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Article

Impact of Work and Project-Based Learning Models on Learning Outcomes and Motivation of Vocational High School Students

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Abstract

In Indonesia, Vocational High School **(**VHS) prepare graduates to be ready to work. Teachers apply practicum learning methods related to the world of work. This quasi-experimental research aimed to examine the effect of the WBL-SL and the PjBL models on technical learning outcomes and learning motivation of VHS students with respect to their prior knowledge level. The subjects of this study were the students of class XII of mechanical engineering at State VHS in Malang City. The research was performed using a factorial design, with two independent variables, namely WBL-SL and PjBL models. The dependent variables were the technical learning outcomes measured using written tests and practicum, and the learning motivation measured using a set of questionnaires. Data was analyzed using a two-way ANOVA model. The results and discussion showed that (1) the technical learning outcomes and learning motivation of the group of students who were taught using the WBL-SL model were superior to the group of students who were taught using the PjBL model; (2) the technical learning outcomes and learning motivation of groups of students who have high prior knowledge were found superior to groups of students who had medium and low prior knowledge; and (3) there was an interaction between the WBL-SL, PjBL, and level of prior knowledge on the technical learning outcomes and learning motivation of VHS students, where the WBL-SL and PjBL models were more suitable for teaching groups of students who have high prior knowledge.

Keywords

Work-based learning · project-based learning · learning outcome · learning motivation · vocational education

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The main concern of vocational education in Indonesia that has surfaced in the recent global era is the intense job competition for its graduates. According to the Central Bureau of Statistics Indonesia, the open unemployment rate at vocational high schools was 8.63% in 2019. Among the contributing factors were the lack of motivation and problem-solving skills of vocational graduates (Chiang & Lee, 2016; Sjukur, 2012). It was due to the increasing demands of the workforce relating to a particular competence. Employment in the 21st century demands various important aspects that must be possessed by the workforce, which includes psychomotor aspects and ideas, skills to access information, media, technology, and skills in life and career (Walser, 2008). All workplaces seek workers who are not only highly skilled but also capable to response on the changes in the contemporary workplace (Andrews & Higson, 2008; Taylor, 2016).

Preparation of excellent workers through vocational education must be performed by design, namely preparation, implementation, and evaluation of learning. So, it is necessary to develop hard skills (cognitive skills and practical skills) and soft skills (character values) of workers in the 21st century in an integrated manner (Sudjimat, 2014). Additionally, students of vocational education must be able to develop critical skills, solve problems, collaborate, lead, adapt, take initiative, communicate, and manage information. Further, they must be agile, curious, and imaginative (Sudira, 2012).

The development of hard skills and soft skills that suit the needs of the 21st century employment requires vocational education to implement a curriculum that combines school- and workplace-based learning (Schaap et al., 2012) to facilitate students to learn in both school and work context (Bouw et al., 2019). In other words, the vocational learning environment must be created creatively to facilitate optimal practical learning experiences for students (Billett, 2013). Many terms are used in vocational learning environments (Fenwick, 2006), for example, work-related projects (Tynjälä, 2008), hands-on simulations (Khaled et al., 2015), workplace simulations (Jossberger et al., 2010), school-based vocational training (Jonasson, 2014), work-related learning arrangements (Lappia, 2011), configuration hybrid learning (Cremers et al., 2016), and regional learning environments (Oonk et al., 2016). Such creation of the vocational learning environment can be fulfilled, among others, through the implementation of work-based learning with service-learning (WBL-SL) and project-based learning (PjBL). Currently, PjBL has become a trend in learning at vocational high schools as recommended in the Process Standards issued by the Ministry of Education and Culture of the Republic of Indonesia.

WBL-SL has not been discussed much, let alone implemented in vocational learning in Indonesia. Therefore, the implementation of WBL-SL is a point of interest in the present study in which most previous studies emphasize the difference in the influence between PjBL and conventional learning on vocational education in Indonesia. WBL is a learning model that provides job training and works experience planning programs for students related to their chosen careers. It is a form of education and training that is directly related to work (Glass et al., 2002), and a trend in all fields of education as it can affect student satisfaction and increase the role of teachers in learning (Woltering et al., 2009). In vocational education, WBL should be used and implemented for several reasons, namely, (1) it offers ample opportunities to learn beyond traditional learning, (2) it arises for a demand to achieve higher quality, efficiency, and linkage of education to work, (3) it is needed to develop the job skills of students for the future of employment, (4) to improve the lifelong education and career-long education in the workplace, and (5) to support career development and professional development (Abdillah, 2014).

