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

Bambang Sudarsono * [1], Fatwa Tentama [1], Surahma Asti Mulasari [1], Tri Wahyuni Sukesi [1], Sulistyawati [1], Fanani Arief Ghozali [1], Herman Yuliansyah [1], Lu'lu' Nafiati [2], Herminarto Sofyan [2]
[1] Universitas Ahmad Dahlan, Indonesia.
[2] Universitas Negeri Yogyakarta, Indonesia.
* Corresponding Author. Email: bambang.sudarsono@pvto.uad.ac.id

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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.

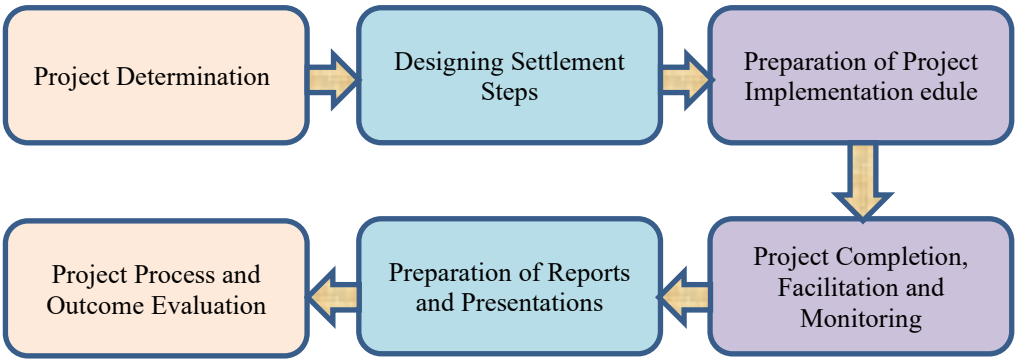

Figure 1. Stages of the Project Based Learning (PjBL)

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.

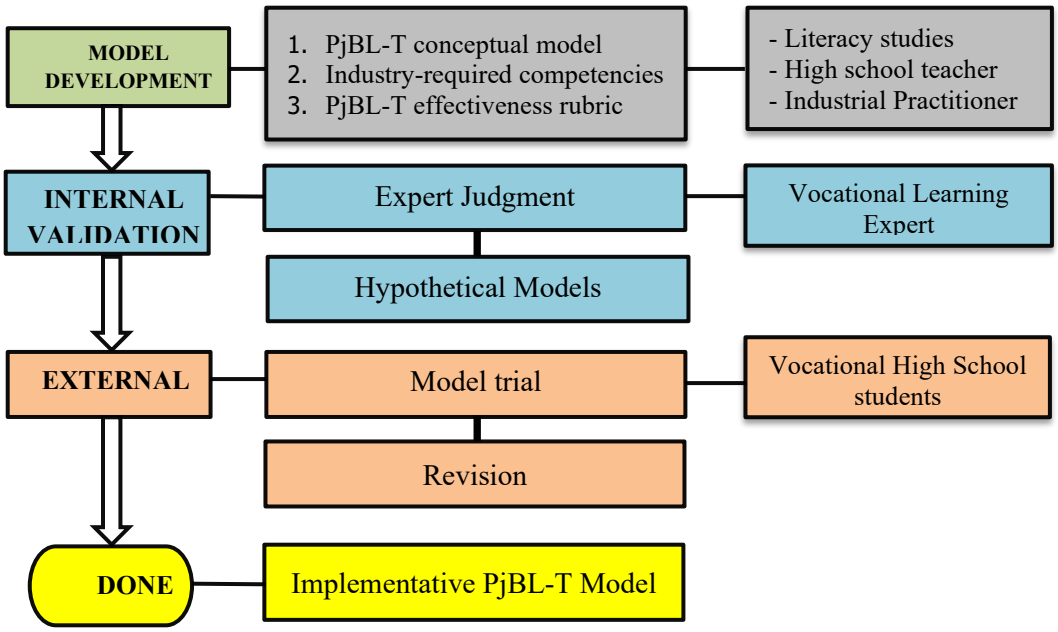

Figure 2. Research Design (Richey & Klein, 2014)

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.

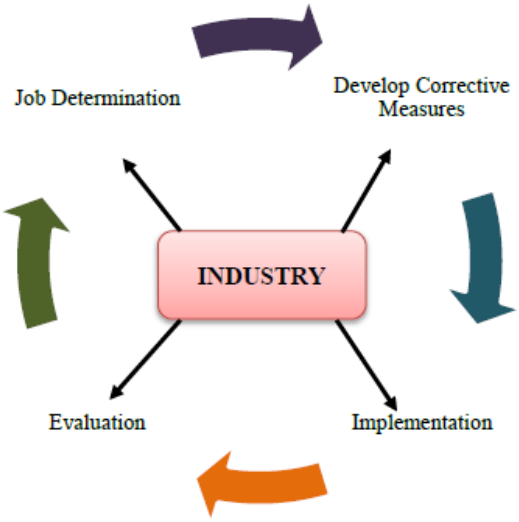

Figure 3. Conceptual PjBL-T Model

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.

