Development of Work-Based Learning SpSG Open Mining Operations

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Abstract. The purpose of this study was to look at a development of the SpSG Work-Based Learning (WBL) model that can activate students. The model designed can be applied by lecturers and according to industry needs. Reveal the impact of the development of a model designed to increase student competence in the Open Mining Operations (OTT) course in Mining Engineering. The chosen industrial location is the Limestone Mine. PT. Semen Padang and Coal Mine PT. AICJ Sawahlunto. The development of the model designed is WBL SpSG (Shift per Shift Group). This is done by considering the time of activities and procedures that apply in the location of the mining industry. Besides integrating all existing competencies in the workplace as a whole by first being given the subject matter of the operational theory of open mining on campus with a program of practical experience directly at the mine site which is guided by qualified industrial teaching staff. The model designed can be applied by lecturers and according to industry needs and to improve student learning outcomes in the Mining Engineering Study Program.

Keyword: Model Development, Work-Based Learning, Open Mining Operations

1. Introduction
The professional career today is branching out so rapidly. Therefore learning in higher education should be as close and relevant as possible to the professional career. Many factors that affect the ability of students in understanding the Open Mining Operations lectures both theory and practice at field such as student interest and motivation, teaching materials, equipments, practice location and others. To resolve these problems, it should be found the best solution regarding to the effective teaching methods, so the students will be ready to compete in professional career.

Lecturers must develop the learning model continually in implementation of education in Higher Education, especially in Mining Engineering Programme. So that the quality of graduates matches with the required of job market. The challenge of professional career with high competencies as technology advances and tight workplace dynamics requires higher education institutions to be able to anticipate and to face the challenges by utilizing all capabilities [1].

The result of research on quality of education becomes the background of education problems in Mining Engineering Programme by using an approach called Work-Based Learning (WBL) or Workplace-Based Teaching and Learning (WBTL). WBL is a learning approach that utilizes the workplace to structure its experiences that contribute to the social aspects, academic aspects, student’s career development and it will be a supplement in learning activities [2]. Learning experiences in
workplace are applied, refined, expanded both at campus and at workplace. With the WBL, students are expected to be able to develop attitudes, knowledge, skills, enlightenment, behaviors, habits, and social intercourse from both place experiences and enable to learn the related to real-life activities [3].

The quality of vocational education outcomes both in terms of process or product is strongly influenced by learning approach that used in conducting vocational education. Implementation of vocational education can’t be done perfectly without collaboration between educational institutions and industry. Theories of experiential learning, contextual teaching and learning, and work-based learning become very relevant in the implementation of vocational education [4]. Based on these conditions, it requires the development of vocational education implementation model with various theories to improve the quality of learning outcomes that will affect the quality of learning outcomes and the quality of graduates. In the implementation of WBL-based vocational education, strategy and tactics are required in the implementation [5].

Based on the data of research results concluded that the utilization of Work-Based Learning approach or WBL in education learning has a positive influence to achievement, motivation, and sustainable of education [6].

The results of the WBL evaluation study has indicate a correlation among outcome learning and impact of graduates by the given learning structures in school and industry. When program objectives, workplace-based curriculums and experiences are designed and applied with adequate staff support and are properly evaluated, then the program will has a positive impact [3].

The essence of work-based learning is to provide opportunities for students to learn in workplace, which is purposed to instilling work behaviour or industrial behaviour [7]. On the other hand, work-based learning is possible to be applied in classroom by presenting the working atmosphere. The application of work-based learning aims to create a learning environment that provides flexibility for the development of knowledge, skills, and attitudes also the values that are highly relevant to reality in the real atmosphere of professional career [8].

The WBL SpSG model (Shift per Shift Group) is a WBL implementation model that fixes inadequacy and weaknesses of existing models. So far, the WBL activities of Blasting Technique that are carried out is only to review the blasting activities at mine site after completed theoretical lecture at campus. Current field activities is carried out without being equipped with a practice module and structured program.

The implementation of WBL SpSG is designed to provide a real experience of the expected competencies in the course of Blasting Techniques. Each competence has different characteristics, so it gains more experiences. It also provides an opportunity to reflect on the experience in the process of generalization and abstraction related to subsequent experiential activities.

Shift per Shift Group is closely meant for each group is divided into four groups and each group performs one work shift for one expected competence. The first shift will be presenting experience to other shifts and so the second shift will do the same to other shifts. It will be done by considering the timing of activities and prevail procedures at the mining industry. In addition to integrating all competencies in the workplace as a whole, students will be equipped with theoretical material on campus and with real experience in the mining industry location guided by qualified instructors.