The implementation of the WBL model in schools can be in various forms, namely apprenticeship opportunities, career mentorship, cooperative work experience, credit for prior learning, internship, job shadowing, practicum, school-based entrepreneurship, service-learning (SL), teacher externship, preparation of vocational education, vocational high school student organizations, volunteer services, and field trips (Atkinson, 2016; Siswanto, 2012). One of the WBL models that are practically implemented in vocational high schools is the SL type (WBL-SL). In WBL-SL, students are involved in organizing academic learning and designing practical activities provided by schools to meet community needs. Thus, WBL-SL will be able to develop students' attitudes, knowledge, skills, insight, behavior, habits, and associations through their learning experiences (Luchyto Chandra et al., 2017). In addition, WBL-SL emphasizes the occurrence of positive changes in the potential of each student in society (Gray & Albrecht, 1999), so that their technical and interpretative skills will develop (Wagner et al., 2001).

There are at least two main activities where students participate in WBL-SL, namely, (1) participate in organized service activities to meet the needs of a particular community and (2) reflect on service activities in such a way to gain further understanding of the learning content, a broader appreciation of the discipline, and enhancement of personal values and civic responsibility (Bringle et al., 2006). The learning is designed based on alignment to connecting school and work practices (Bouw et al., 2019), in which students receive assignments to present their work at school (Akkerman & Bakker, 2012). Thus, the professional products and services by students, and the necessary resources and equipment can be identified (Bouw et al., 2019).

Various empirical studies on the implementation of the WBL model on VHS show that WBL is beneficial for students and the achievement of TVET's goals, namely, preparing a workforce for those who have already had knowledge of behavior and skills to work effectively (Haruna & Kamin, 2019). Siregar (2018) insisted that the average learning outcomes of building construction workers who attended training using the WBL model for four meetings increased significantly. This is shown by the majority (96.67%) of the participants whose pretest results were declared incompetent and shortly after changed into competent all of them (100.00%) at the end of the fourth meeting with an average posttest score of 84.25. In addition, the scores of participants' activity, which indicates their learning motivation, also increased significantly from 37.72 to 67.42. The implementation of the WBL model in the Diploma III Automotive Study Program also improve student learning outcomes in the aspect of automotive mechanic knowledge, professional attitude, mental readiness to work compared to the learning outcomes of students who follow the conventional model (Siswanto, 2012). Similar research findings were also reported by Subekti (2019) which stated that the implementation of the WBL model in the debriefing of VHS students who will take part in industrial practices can improve their learning outcomes in the form of teamwork skills and employability skills.

PjBL is a learning model that systematically involves students in learning knowledge and skills through a structured inquiry process referred to as complex, authentic questions and carefully designed projects and assignments (Albritton & Stacks, 2016). It has many advantages over conventional learning models commonly applied by teachers in vocational high schools. It can organize projects in learning (Gülbahar & Tinmaz, 2006) to increase learning motivation and learning outcomes of vocational students (Luchyto Chandra et al., 2017). It can facilitate students to be directly involved in thinking activities (Al-Sharif, 2015; Mills & Treagust, 2003) and learn through a discovery process with a series of questions arranged in a task or project (Buck Institute for Education, 2007). Through PjBL, students are also challenged to learn how to study and work cooperatively in finding solutions to problems in real life (Olatoye & Adekoya, 2010). Moreover, students will get the opportunity to practice the problem-solving process consciously and receive feedback from the teacher to know the quality of their problem-solving skills. Therefore, teachers and students must be able to work together in planning and implementing projects during the learning process (Mitchell et al., 2009).

The superiority of the PjBL model in the learning process greatly influences student learning outcomes and motivation. Moursund (2003) identified five advantages of PjBL, namely, (1) increased motivation, (2) increased problem-solving skills, (3) improved library research skills, (4) increased collaboration, and (5) increased resource-management skills. Many research studies have proven these advantages. Empirically, Ravitz (2010) stated that the use of projects as a learning tool can encourage student motivation and can be a means of showing and explaining what students have learned. The increased learning outcomes of students who are taught using the PjBL model have also been suggested by other researchers, such as Purworini (2006), Du and Kolmos (2006), and Hayati (2013). In addition, the advantages of the PjBL model in increasing student motivationhave been studied by Zhou et al. (2012) and Chiang and Lee (2016).

