, the fund can cover up to 100% of the costs.

In Germany, the dual vocational training system is prioritized to support the establishment of strong relationships between educational institutions and industries, as well as to support the development of both (Hippach-Schneider & Huismann, 2016). Companies that participate in the program are monitored by the responsible Regional Administrative Authority. There are no specific tax laws that support companies engaged in WBL or dual education initiatives.

4. WBL for engineering vocational education

Vocational and technical education in Indonesia continues to face demands to produce

professional graduates that meet the needs of a constantly evolving industrial world. After the ASEAN Economic Community (AEC) challenge that began in late 2015, a new challenge emerged with the advent of the fourth industrial revolution. Vocational education is directly impacted by the presence of the AEC and the fourth industrial revolution, both in Vocational High Schools (VAC) and diploma programs at higher education institutions. This is evidenced by the low absorption rate of Indonesian vocational education graduates in the job market. Based on data from the Central Statistics Agency (BPS) of Indonesia, in the last five years, the highest number of graduates who were not absorbed by the workforce were vocational school graduates (VAC) (Badan Pusat Statistik Indonesia, 2021). This data indicates that there is a gap in the absorption rate of vocational education graduates. The low absorption rate of Indonesian vocational education graduates is suspected due to many graduates who do not meet the competency requirements according to the needs of the job market, and the presence of foreign investors bringing new and specific technologies that further exacerbate the competency gap among vocational education graduates.

The low quality of human resources makes it difficult for the workforce and industries to recruit competent human resources in a short time. It is further revealed that new investors from abroad who bring new and specific technologies are having difficulties in finding skilled workers who meet their required competencies. An effort that vocational education should make is to establish collaboration with the industry. Through Presidential Instruction No. 9 of 2016, the government has declared the Revitalization of VAC to improve the competitiveness of Indonesia's human resources. One of the programs developed is the relationship between VAC and the industry through industrial practice. Industrial practice activities are generally carried out for one semester and practical activities are not related to a specific subject. What happens cannot be measured whether the learning taught in school is related to the world of work. Industrial practice activities carried out do not guarantee that everything learned by students in the class will be found or learned again in the internship place. Therefore, the development of a WBL model is needed which can integrate learning activities for students in class by providing opportunities for students to learn in industries or workplaces related to the subjects they are studying in class.

WBL is highly suitable for educational institutions, especially with the emergence of new technologies in the era of the fourth industrial revolution (Schuh et al., 2015). Another view suggests that WBL can foster the development of the personality and professionalism of students, making them ready to enter the workforce (Hernández-Fernández et al., 2018). Countries that implement WBL in vocational education tend to have lower youth unemployment rates and better job market integration compared to countries with school-based vocational education (Jørgensen, 2015).

5. The concept WBL

In concept, the WBL model is a collaborative learning program between educational institutions and industries, where the industry provides opportunities for students to gain direct and real experience about the production of goods and services. The essence of this model is that students can learn in both industry and educational settings, creating a learning environment that is connected to the industry to structure experiences gained in the industry, contributing to the social, academic, and career development of learners and serving as a supplement to learning activities. Meanwhile, the output of WBL is to provide greater career opportunities for students and meet the needs of the job market as a result of the dynamic scale of activities that combine social, organizational, and personal aspects integrated into clear and structured learning. The principles of WBL include seven principles, namely 1) supporting career advancement, 2) providing meaningful tasks to build skills, 3) offering compensation, 4) clarifying skill identification targets, 5) developing skills, 6) also supporting entry into higher education, and 7) providing comprehensive support to students.

In the implementation of WBL, there are three main stages that vocational schools must undergo, namely the exploration of cooperation, program implementation, and evaluation (see Figure 1).