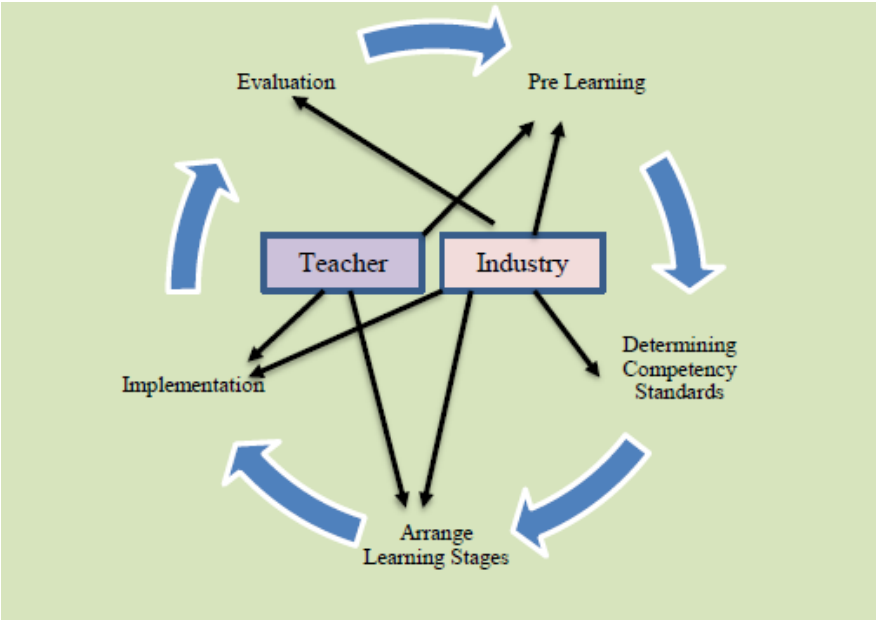

Figure 4. Hypothetical PjBL-T Model

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

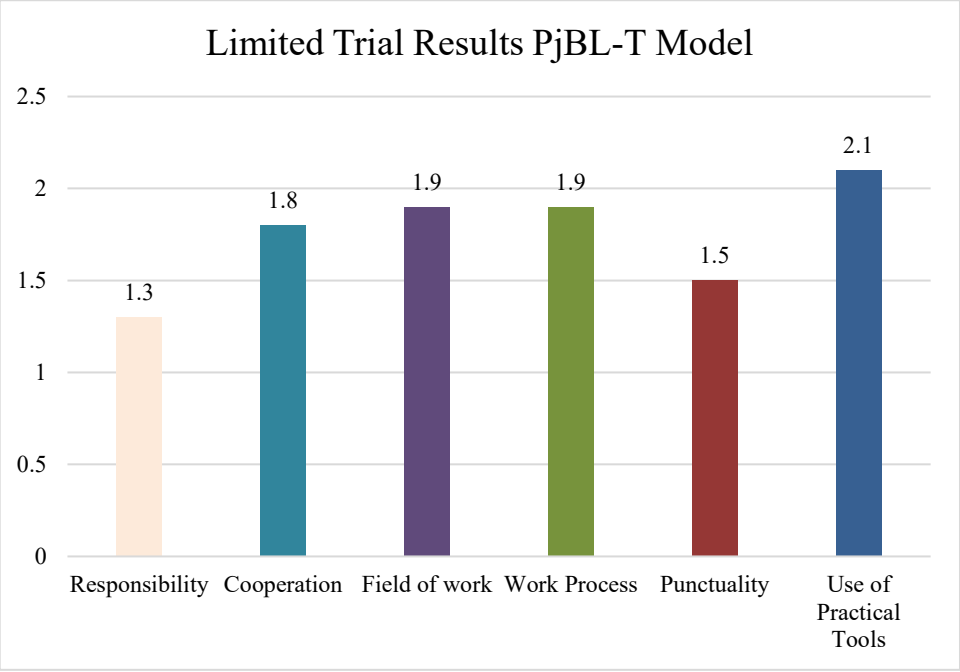

Figure 5. Limited Trial Results

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

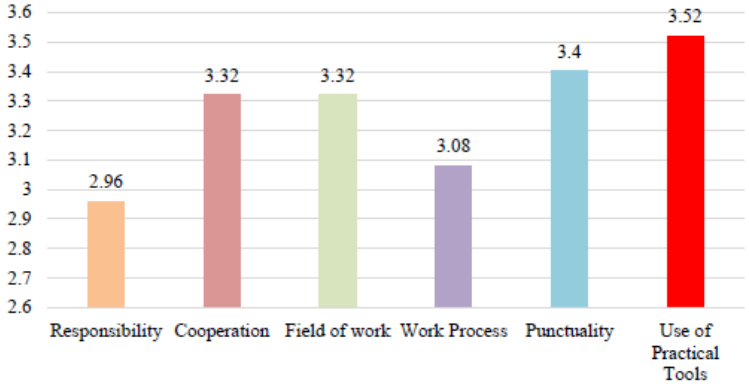

Figure 6. Extended Trial Results

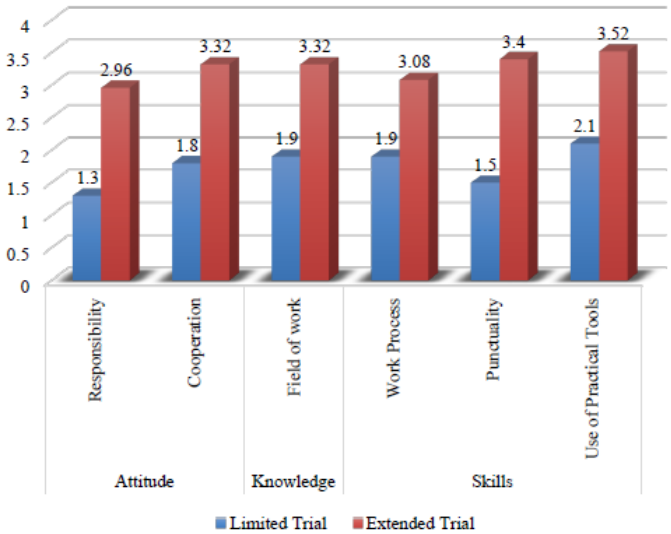

Figure 7. Comparison Data Limited and Extended Trial of the PjBL-T Model

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.

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