

# Development of Integrated Welding Jobsheet Production Based Learning in Vocational High School

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## ABSTRACT

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This study aims to analyze the use of integrated welding jobsheets that are usually done at SMK Muhammadiyah 2 Ajibarang. After analyzing and then developing the use of an integrated welding jobsheet commonly used at SMK Muhammadiyah 2 Ajibarang, it becomes an integrated jobsheet that is combined with existing work orders in the industry. The use of the jobsheet was developed to increase the knowledge and competence of students in the Machining Engineering skill competency. This research is research and development (R&D). Stages of research using the design Analysis, Design, Development, Implementation, Evaluation. This research was conducted at SMK Muhammadiyah 2 Ajibarang. The subjects in this study were grade 12 students of Machining Engineering Skills at SMK Muhammadiyah 2 Ajibarang. This study uses a quasi-experimental nonequivalent control group design research method. Collecting data using a questionnaire, pretest, posttest. This study uses expert validators to validate the integrated jobsheet that will be developed, where the average validation result of the three expert validators is 4.25 or 80.5% which can be declared valid. Analysis of research data was done by using the validity of the questionnaire and T-test. To compare the achievement results in the class before being given practical treatment using an integrated worksheet and after being given treatment. We can test this comparison by means of different power testing carried out by

pretest and posttest. The result of this research is that the use of integrated welding jobsheet can increase students' knowledge and competence. This study shows an increase in knowledge and competence, after being treated three times by using the use of an integrated worksheet that has been combined with a work order with (Tcount = 11.224 and Sig. = 0.000). The results presented in the form of data analysis are the results of research that has gone through several stages. Integrated jobsheet development research is able to increase students' knowledge and competence of Machining Engineering skills. The Integrated Jobsheet is declared valid to assist the learning process of welding practice in production-based learning in order to increase knowledge and competence.

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## **Introduction**

In the global era, the field of education in Indonesia is still faced with challenges and more complex difficulties, both now and in the future. Indonesia must be able to compete with other countries in terms of products, services, and preparation human resources (HR) (Lasmi et al, 2023). Vocational High Schools (SMK) are vocational schools that are directly related to practice in accordance with their respective areas of expertise (Suhardi, D, dkk, 2022). SMK prioritizes education by honing students' skills with science and technology in accordance with the current developments in the world of work (Ramadhan, 2016).

SMK is synonymous with workshop practice because the expected output of students must be able to carry out the practice properly and correctly. In carrying out practical activities each student must have a reference or guideline, so that practical activities run smoothly. One of the references or guidelines in the implementation of practice is a worksheet (jobsheet).

Wilkins (2001) states "vocational education is one of the key factors in ensuring economic development, competitiveness and social stability in all countries, both developing and industrialized". This is due to a belief that the success of vocational education in producing a skilled workforce is an important part of the human resource development strategy to equip the community with the knowledge and skills needed by the world of work and industry. Thus, vocational education graduates are expected to be able to fill available job opportunities with the provisions they have and get appropriate compensation. But the current conditions are very

different and not as expected.

Burke (2005) defines competence as follows: "Competency; statements describing the outcomes expected from the performance of professionally related functions, or those knowledge, skills, and attitudes thought to be essential to the performance of those functions". Competence is a statement of ability that describes the expected results of a related profession, or the knowledge, skills, and attitudes that are important in a particular job. In this case, competence is defined as the knowledge, skills, and abilities possessed by someone who has become part of himself, so that he can carry out cognitive, affective, and psychomotor behaviors as well as possible.

### **Method**

This research is research development or Research and Development (R&D) using the ADDIE model development method (Analysis, Design, Development, Implementation, Evaluation). The ADDIE model was developed by Branch (2009) to design learning systems. Following are examples of activities at each stage of the development of the learning model, that this:

1. Analysis in this analysis phase, the main activity is to analyze the need to develop a new learning model and analyze the feasibility and conditions for developing a new learning model.
2. Design The design stage is the stage of designing the learning model, the design stage has similarities with designing teaching and learning activities.
3. Development stage in the ADDIE model contains product design realization activities.
4. Implementation at this stage the designs and methods that have been developed are implemented in real situations, namely in the classroom.
5. Evaluation at the evaluation stage the researcher will state the effectiveness of developing this learning model using quasi experiments.