2. Methodology
Research design is research and development [9], using the "ADDIE" Model Theory (Branch, 2009)[10] and refers to design and development research [11] incorporating model development and model validation. The validation process is done in two stages, namely internal and external validation. Internal validation is performed on model and model components by vocational education experts, educational technology experts, and evaluation experts. External validation is conducted in the form of small group trials, large groups and field trials. The analysis of model development stage is done by qualitative approach, and quantitative analysis is purposed to analyze data of model validation result by experts and test result. Associated with reliability testing, particularly the price of
intra-class correlation coefficients (ICC), is based on Cicchetti, et al. [12]. In order to the practical and effective terms, the results of his analysis were consulted with the criteria of Guskey & Bailey ([13].

3. Result and Discussion
3.1. Product Analysis
Product analysis is done by identifying the implementation of learning in the Open Mining Operations program about the WBL model. The identification of the WBL model in the teaching and learning process carried out by lecturers consists of identifying the application of learning theories and practices.

Identification of WBL implementation in the teaching and learning process is carried out by direct observation and interviews. Observations and interviews are related to learning tools, practice modules, building learning situations, organizing student groups, how to connect concepts learned with students' real life, presentation activities, and reflection on related topics.

3.2. Results of Model Development
Development of the WBL SpSG Open Mining Operations model of the Mining Engineering study program carried out in three stages: (a) the pre-development stage, (b) the model development stage, and (c) validation. The development of this learning model is motivated by the uniqueness of Open Mining Operational courses compared to other subjects in the Mining Engineering study program. The role and motivation of students in the teaching and learning process is still low, and the learning model has not been oriented to industrial needs [14]. Based on this phenomenon, a preliminary study is carried out which is a pre-model development stage. The preliminary study aims to identify: (1) problems that exist in looking at the learning strategies applied to open pit operations; (2) the competencies needed by the mining industry in the field of open pit operations.

After producing a theoretical model, the next process is to develop a model. This stage is characterized by implementing Focus Group Discussions (Briller, Schim, Meert, & Thurston, 2008) twice. This activity involved vocational technology education experts, vocational education practitioners, lecturers, linguists, and the mining industry. The first FGD activity aims to obtain information on the completeness of learning tools and practice modules related to the competencies needed. The second FGD activity aims to produce a hypothetical model and scope of instruments used in this study.

Instrument validity test is done by experts consisting of curriculum experts of Vocational Technology Education, learning media experts and evaluation experts. Validation is done by using product validation sheet. Expert validity uses an assessment questionnaire which is used the modified Likert scale like category 1 = disagree, 2 = not really disagree, 3 = agree, 4 = strongly agree. The assessed aspects in the validation instrument are the Model Book (Lecturer's Handbook and Student Handbook), PBM Aspects (RPP, Format Assessment of knowledge aspect, Format Assessment of skills aspect, Format Assessment of WBL competence, Format Assessment of Group presentation, and Format Assessment of Class discussion), practical model aspects (Format assessment of model implementation and Format Assessment of lecturer behaviour) and Model Effectiveness Aspects (Format Assessment of Model effectiveness for Lecturers and students).

The coefficient of validity and reliability of expert valuation are presented in Table 1, Table 2 and Table 3. The results of the assessment show that all instruments have met the valid and reliable criteria with the coefficient of validity and Aiken reliability ≥ 0.6 (Aiken, 1985)[16]. Thus it can be concluded that the model and its device are feasible to be used for testing.

| Item | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| V    | 0.8| 1.0| 1.0| 1.0| 1.0| 1.0| 0.6| 1.0| 1.0| 1.0| 0.7| 1.0| 1.0| 1.0| 1.0| 1.0|
| H    | 0.9| 0.9| 0.9| 0.9| 0.9| 0.9| 0.8| 0.9| 0.9| 0.9| 0.9| 0.9| 0.9| 0.9| 0.9| 0.9| 0.9|
### Table 2. Recapitulation of Instrument Validity Test Results

| No | Instrument                                                                 | Inter-Rater Agreement Test Results (ICC) | Information |
|----|-----------------------------------------------------------------------------|-----------------------------------------|-------------|
| 1  | 1.1 Model Book                                                             | 0.77                                    | Valid       |
|    | 1.2 Tecturer Hand Book                                                     | 0.77                                    | Valid       |
|    | 1.3 Student Hand Book                                                      | 0.71                                    | Valid       |
| 2  | 2.1 Course Program Plan                                                    | 0.96                                    | Valid       |
|    | 2.2 The format of the assessment of learning results in the knowledge aspect | 0.90                                    | Valid       |
|    | 2.3 The format of assessment of skills aspect learning outcomes             | 0.96                                    | Valid       |
|    | 2.4 Assessment format of competency rubric                                | 0.92                                    | Valid       |
|    | 2.5 The format of the group presentation                                  | 0.95                                    | Valid       |
|    | 2.6 The format of the class discussion                                     | 0.92                                    | Valid       |
| 3  | 3.1 Format model assessment format                                          | 0.92                                    | Valid       |
|    | 3.2 Lecturer activity assessment format                                    | 0.92                                    | Valid       |
| 4  | 4.1 The model effectiveness assessment format (done by the lecturer)       | 0.93                                    | Valid       |
|    | 4.2 The model effectiveness assessment format (undertaken by students)     | 0.94                                    | Valid       |