Learning performance improvement of VHS students taught using the PjBL model has been reported by many researchers. The research findings of Chiang & Lee (2016) depicted that the implementation of the PjBL model has a positive effect on learning motivation and problem-solving abilities of VHS students compared to the traditional model. The implementation of the PjBL model with seven steps is reported to be very effective in increasing the productive competencies of VHS students (Jalinus et al., 2017). This is in line with the research findings of Namiroh et al. (2019) which showed that productive learning outcomes in the form of creative products achieved by students taught using the PjBL model were superior to groups of students who were taught using the conventional model. Regarding learning motivation, the research findings of Belagra and Draoui (2018) exposed that the integration of tutorials with the PjBL model has been proven to increase students' motivation to learn and master the subject of power electronics. The findings of this study are reinforced by the conclusions of Viswambaran and Shafeek (2019) which showed that the PjBL model has a positive impact on the attitudes of vocational education students towards learning with the indications of the increase of their self-confidence and efficacy. Therefore, most VHS teachers stated that the PjBL model could increase students' active participation (95%), motivate them to learn (96%), and help them to acquire various curricular skills (90%) (Gómez-Pablos et al., 2017).

Along with the learning model used by the teacher, the effectiveness of learning is also influenced by the prior knowledge of students. Prior knowledge plays a mediating role in driving constructive mental activity in learning by helping students to build an understanding of the new concepts they are learning (Svinicki, 2007). Experts believe that prior knowledge greatly affects student learning outcomes and better conceptual construction skills to increase the amount of information available in their memory (Addison & Hutcheson, 2001; Dochy et al., 2002). Therefore, their prior knowledge has a significant effect on the learning achievement (Hailikari et al., 2008). Regarding skills learning outcomes, Purwanto (1990) argued that it can be influenced by student input, instrumental input, the environment, and the thinking process performed by students. The thinking process starts in a situation that requires prior knowledge, and its quality will affect the final results (Letseka & Zireva, 2013). This is in accordance with Bakry (2015) notion, who stated that the mental activity of a person to find meaning, make judgments, solve problems, or make decisions requires initial information and experiences in everyday life.

Various research findings related to the superiority of the WBL model and the PjBL models, as described previously, are all compared to conventional models which are hard to find, and even no longer used in VHSs. Since the implementation of the competency-based curriculum since 2013, it is stated firmly in the standard of the education process that to encourage the ability of students to produce contextual work, both individually and in group. It is strongly recommended to use a learning approach that produces project-based learning (Regulation Of The Minister Of Education And Culture Number 22, 2016). This means that various VHSs are currently implementing the PjBL model.

Therefore, this research is expected to be able to test the effectiveness of the PjBL model that currently exists in VHS with an innovative learning model in the form of WBL-SL to improve technical learning outcomes and students' learning motivation. The choice of the two dependent variables is based on the fact that until now technical learning outcomes and learning motivation are still the main indicators of the low quality of education in VHS (Chiang & Lee, 2016; Sjukur, 2012). Based on the above reason and taking into account that prior knowledge is also very influential on learning outcomes (Hailikari et al., 2008; Purwanto, 1990), this study aimed to examine (1) the differences in technical learning outcomes and learning motivation between groups of students taught using the WBL-SL and PjBL models; (2) the differences in technical learning outcomes and learning motivation between groups of students with high, medium, and low prior knowledge; and (3) the interaction between the learning model used by the teacher and the prior knowledge of students on technical learning outcomes and student learning motivation.

Method

Research Design

This quasi-experimental research was performed using a 2 × 3 factorial design (Spliid, 2002) in which two columns state the independent variable (X_1), namely, the WBL-SL model ($X_{1.1}$) given to the experimental class and the PjBL model ($X_{1.2}$) given to the controll class, whereas three rows state the moderator variables (X_2) in the form of prior knowledge which was divided into three, namely: high ($X_{2.1}$), medium ($X_{2.2}$), and low ($X_{2.3}$). The dependent variable was the technical learning outcomes of students (Y_1) and their learning motivation (Y_2). The research design is described in Table 1.