### **Result and Discussion**

Production-based learning is a learning model that is very suitable to be applied to practical learning, with integrated jobsheet development students will think more creatively and be able to calculate the estimated cost of a product they make. Integrated jobsheet development research on production-based learning using ADDIE type R & D, this research was carried out with the following steps:

#### **Analysis**

At this stage the researcher analyzed matters relating to jobsheet which are commonly used for practice in the production-based learning model that will be developed, that this:

#### **Curriculum analysis and learning administration**

Curriculum analysis is done by studying learning materials:

Competency Standard, Basic Competency (KD) in accordance with welding practice materials.

Tabel 1. Competency Standards and Basic Competency (Kemendikbud, 2019)

Standard Competency	Basic Competency
3.1 Applying the plate to plate welding technique at the corner joint position under the hand.	4.1 Perform plate to plate welding at the corner joints under hand.
3.2 Applying plate to plate welding techniques on blunt joints in the underhand position.	4.2 Perform plate to plate welding on a blunt joint position under the hand.

From the KI or KD table above it can be analyzed that the application of welding practices in accordance with the KI or KD above is not as expected, students are only required to practice welding corner joints and blunt joints in the underhand welding position.

### Learning Objectives

After studying the competency standards and basic competencies above, the authors conclude that the objectives of this production based learning are: (a). Students can weld according to industry standards by writing their own work steps according to the directions on the integrated jobsheet. (b). Students can weld plate joints with corner joints. (c). Students can weld plate joints with blunt joints. Providing an outline on the jobsheet is a reference for students to recall and review the supporting theory needed for practical implementation.

### Analysis of the needs of practice and learning processes

Analysis of students practical needs by conducting interviews with students regarding current welding practices and observing school conditions, such as: welding machine and place of practice, this aims at problems in the learning process. The data obtained from interviews and observations are as follows:

- 1) Students still think that so far welding practices have not been optimal.
- 2) The process of learning welding practice for students requires new innovations, especially on jobsheets so that students are even more skilled in welding practice.
- 3) Students are still not able to maximize welding practice because they are only required to be able to weld not to produce products.
- 4) Not many teachers have innovated about worksheets integrated with welding practice, so welding practice is considered monotonous and has not been able to attract students to be more creative through welding practice.

5) The machining engineering workshop of SMK Muhammadiyah 2 Ajibarang is not only used for welding practice but is also used for other machining practices, so that welding practice is not optimal.

a. Material Analysis

After conducting a practical needs analysis, then selecting the material to be developed in welding practice. This practice material was consulted with the head of the Machining Engineering competency department and productive teachers of machining engineering at SMK Muhammadiyah 2 Ajibarang. Welding practice material with reference to the manufacture of a product was chosen with the aim that students can calculate the estimated cost required to make a product so that students can calculate the price of a product.

b. Learning media analysis

This analysis was carried out to find out the problems that exist in jobsheet learning media. The jobsheet learning media that is often used is felt to be less effective in being able to produce an increase in student practice for the better. The practice of students who felt that they were lacking greatly influenced the increase in knowledge and competence in metal welding subjects.

**Design**

The design phase is carried out by making an initial design that will be used in the development of an integrated jobsheet in a production based learning model by preparing the worksheet used in the form of a jobsheet. This stage is as follows:

a. Make initial plans

This process is carried out by creating an integrated jobsheet design that is used to support the development process. The worksheets used in this study are in the form of integrated worksheets to support the learning process of practical welding, after the worksheets used have been designed, the next step is to develop the process of developing integrated worksheets in the production-based learning model.

b. Create a welding practice plan

This process is carried out by preparing an integrated jobsheet design that will be used as a guide in practice. Jobsheets or student worksheets are student guides that are used to carry out investigative or problem solving activities. Jobsheets or student worksheets contain a set of basic activities that must be carried out by students to maximize understanding in an effort to form basic abilities according to indicators of achievement of learning outcomes that must be taken (Trianto, 2009:223).

c. Make grids and pretest posttest questions

At this stage the researcher will make a grid and pretest-posttest questions that will be used for

evaluation after the practical welding, to find out whether or not the learning process for practical welding with integrated jobsheet development in the production based learning process that shown on figure 1.