### Table 3. Recapitulation of Instrument Reliability Test Results

| No | Instrument                                                                 | Inter-Rater Agreement Test Results (ICC) | Information |
|----|-----------------------------------------------------------------------------|-----------------------------------------|-------------|
| 1  | 1.1 Model Book                                                             | 0.91                                    | Reliable    |
|    | 1.2 Tecturer Hand Book                                                     | 0.91                                    | Reliable    |
|    | 1.3 Student Hand Book                                                      | 0.91                                    | Reliable    |
| 2  | 2.1 Course Program Plan                                                    | 0.92                                    | Reliable    |
|    | 2.2 The format of the assessment of learning results in the knowledge aspect | 0.92                                    | Reliable    |
|    | 2.3 The format of assessment of skills aspect learning outcomes             | 0.92                                    | Reliable    |
|    | 2.4 Assessment format of competency rubric                                | 0.92                                    | Reliable    |
|    | 2.5 The format of the group presentation                                  | 0.92                                    | Reliable    |
|    | 2.6 The format of the class discussion                                     | 0.92                                    | Reliable    |
| 3  | 3.1 Format model assessment format                                          | 0.92                                    | Reliable    |
|    | 3.2 Lecturer activity assessment format                                    | 0.92                                    | Reliable    |
| 4  | 4.1 The model effectiveness assessment format (done by the lecturer)       | 0.92                                    | Reliable    |
|    | 4.2 The model effectiveness assessment format (undertaken by students)     | 0.92                                    | Reliable    |
4. Discussion
The final product consists of: (a) product name, (b) descriptive analysis of soft skill scores of open mining operational competencies (c) review of the validity of the model and its equipment, (d) study of model practicality, and (e) study of model effectiveness.

This product was born from a series of preliminary study activities, the development of a theoretical model, validation and trial, which aims to develop an Open Mining Operational WBL model. Based on these objectives, finally resulted in the development of the Open Mining Operational WBL model. Related to the name of the product, because the competencies expected by the students of Mining Engineering study program are related to Open Mining Operational competencies. In its implementation, field practice must be carried out at the mining industry's work site. The term work shift is used at the mine site, so this model is abbreviated as "SpSG" (Shift per Shift Group).

Generally, the score of each soft skill elements of mining engineering competence increase every week, especially the nine elements of soft skills aspect of Mining Engineering programme. The improvements occurs among aspect of communication, cooperation, work ethic, discipline, honesty, adaptation, problem solving, and responsibility. It indicates that the developed model can improve the soft skills aspects of Mining Engineering competence.

As one of the product quality requirements, the model validity testing is done by experts consisting of curriculum experts, learning technology and evaluation experts. Completeness of the model include: (1) model book, (2) learning device, (3) practice module, (4) instrument of assessment of PBM tools, (5) assessment of practicability instrument and assessment of effectiveness instrument, the results shows model has fulfilled validity requirement. Reliability testing of the completeness model meets reliability requirements. By reached out of valid and reliable requirements, then model and model book can already be used.

The practicality level of a model, the assessment is done through a trial. For the development of this model, its practicality level is assessed through small group trials, large group trials and field trials. The implementation of both small group trials and large group trials and field trials, the assessment is conducted by three observers, using a practicality valuation instrument consisting of assessing the implementation and lecturer's activities. In small group, large group and field trials, the results indicate that the model meets the practical criteria that revealed through the assessment of the implementation and lecturer's activities.

Assessment of effectiveness was also conducted in small group trials, large group trials and field trials. Assessment carried out by the observer and student, using a special instrument for assessing the effectiveness of lecturers, and the effectiveness of the assessment instrument specifically for students. Where both instruments have met the valid and reliable criteria.

The SpSG Work-Based Learning Model provides a real learning experience in accordance with learning needs, namely connecting learning on campus and learning in industry with open pit operational engineering experts, can be referred to as integrated learning with work, so this relates to Martin and Hughes (2009)[17], Prossers (1949)[18] that learning that is integrated with work will provide experience for students and connect between formal education in schools and professional careers. This model provides an opportunity to combine theoretical skills in education with direct application in professional careers. A better learning experience will greatly support the competency of Mining Engineering students.

5. Conclusion
This study shows that the development of the SpSG Operational Based Learning System for the Oldest Mining is feasible to be used by prospective users and related parties in learning. The model designed can be applied by the lecturer and in accordance with the needs of the industry. The application of the SpSG work-based learning model can improve the Open Mining Operational competency of Mining Engineering students.

Through small group trials and large group and field trials, that this model can also improve soft skills related to Open Mining Operational competencies (Communication Ability, Cooperation, Work...
Ethics, Discipline, Honesty, Adaptation, Problem Solving, and Responsibility) of students Mining Engineering.

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