Table 1. *Factorial research design*

Prior knowledge levels (X_2)	*Learning models (X_1)*	
	WBL-SL ($X_{1.1}$)	*PjBL ($X_{1.2}$)*
High ($X_{2.1}$)	Y_1, Y_2	Y_1, Y_2
Medium ($X_{2.2}$)	Y_1, Y_2	Y_1, Y_2
Low ($X_{2.3}$)	Y_1, Y_2	Y_1, Y_2

Participants

The participants of the current study were students of SMK Negeri 6 Malang, East Java, Indonesia, which consisted of two classes, namely, Class XII Mechanical Engineering-1 (XII-ME1) with 26 students and Class XII Mechanical Engineering-2 (XII-ME2) with 30 students. Class XII-ME1 and XII-ME2 students were taught using the WBL-SL (as experimental class) and PjBL models (as control class), respectively, in the Lathe Machine Work Subject with complex lathe material. Practicum learning in VHS basically used the PjBL model, therefore, the WBL-SL model was positioned as a form of practicum learning innovation that was used in the experimental class and the PjBL model was used in the control class.

The main difference in the learning syntax in the PjBL and WBL-SL models lay in the way the students received project assignments. In the PjBL class, project assignments were given by the teacher in the form of project description, so that students could work on the following stages: making working drawings; formulating the stages of the process; determining materials, machines, and equipment; and working on the project in groups. In the WBL-SL class, before carrying out the learning stages as in the PjBL class, students in groups held observations to find out the various products needed by the community whose work can be completed in a complex lathe practicum. The results of these observations were consulted with the teacher and after being approved, the students can do it in stages as in the PjBL class. This experimental research was conducted in five meetings with seven learning hours per session (7 × 45 min).

Instruments

The prior knowledge of students' data was collected by tests, whereas data on their technical learning outcomes were collected using tests and practical assessment sheets, and meanwhile their learning motivation was collected through a questionnaire. All research instruments were developed with the following stages: compiling the instrument grid, writing draft instruments, conducting expert validation, and conducting field trials. The instrument grid for the prior knowledge test and the technical learning outcomes was developed according to the Syllabus for Lathe Machine Work on complex lathe material used by vocational teachers in the vocational high schools where the research was conducted. Meanwhile, the learning motivation instrument grid was adapted from Schunk et al. (2014), which includes persistence, tenacity, interest, and pleasure in finding and solving problems. Instrument validation was analyzed using the Pearson Product-Moment technique. Based on the provisions proposed by Sarjono and Julianita (2011), the obtained results were: 27 of 30 analyzed items of the instrument for technical learning outcomes were valid; 32 of 35 analyzed items of the instrument for learning motivation were valid. The reliability of the instrument was calculated with the Cronbach's Alpha formula and obtained a result of 0.756 and 0.744 for the technical learning outcome and the learning motivation instruments, respectively.

Data Analysis

The obtained data were analyzed using a two-way analysis of variance (ANOVA) performed by the SPSS 20 program, along with the normality and the homogeneity tests (Sarjono & Julianita, 2011). The normality test was performed by the Kolmogorov–Smirnov test, whereas the data homogeneity test was using the Levene test. The results of the Kolmogorov-Smirnov test showed that the learning outcome and learning motivation data of the students were normally distributed with p-values of 0.46 and 0.28, respectively. The results of the Levene test also show that the two data sets are homogeneous with p-values of 0.32 and 0.13, respectively. Based on these two prerequisite test results, it can be concluded that all research data has met the requirements to be analyzed using a two-way ANOVA technique.

Results

The technical learning outcomes and learning motivation of students in the experimental (WBL-SL) and control (PjBL) classes are described in Tables 2–5.