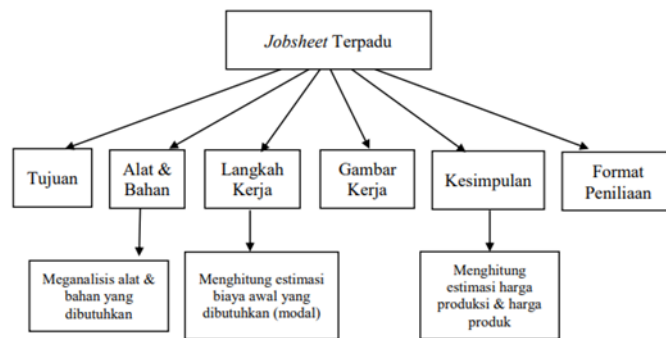


Fig 1: Integrated jobsheet design

## Development

In this development stage, it is the stage where the learning model and learning media are tested on the experimental class, so that the learning model developed can be used for learning. The stages of the development process are as follows:

- a. Creating an integrated jobsheet, in making this integrated jobsheet, the design is made according to the learning model developed to be more innovative, namely from the initial jobsheet which only requires students to only be able to weld, now it is made so that students are more creative and can calculate the cost of making a product up to the cost of selling the product.
- b. Expert Validation Expert validation was carried out to provide input for the development of an integrated jobsheet for welding in production based learning at SMK. At this stage the researcher consulted Mr. Tris Sugiarto, S. Pd., S. T., M. T. as the Chair and Lecturer of the metal welding course at the Wiworotomo Technical College, Purwokerto. The validation input results are as follows:
  1. Readiness for learning: before the learning process for the teacher is translated into lesson plans according to KI or KD and for administration of completeness of learning.
  2. Learning process: the teacher makes practical implementation instructions equipped with SOP in learning, the learning process refers to the curriculum and also refers to the KKNi.
  3. The results of the process of using an integrated jobsheet that must be in accordance with the work order: 1) learning process, 2) the method used, 3) curriculum alignment, 4) classroom conditioning. And learning is said to be effective if from the results of using an

integrated jobsheet that has been developed there is an increase in students knowledge and competence.

- c. Practitioner Validation Validation is intended to determine the feasibility of experts, namely media experts. Based on the validation by the experts, data was obtained about the shortcomings and weaknesses of the integrated jobsheet, so that in the validation, the revision stage was obtained from media experts.

In the development stage, product trials were carried out in the form of validity tests on material experts. Testing is carried out by material expert assessment of product aspects that have been compiled using a Likert scale assessment with 5 alternative answers, namely: score 1 = invalid; score 2 = less valid; score 3 = quite valid; score 4 = valid; and score 5 = very valid. The result is as follows:

- 1). Setting up a work area before learning begins with a percentage of 80.8% valid category,
- (2). Preparing tools and materials to carry out learning with a percentage of 90.4% valid category,
- (3). Does the teacher check student attendance before learning begins with a percentage of 80.8% valid category,
- (4). The teacher arranges the student's workplace so that in demonstrations all students can see clearly with a percentage of 80.8% valid category,
- (5). I pay close attention when the teacher demonstrates the subject matter with a percentage of 80.0% valid category,
- (6) I follow the teacher's instructions when doing practice with a percentage of 80.8% valid category,
- (7). If I encounter difficulties when doing practice, I immediately ask the teacher with a percentage of 80.8% in the valid category,
- (8). In practical activities I try to finish on time with a percentage of 70.4%, the category is quite valid,
- (9). The teacher gives directions to students before doing practice with a percentage of 100% valid category,
- (10). Teachers always provide assistance to students who experience difficulties during practice with a percentage of 80.8% valid category,
- (11). The teacher always gives the opportunity to ask students who have difficulty practicing with a percentage of 80.8% in the valid category,
- (12). The teacher always pays attention to every process carried out by students during practice with a percentage of 70.4%, the category is quite valid,
- (13). Does the use of an integrated worksheet make the learning process better with a valid category percentage of 80.4%,
- (14). The use of an integrated jobsheet students understand the material being taught with a percentage of 100% valid category,
- (15). Does the use of an integrated jobsheet make the teaching and learning process more communicative with a percentage of 90% valid category,
- (16). I always use PPE when practicing with a valid percentage of 80%,
- (17). I use the equipment according to its function with a valid percentage of 80%,
- (18). Is the use of an integrated jobsheet in accordance with the use of work orders in DUDI with a percentage of 80% valid categories,
- (19). I do creativity in practice according to the directions in the integrated jobseet with a percentage of 80.8% valid