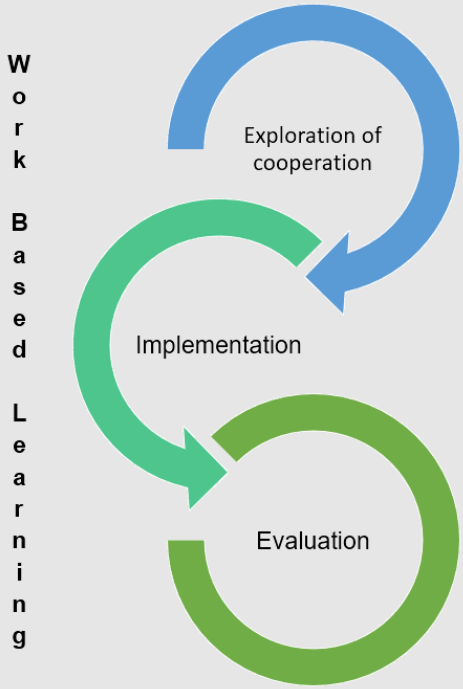

Figure 1: The main stages that vocational schools to implement WBL

1. Exploration of cooperation

   The established collaboration is between educational institutions and industries. The applied collaboration concept refers to the win-win solution philosophy, which benefits both parties. Educational institutions receive assistance in providing education, achieving learning objectives, and having industries present in the learning process. Industries also benefit from having access to education graduates (potential workers) who are ready for work. Building collaboration with industries is not an easy task; connectivity and regulations favour education as a shared responsibility of schools and industries. While schools may be proactive in establishing relationships with the world of work (school-driven), industries are also aware and initiate offering educational and training opportunities to schools (the world of work-driven). Industries can offer internship programs (apprenticeships, job shadowing, on-the-job training, collaborative programs, teaching factories, etc.) to schools. Government regulations are essential to support the collaboration between schools and industries. In several developing and developed countries, vocational laws have been enacted that can bind industries and vocational schools that carry out work-based learning.

   This collaboration can take the form of creating a Memorandum of Understanding (MoU), which is a legal document that describes an agreement between two parties. In its implementation, the institution proposes a collaboration with the industry on the joint application of WBL, with a mutual benefit orientation.

2. Implementation

   Reforming vocational education in Indonesia requires providing real work experience to students to equip them with proficient skills. Industries also need to

be involved in enhancing the quality of education to obtain a professional workforce, allowing the industry to progress and develop. Work-Based Learning (WBL), which has been widely implemented in developed and developing countries, should be a reference for vocational education in Indonesia. The implementation of WBL in vocational education in Indonesia can be carried out in two forms:

a. Integrated Student Work

Schools can establish an industry (manufacturing goods or providing services). Learning in school is no longer limited by subject-specific classrooms or separate assignments with different topics, which results in students' skills and experiences being unfocused. The change from compartmentalized classes to a cohesive task for students involves not only student-to-student collaboration but also teachers collaborating with other teachers who have different areas of expertise (as illustrated in Figure 2).

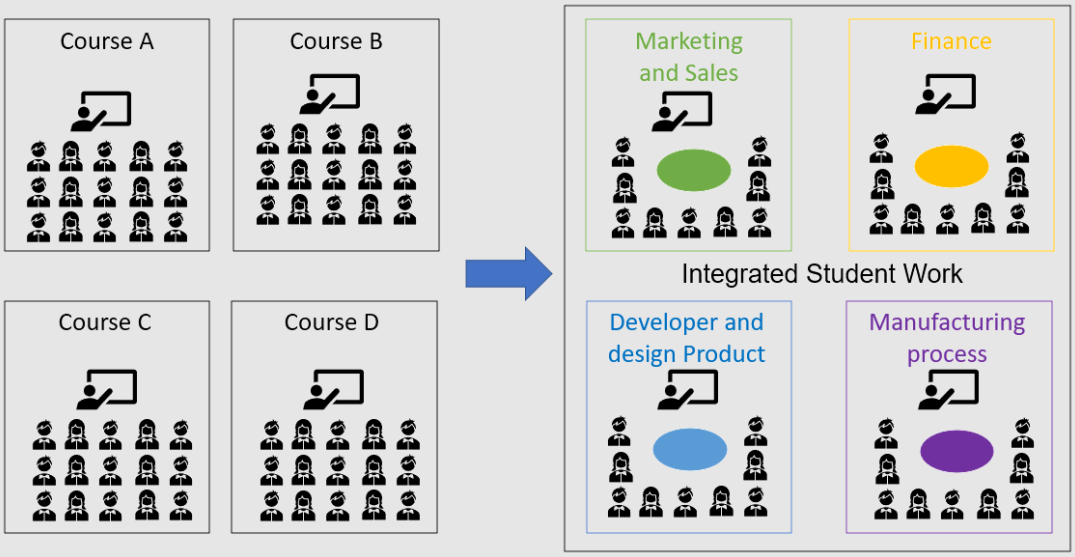

Figure 2: Reforming segmented classes into an "integrated student work" approach.

In the "Integrated student work" approach to learning, classes are formed into a cohesive task of creating a single product, with students being assigned tasks based on their interests and skills. Each student focuses on one area of work. All teachers or instructors join a simulated company acting as production consultants. In this environment, students will gain real-world experience in an industrial setting. The product created can be a potentially marketable product or a product ordered by the community.

b. Teaching Factory

Teaching Factory is similar to "Integrated student work" but involves partnerships with industries. Learning activities are supported by industries, both by providing expert personnel from the industry to become teachers or practicing instructors, and by providing facilities and infrastructure to support learning (as illustrated in Figure 3). In each field of work, not only are teachers involved in teaching but also industry practitioners.