Table 2. *Students technical learning outcomes of the WBL-SL and PjBL classes*

Treatment	*N*	*Mean*	*Std. deviation*	*Median*	*Minimum*	*Maximum*	*Range*	*Variance*
WBL-SL	26	83.65	5.40	84.00	73.00	99.00	26.00	29.43
PjBL	30	81.62	6.50	81.80	70.60	95.10	24.50	42.32

Table 3. *Students technical learning outcomes with high, medium, and low prior knowledge*

Level of prior knowledge	*N*	*Mean*	*Std. deviation*	*Median*	*Minimum*	*Maximum*	*Range*	*Variance*
High	22	88.06	4.09	86.15	85.00	99.00	15.00	16.76
Medium	23	81.02	2.90	81.60	79.00	84.00	11.20	8.42
Low	11	74.80	3.18	73.60	70.60	73.80	8.40	10.15

Table 4. *Students learning motivation of the WBL-SL and PjBL classes*

Treatment	*N*	*Mean*	*Std. deviation*	*Median*	*Minimum*	*Maximum*	*Range*	*Variance*
WBL-SL	26	84.61	5.37	85.00	74.00	100.00	26.00	28.86
PjBL	30	82.65	6.46	82.85	71.60	96.10	24.50	41.76

Table 5. *Students learning motivation with high, medium, and low prior knowledge*

Level of prior knowledge	*N*	*Mean*	*Std. deviation*	*Median*	*Minimum*	*Maximum*	*Range*	*Variance*
High	22	89.01	4.07	87.15	85.00	100.00	15.00	16.59
Medium	23	82.01	2.90	82.60	80.00	86.00	11.20	8.46
Low	11	72.90	3.11	74.60	71.60	74.80	8.40	9.69

Based on Tables 2–5, the average values of technical learning outcomes and learning motivation in the WBL-SL class were higher than those in the PjBL class. Meanwhile, the prior knowledge was proven to be in line with the technical learning outcomes and learning motivation of students. It means that students with high prior knowledge have a higher tendency to achieve better learning outcomes and motivation than those with moderate and low prior knowledge. The statistical results using a two-way ANOVA are shown in Tables 6 and 7.

Table 6. *Results of a two-way ANOVA analysis for students technical learning outcomes*
Dependent variable: LEARNING_OUTCOMES at p < 0.05

Source	*Type III sum of squares*	*Df*	*Mean square*	*F*	*Sig.*
Corrected model	1241.65[a]	5	248.33	15.94	0.00
Intercept	326202.80	1	326202.80	20939.27	0.00
WBL-SL _PJBL	139.29	1	139.29	8.94	0.00
PRIOR_KNOWLEDGE	954.24	2	477.12	30.62	0.00
WBL-SL _PJBL × PRIOR_KNOWLEDGE	172.62	2	86.31	5.540	0.00
Error	778.92	50	15.57		
Total	383797.84	56			
Corrected total	2020.58	55			

a. R-squared = 0.61 (adjusted R-squared = 0.57)

All p-values (Sig.) for the three sources of analysis were <0.05 (Table 6). For WBL-SL and PjBL sources, they have an F-count value of 8.94 with a p-value (Sig.) of 0.00 (<0.05). Thus, H_0 is rejected, which implied a difference in technical learning outcomes between the WBL-SL and PjBL classes. It indicated that the technical learning outcomes of the WBL-SL model are better than those of the PjBL model. An F-count value of 30.62 with a p-value (Sig.) of 0.00 (<0.05) was obtained for the source of the prior knowledge level. As H_0 was rejected, there were differences in technical learning outcomes between students with high, medium, and low prior knowledge levels.

The group of students with high prior knowledge will also have high technical learning outcomes compared with those who own moderate and low prior knowledge. The interaction between the learning models (WBL-SL and PjBL) and the prior knowledge shows an F-count value of 5.54 with a p-value (Sig.) of 0.00 (<0.05), which indicated an interaction between the learning models and prior knowledge of students on the technical learning outcomes. The group of students who have high prior knowledge from both the WBL-SL and the PjBL classes have high technical learning outcomes. In other words, to produce high technical learning outcomes for students, the WBL-SL and PjBL models are suitable for groups of students who have high prior knowledge.

Table 7. *Results of a two-way ANOVA analysis for students learning motivation*
Dependent variable: STUDENT_MOTIVATION at p < 0.05

Source	*Type III sum of squares*	*Df*	*Mean square*	*F*	*Sig.*
Corrected model	956.75[a]	5	191.35	9.29	0.00
Intercept	336686.72	1	336686.72	16352.90	0.00
WBL-SL _PJBL	147.13	1	147.13	7.15	0.01
PRIOR_KNOWLEDGE	746.52	2	373.26	18.13	0.00
WBL-SL _PJBL × PRIOR_KNOWLEDGE	147.60	2	73.80	3.58	0.03
Error	1029.44	50	20.59		
Total	393033.62	56			
Corrected total	1986.19	55			

a. R-squared = 0.48 (adjusted R-squared = 0.43)