category, (20). I want to work in the industry when I graduate with an 80% valid category percentage.

Process Results The use of an integrated jobsheet for production-based learning models obtained an average value of the first validator (V1) of 4.45 with an achievement percentage of 88.9% which was in the valid category, then from the second validator (V2) an average score was obtained an average of 4.0 with an achievement percentage of 80.0% in the valid category, and from the third validator (V3) an average score of 4.3 is obtained with an achievement percentage of 80.6% in the valid category. The average score of the three validators is 4.25 with an achievement percentage of 80.5% in the valid category.

The following is input from the validator on the product compiled by the researcher:

Table 2. Input Validator About integrated jobsheet

No	Expert Validator	Input
1	Warso, ST., MT.	Learning using the developed jobsheet is easy to understand and apply to students during practice and this jobsheet can make students more creative in doing practice.
2	Indarmawan, M.Pd.	The results of implementing the use of integrated jobsheets when implementing practices can be evaluated with the learning process, and it can be said to be effective if changes occur in students including increasing knowledge about work order sheets in the industry and welding skills using reference from integrated jobsheets.
3	Dasirin, ST	For learning, using an integrated jobsheet is quite good, because it is easier for students to practice welding because they see the guidelines on the jobsheet which are similar to the work orders in the company with the calculation of capital costs and the estimated cost of product prices.

## Implementation

The implementation phase was carried out on a limited basis at SMK Muhammadiyah 2 Ajibarang as a place used to conduct research and apply research using integrated jobsheets that researchers created. The design that will be implemented is prepared according to the situation and conditions that exist in the school.

The learning implementation is carried out according to the design that the researcher has made, before being implemented the researcher distributes the pretest questions to the experimental class and the control class, after the pretest results are taken then the implementation of the integrated jobsheet is implemented in learning in actual practical learning conditions, namely being tested in the practice of welding for the experimental class XII Mechanical Engineering 1 and for the control class class XII Mechanical Engineering 2 continued to practice welding using the jobsheet that was previously used at SMK Muhammadiyah 2 Ajibarang. The recapitulation of the research pretest



values can be seen in the table below.

Table 3. Recapitulation of control class students' pretest scores

<b>NO</b>	<b>Mark</b>	<b>Category</b>	<b>Qualification</b>	<b>The number of students</b>
1	90 – 100	A	Very good	1
2	72 – 89	B	Good	11
3	57 – 71	C	Enough	13
4	34 – 56	D	Not enough	5
<b>AMOUNT</b>				<b>30</b>

Based on table 4.4 above, the research results show that the students' pretest results in knowledge of integrated jobsheets are in the very good category (90-100) 1 student. Students who get good category (72-89) are 11 students. Students who get enough category (57 - 71) are 13 students. Students who get less category (34-56) are 5 students.

Table 4. Recapitulation of experimental class students' pretest scores

<b>NO</b>	<b>Mark</b>	<b>Category</b>	<b>Qualification</b>	<b>The number of student</b>
1	90 – 100	A	Very good	0
2	72 – 89	B	Good	13
3	57 – 71	C	Enough	11
4	34 – 56	D	Not enough	6
<b>AMOUNT</b>				<b>30</b>

Based on table 4.5, the research results show that the students' pretest results in jobsheet reading fluency are in the very good category (90-100). Students who get good category (72-89) are 13 students. Students who get enough category (57-71) are 11 students. Students who get less category (34-56) are 6 students. The recapitulation of the posttest research scores can be seen in the table below.