ISSN 2963-7511

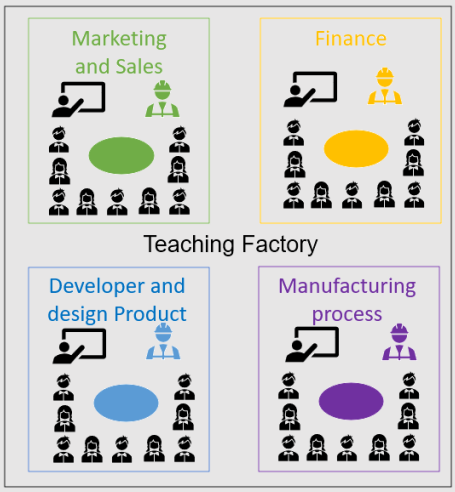

Figure 2: Teaching Factory

Many industries realize that having competent workforce readiness is crucial for the advancement of their businesses. The involvement of industries in learning will catalyze the formation of student competencies. Teachers play a vital role in the learning process, from preparation to implementation and evaluation, aided by industry practitioners. Industries can assist schools by supplying equipment or machines that the schools do not yet possess.

c. Industrial internship

Students need to gain real industry experience, which means learning outside of school through internships in industries. This activity will enrich students' experiences in their chosen fields of expertise. The formation of student competencies can be done step by step. Students need to learn the basics of knowledge and competencies in conventional classes, followed by experience in "integrated student work" classes. After that, students can enter teaching factory classes partnered with industries, and finally participate in industrial internships for real industry experience. These steps will form mature student skills. The stages of student competency formation are shown in Figure 4.

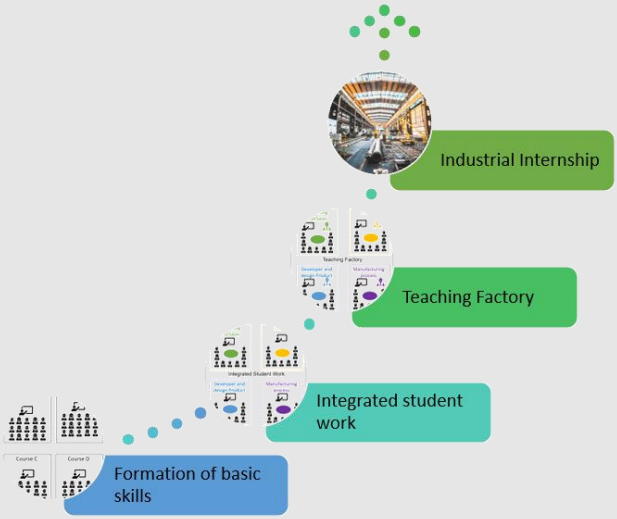

Figure 4: Formation of student competence can be done in a tiered way

3. Evaluation

The evaluation process is a continuous phase of the WBL program, as the evaluation results are used to improve future programs. The evaluation is conducted comprehensively in both educational and industrial institutions. In addition to these, evaluations are also carried out on students to assess their satisfaction, learning outcomes, and competencies. The output of the evaluation is recommendations that must be implemented in the development of WBL in the future.

6. Conclusions

The implementation of WBL in various countries such as China, Malaysia, Romania, Poland and Germany have proven to be effective and efficient, providing benefits for educational institutions and industries there. Some of these countries even pay special attention to WBL by including it in their government laws as a practical form of bridge between educational institutions and industry. The industry is very concerned about the availability of a competent workforce; therefore, they are involved in improving the quality of learning. WBL is the answer to the mismatch of competencies possessed by vocational education graduates with the competencies needed by the industry. WBL provides a great opportunity for students to gain experience in how a real working environment is. The best application of WBL begins with creating cooperation in the form of a memorandum of understanding (MoU) between educational institutions and industry, focusing on mutual benefits and sustainable human resource development with an orientation of task facilitation, mentoring and monitoring.

Implementation of WBL will lead to mutually beneficial partnerships between educational institutions and industry, particularly in improving the quality and quantity of human resources. The application of WBL in vocational education institutions will provide new learning variations and change learning patterns in the classroom.

Acknowledgements

The authors would like to express gratitude to the research team from the Vocational Research Center at Universitas Negeri Padang for providing input and suggestions to improve the quality of this article.

Declarations

Author contribution

Nizwardi Jalinus was responsible for developing the article concept, analyzing data, and writing the article. Syahril analyzed data and contributed to writing the article, while Syaiful gathered data and also contributed to writing the article. Gulzhaina Kuralbayevna Kassymova edited the article's structure, analyzed data, and proofread the final article.

Funding statement

The authors would like to thank Lembaga Penelitian dan Pengabdian Kepada Masyarakat Universitas Negeri Padang for funding this work with a contract number: 1759/UN35.13/LT/2022.

Competing interest

The authors declare no conflict of interest.