In general, the results of data analysis for the learning motivation variable have the same direction as the technical learning outcome variable. For WBL-SL and PjBL sources, they have an F-count value of 7.15 with a p-value (Sig.) of 0.01 (<0.05). Thus, H_0 was rejected, which means that there is a difference in learning motivation between the WBL-SL and PjBL classes. It indicated that the learning motivation of students taught using the

WBL-SL model is more eminent than those using the PjBL model. F-count value and p-value obtained for the source of the prior knowledge were 18.13 and 0.00, respectively. Thus, H_0 was rejected.

These findings emphasize that there was a difference in learning motivation between students with high, medium, and low prior knowledge levels. Students with high prior knowledge will also have high learning motivation compared with those who have moderate and low prior knowledge. The interaction between the learning models (WBL-SL and PjBL) and the prior knowledge shows an F-count value of 3.59 with a p-value (Sig.) of 0.03 (>0.05), proving an interaction between the learning models and prior knowledge to learning motivation of students. Groups of students who have high prior knowledge from both the WBL-SL and PjBL classes have high learning motivation. That is, to produce high learning motivation, the WBL-SL and PjBL models are suitable for groups of students who have high prior knowledge.

Discussion

Learning Outcomes and Learning Motivation of WBL-SL Class are More Eminent than of PjBL Class

The main difference in performing the WBL-SL and PjBL models lies in the stages of the learning process. In the WBL-SL model, the learning process begins with a group assignment to make observations at various machine workshops that require product components from complex lathe work as a service to the community proposed by Siswanto (2012). In contrast, in the PjBL model, the students worked individually after getting an explanation of the project assignments. The assignments are given in the form of work descriptions and drawings, so that students only need to compile work procedures and do them on lathes and other supporting machines.

The characteristics of the WBL-SL learning as described above really demand cooperation and mutual support between students in one group, even in one class or between groups, to achieve predetermined learning goals (Rüütmann & Kipper, 2011). Such characteristics can facilitate the learning to real life work activities (Lynch & Harnish, 1998) and bridge the gap between theory and practice (Quick, 2010; White, 2012) to form a professional attitude, work-mental readiness, and independence of students (Siswanto, 2012). Along with the support of professional teachers, the WBL-SL model can lead students to achieve higher learning outcomes and learning motivation than the PjBL model, as shown in Tables 2 and 4. This is in accordance with the opinions by Fallows and Weller (2000), Braham and Pickering (2007), and Garnett and Young (2008) who concluded that the WBL model would have a positive impact on student learning outcomes, both in the form of technical and interpretative skills (Wagner et al., 2001) if applied with adequate teaching staff support and evaluated correctly. Pless et al. (2011), Siswanto (2012) and Siregar (2018) who stated that WBL model and SL pedagogy can improve overall student learning outcomes, in cognitive, affective, and skill aspects.

The present study also found that students from the WBL-SL class showed higher learning motivation than those from the PjBL class. Providing the opportunity to design or create contextual products and work collaboratively in groups with the direction of the teachers appears to motivate and develop self-confidence in completing the assignments. Such processes would cause a cognitive imbalance in students that encourages curiosity and raises many questions (Sutrisno, 2011), which in turn can foster their authentic experience (Cremers et al., 2016). The WBL-SL model can influence the positive attributions of school-based learning into WBL (Jonasson, 2014), so the motivation of students to do these tasks will increase (Cremers et al., 2016).

The findings of the current study are consistent with Quick (2010) and White (2012) that show that the WBL model can increase student motivation in the learning process. The present study is also in line with Bielefeldt et al. (2009) who stated that the WBL-SL model is more able to motivate students than the PjBL model, as it is very effective in helping students to develop non-technical skills, such as teamwork, communication, leadership, and project management. Rockenbaugh et al. (2011) also explained that the involvement of students in learning the WBL-SL model is parallel with their values, interests, and motivation in learning techniques.