Table 5. Recapitulation of control class students' posttest scores

<b>NO</b>	<b>Mark</b>	<b>Category</b>	<b>Qualification</b>	<b>The number of student</b>
1	90 – 100	A	Very good	7
2	72 – 89	B	Good	15
3	57 – 71	C	Enough	8
4	34 – 56	D	Not enough	0
<b>AMOUNT</b>				<b>30</b>

Based on table 4.6, the results of the study show that the posttest results used an integrated

jobsheet on welding practice, including the very good category (90-100) 7 students. Students who get good category (72-89) are 15 students. Students who get enough category (57 - 71), namely 8 students. Students who get less category (34 - 56) that is not there.

Table 6. Recapitulation of experimental class students' posttest scores

NO	Mark	Category	Qualification	The number of student
1	90 – 100	A	Very good	12
2	72 – 89	B	Good	13
3	57 – 71	C	Enough	6
4	34 – 56	D	Not enough	1
AMOUNT				30

Based on table 4.7, the results of the study show that the results of the posttest used an integrated jobsheet in welding practice, including the very good category (90-100) for 12 students. Students who get good category (72-89) are 13 students. Students who get enough category (57-71) are 6 students. Students who get less category (34-56), namely 1 student.

Based on the results obtained, the researcher managed the data using the SPSS application with an independent sample T test to determine the significance value (p). before the independent test of the sample T test is carried out, the prerequisite test is first carried out, namely the normality and homogeneity tests can be seen in the following table:

a. Normality test

The normality test is used to determine whether the data is normally distributed or not. To find out the normality of the distribution, the Kolmogorov-Smirnov formula is used. The data is said to have a normal distribution if the value of Sig. > a (0.05). The results of normality test calculations can be seen in the following table:

Table 7. Normality Test Results

No	Variabel Uji	Sig.	α	Hasil
1	Pretest Experiment	0,416	0,05	Normal
2	Posttest Experiment	0,339	0,05	Normal
3	Pretest Control	0,184	0,05	Normal
4	Posttest Control	0,982	0,05	Normal

Based on table 4.8, it can be seen that from the normality test results a significance value (Sig.) is obtained for the Pretest Experiment test variable of 0.416; on the Posttest Experiment of 0.339; on the Control Pretest of 0.184; and in the Posttest Control of 0.982. The significance value of the four test variables is more than the significance level (a) of 5% (0.05), so that the four test variables

are declared normal.

b. Homogeneity Test

Homogeneity test was carried out on data from the experimental class and from the control class with the aim of ensuring that the data from the two test groups did not have a significant difference. Homogeneity testing was carried out by the F test. Data from the two test classes were declared homogeneous if they had  $F_{count} < F_{table}$  and  $Sig. > \alpha$  (0.05). The homogeneity test results are as follows:

Table 8. Homogeneity Test Results

No	Variabel Uji	F <sub>hitung</sub>	df <sub>1</sub> ; df <sub>2</sub>	F <sub>tabel</sub>	Sig.	α	Hasil
1	Pretest	0,400	1; 58	0,703	0,405	0,05	Homogen
2	Posttest	0,194	1; 58	1,448	0,234	0,05	Homogen

Based on table 4.9, it can be seen that from the results of the homogeneity test it shows that the pretest test obtained  $F_{count}$  (0.400)  $< F_{table}$  (0.703) and  $Sig.$  0.405  $> \alpha$  (0.05) while in the posttest the value of  $F_{count}$  (0.194)  $< F_{table}$  (1.448) and  $Sig.$  0.234  $> \alpha$  (0.05). These results indicate that the pretest and posttest scores have no significant difference and are declared homogeneous.