References

Badan Pusat Statistik Indonesia. (2021). Keadaan Ketenagakerjaan Indonesia Februari 2021. *Berita Resmi Statistik, No.37/05/Th. XXIV, 05 Mei 2021*.

Becker, K. (2007). Digital game-based learning once removed: Teaching teachers. *British Journal of Educational Technology*, *38*(3), 478–488. https://doi.org/10.1111/J.1467-8535.2007.00711.X

Billett, S. (2011). *Vocational Education*. Springer Netherlands. https://doi.org/10.1007/978-94-007-1954-5

Boud, D., & Solomon, N. (2001). *Work-based learning: a new higher education?*

Bragg, D. D., Hamm, R. E., & Trinkle, K. A. (1995). *Work-based learning in two-year colleges in the United States*. NCRVE.

Cerkez, E.-B., Stroie, D.-C., Vlăduț, Z.-E., Mărginean, F., Rădulescu, A., Zamfir, A.-M., & Voinea, L. (2016). *Vocational education and training in Europe – Romania*. http://libserver.cedefop.europa.eu/vetelib/2016/2016_CR_RO.pdf

Chłoń-Domińczak, A., Dębowski, H., Holzer-Żelażewska, D., & Maliszewska, A. (2016). *Vocational education and training in Europe – Poland*. https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_PL.pdf

Deitmer, L., Burchert, J., & Han, X. (2013). *Work-Based Learning in China* (pp. 115–128). https://doi.org/10.1007/978-94-007-5398-3_8

Fallows, S., & Weller, G. (2000). Transition from student to employee: a work-based programme for 'graduate apprentices' in small to medium enterprises. *Journal of Vocational Education and Training*, *52*(4), 665–685. https://doi.org/10.1080/13636820000200143

Gilbert, E. D., & Blackwell, E. (2007). Industry/university partnerships. *Package Printing*, *54*(8), 52. https://doi.org/10.1108/03090599410068033/FULL/XML

Halimah, & Syaddad, H. N. (2020). Preparing the Preservice Teachers to be the Industrial Revolution Teacher 4.0 Era. *Proceedings of the 3rd International Conference on Learning Innovation and Quality Education (ICLIQE 2019)*. https://doi.org/10.2991/assehr.k.200129.144

Hernández-Fernández, J. D., Vílchez, J. M., Massaro, F., Marchesini, E. J., & Siregar, S. (2018). A Study of Work Based Learning For Construction Building Workers. *Journal of Physics: Conference Series*, *970*(1), 012024. https://doi.org/10.1088/1742-6596/970/1/012024

Hippach-Schneider, U., & Huismann, A. (2016). *Vocational education and training in Europe – Germany*. https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_DE.pdf

Ismail, S., Mohamad, M. M., Omar, N., Heong, Y. M., & Kiong, T. T. (2015). A Comparison of the Work-based Learning Models and Implementation in Training Institutions. *Procedia - Social and Behavioral Sciences*, *204*, 282–289. https://doi.org/10.1016/J.SBSPRO.2015.08.153

Jalinus, N., Syahril, S., & Nabawi, R. A. (2019). A Comparison of the Problem-solving Skills of Students in PjBL Versus CPjBL Model: An Experimental Study. *Journal of Technical Education and Training*, *11*(1), 36–43. https://doi.org/10.30880/jtet.2019.11.01.005

Jørgensen, C. H. (2015). Challenges for Work-Based Learning in Vocational Education and Training in the Nordic Countries. In *Working and Learning in Times of Uncertainty* (pp. 159–171). SensePublishers. https://doi.org/10.1007/978-94-6300-244-8_12

Schuh, G., Gartzen, T., Rodenhauser, T., & Marks, A. (2015). Promoting Work-based Learning through INDUSTRY 4.0. *Procedia CIRP*, *32*, 82–87. https://doi.org/10.1016/J.PROCIR.2015.02.213

Seagraves, L., Osborne, M., Neal, P., Dockrell, R., Hartshorn, C., & Boyd, A. (1996). *Learning in Smaller Companies: Final Report*.

Seufert, S. (2000). Work-Based Learning and Knowledge Management: An Integrated Concept of Organizational Learning. *European Conference on Information Systems*.

Stones, E. (1994). Assessment of a Complex Skill: improving teacher education. *Assessment in Education: Principles, Policy & Practice*, *1*(2), 235–252. https://doi.org/10.1080/0969594940010207

UNESCO. (2011). *International Standard Classification of Education: ISCED 2011*. UNESCO Institute for Statistics.

UNESCO-UNEVOC. (2013). *Revisiting global trends in TVET: Reflections on theory and practice*. UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training. https://www.dcdualvet.org/wp-content/uploads/2013_UNESCO-UNEVOC_Revisiting-global-trends-in-TVET.pdf