Learning Outcomes and Learning Motivation of Students Based on Their Prior Knowledge

There were differences in technical learning outcomes and learning motivation between groups of students with high, medium, and low prior knowledge. Students with high prior knowledge showed higher technical learning outcomes and learning motivation than those with medium and low prior knowledge as shown in Tables 3 and 5. It shows that prior knowledge plays a mediating role in driving constructive learning process activities (Chu et al., 2017) that affect student learning outcomes (Purwanto, 1990). This result is consistent with Addison and Hutcheson (2001) and Dochy et al. (2002), who figured that the average learning outcomes of students who have high prior knowledge are better than those who have low prior knowledge.

One of the benefits of prior knowledge is to help students connect existing knowledge with new concepts to improve their understanding (Svinicki, 2007). Hailikari et al. (2008) found that prior knowledge of previous materials has a significant effect on student achievement. Chu et al. (2017) argued that prior knowledge plays a mediating role in driving constructive mental activity in learning, including shaping learning motivation. In other words, the prior knowledge functions as a formation of interest to build attitudes that underlie the learning motivation. The prior knowledge is parallel with the attitudes to increase the learning motivation of students.

Interaction of the Learning Models and Prior Knowledge on Technical Learning Outcomes and Learning Motivation

The interaction between learning models (BWL-SL and PjBL) and the prior knowledge on technical learning outcomes in the current study echos those of Degeng (2013) who asserted that student learning outcomes were strongly influenced by the applied learning model and student characteristics including the prior knowledge. The present study found that the prior knowledge affects the effectiveness of the learning models, especially to facilitate students to learn contextually through information-seeking, problem-solving, and coordination in assignments (Rahmat et al., 2016). It means that technical learning outcomes and student learning motivation will be proficient if the application of the WBL-SL and PjBL models is performed by teachers in groups of students with high prior knowledge.

There are at least two factors that influence the interaction between learning models and the prior knowledge (Rahmat et al., 2016). First, the implementation of learning models requires active learning by students using their prior knowledge. Students with high prior knowledge can solve a problem presented in the learning models faster than those with low prior knowledge. High prior knowledge will provide a better conceptual construction to increase the amount of information needed to solve problems available in memory (Dochy et al., 2002). In other words, high prior knowledge plays a mediating role in driving constructive learning process activities (Chu et al., 2017) as demanded in the WBL-SL and PjBL models. Students with high prior knowledge are faster to think, understand a concept, and analyze certain problems than those with low prior knowledge.

Second, the learning process of the WBL-SL and PjBL models places the teacher as a facilitator when students work on assignments or projects. Students receive guidance and feedback from the teacher on the initial design, work plans, and process of making products. In this context, students with high prior knowledge will be more active in communicating with teachers than those with low prior knowledge. The results were consistent with the findings by Rahmat et al. (2016) that the learning model used by teachers interacts with the prior knowledge in determining learning outcomes.

Furthermore, while affecting technical learning outcomes, the interaction between learning models and prior knowledge in the present study also affects learning motivation. The use of the WBL-SL and PjBL models in groups of students with high prior knowledge can 0foster high motivation. These findings are in line with Rasyid et al. (2015) who concluded that there is an interaction between the use of learning models and prior knowledge on student learning motivation.

Conclusion

Based on the results, it can be concluded as follows. First, there are differences in technical learning outcomes and learning motivation between groups of students who are taught using the WBL-SL model and the PjBL model, in which the average outcomes and motivation in the WBL-SL class were higher than those in the PjBL class. Second, there are differences in technical learning outcomes and learning motivation between groups of students with high, medium, and low prior knowledge, in which the average values for groups of students with high prior knowledge are superior to moderate and low prior knowledge. Third, there is an interaction between the learning model implemented by the teacher with the prior knowledge of students in determining technical learning outcomes and learning motivation. Best interactions that produce superior technical learning outcomes and learning motivation were found between the WBL-SL model and prior knowledge. Meanwhile, the interaction between the PjBL model and prior knowledge was only intense in determining student learning motivation.

The implication of this research is that teachers can use the WBL-SL model to improve technical learning outcomes and learning motivation of VHS students. Therefore, it is also recommended to the researchers to conduct other experimental studies that test the effectiveness of other types of WBL models as stated by Atkinson (2016) and Siswanto (2012), for example the types of apprenticeships and traineeships, simulation, career mentorship, cooperative work experience, credit for prior learning, etc. The dependent variable should not only be limited to technical learning outcomes and learning motivation but also includes work characteristics, employability skills, and other forms of hard and soft skills.

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