c. Test paired sample t-test

Testing the increase in the use of combined jobsheets in the practice of classifying students in the experimental group and the control group was carried out using the T-test (paired sample T test) if the value of  $T_{count} > T_{table}$  and  $Sig. < \alpha$  (0.05). The test results are as follows:

Table 9. Test results paired sample t test

No	Kelompok Uji	T <sub>hitung</sub>	Df	T <sub>tabel</sub>	Sig.	α	Hasil
1	Experiment	11,824	30	11,321	0,000	0,05	There is an increase
2	Control	10,015	30	11,321	0,473	0,05	No upgrade

Based on table 4.10, it can be seen that from the results of the t-test the results obtained from testing in the experimental group are  $T_{count}$  (11.824)  $> T_{table}$  (11.321) and  $Sig.$  (0.000)  $< \alpha$  (0.05) which can be said that there is an increase in the application of the production-based learning model in the experimental group after being given an intervention in the form of an integrated worksheet. Then in the test in the control group, the value of  $T_{count}$  (10.015)  $< T_{table}$  (11.321) and  $Sig.$  (0.473)

> a (0.05) which can be said that there was no increase in the production-based learning model in the control group because the control group was not given integrated jobsheet intervention.

The results showed that the use of integrated jobsheets in the practice of classifying students with production-based learning models increased both knowledge and competence. Production-based learning in lectures in workshops can provide an increase in the quality and meaningfulness of learning, especially learning experiences that link practical students to actual work or work objects in accordance with field standards and specifications (Suryadi, 2009). Production based learning can improve student productivity and accountability skills (Nuri, 2018).

At the end of class practice students use integrated jobsheets so students have:

- a. Knowledge of the use of jobsheets and the use of integrated jobsheets as well as work orders in the industry.
- b. Practical welding competence of students increasingly refers to industry work standards and practical welding competence for the production of a product.

### Evaluation

The last step of this research is evaluation. Evaluation is carried out to see whether the learning system being developed is successful or not. Researchers at the evaluation stage will calculate the effectiveness of integrated jobsheet development on student teaching practices using quasi experiments. With calculations using an independent sample T test is as follows:

Testing the differences in the use of integrated jobsheets in the practice of classifying students in the experimental group and the control group was carried out using the T-test (independent sample T test) if the value of  $T_{count} > T_{tabel}$  and  $Sig. < \alpha$  (0.05). The test results are as follows:

Table 10. Independent test results sample T test

No	Kelompok Uji	$T_{hitung}$	df	$T_{tabel}$	Sig.	$\alpha$	Hasil
1	Pretest	10,360	58	3,061	0,405	0,05	No upgrade
2	Posttest	12,506	58	3,061	0,034	0,05	There is an increase

Based on table 4.11, it is known that from the results of the independent T-test the results obtained on the pretest test are the value of  $T_{count}$  (10.360)  $> T_{tabel}$  (3.061) and  $Sig.$  (0.405)  $> \alpha$  (0.05) which can be said that there is no difference in the knowledge and competence of teaching students in the use of an integrated jobsheet in the practice of teaching students in the pretest testing in both groups. Then in the posttest test the value of  $T_{count}$  (12.506)  $> T_{tabel}$  (3.061) and  $Sig.$  (0.034)  $< \alpha$  (0.05) which can be said that there are differences in the knowledge and competence of teaching students in the use of an integrated jobsheet in the practice of teaching students in the posttest testing in both groups.

The test results above show differences in the understanding of the integrated jobsheet in the

practice of classifying students in the posttest of the two groups. Thus the application of an integrated jobsheet to student teaching practice can be said to be feasible to be given to a production-based learning process.

### **Conclusion**

This research is included in the type of Research and Development (R&D) or research and development. This method is used with a procedural model, carried out with predetermined rules so that it can produce products and test the effectiveness of these products. Based on the results of the research in the discussion explained that:

1. The use of an integrated welding jobsheet can increase students' knowledge and competence.
2. Development of an integrated jobsheet for practical welding learning with a production based learning model, already using an integrated jobsheet adapted to existing work orders in the industry.
3. The developed jobsheet consists of work steps and calculation of capital and selling value of products produced through work order refinements that are often used in industry.

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