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Simple Additive Weighting Method in the Development of a System Assessing the Feasibility of Job Training Industry.

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Abstract:

The activities of the job training is an activity that must be implemented at Vocational Secondary School. To increase competence skills learners in the workforce, then the school must choose many places of the job training industry by the respective expertise of program participants. Therefore it is necessary that information systems can assist the school in selecting the job training industry by producing the decision support to determine the feasibility of the job training industry for use in the following period. The feasibility of job training industry that is purposed in this research is determined by the alignment of competency expertise on the job training industry with the program expertise of participants and other supporting criteria. That system is called “Sistem Pendukung Keputusan Kelayakan Tempat Praktik Kerja Industri (SPK-KTP)” or System Assessing The Feasibility of Job Training Industry. In decision-making, this system used the method of Simple Additive Weighting (SAW). In addition, the system is also equipped with features to manage the administrative activities of the job training industry, to recap the daily journal, and to recap the supervising report. SPK-KTP is the web-based information system which it is developed using the programming language PHP (Hypertext Preprocessor). System development method that used in the information system is Waterfall Model. The steps of Waterfall Model consist of analysis, design, code, and test. SPK-KTP has done testing to an expert of the information system with value 90,7%, an expert of the job training substance with value 91,6%, supervising teachers with value 83,3%, and learners with value 90,6%. Based on the result, so SPK-KTP is very feasible to use.

Keywords: Decision-Making Support, Information System, SAW, On the Job Training, Web-Based

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Introduction

According to Undang-Undang No. 2 Tahun 1989, Pasal 11 stated that vocational education is education which prepares learners can work in a particular field. In addition, in the vocational education of curriculum structure on Permendiknas No. 22 Tahun 2006 stated that education of vocational high school is organized in the form of a dual system and the learning materials of Basic Vocational Competence and Vocational Competence are adjusted with the needs of program expertise to meet the working competence standard in the world of work. Therefore, the vocational school prioritizes the competencies required in the world of work.

The job training is one of the activities that characterize the vocational school. One of the things that become the learner's supply focus of the job training is the implementation of the program job training that poured in a journal whose they bring (Harjono, 2012:52). Therefore, the implementation of the job training should be strongly observed. With the daily activity journals reporting, so it can be known whether the job training industry can be reused on the next school year or not. All types of work performed during the execution of the job training recorded in the daily journal of the job training, so that from the daily activities record can be known type of work that did during the execution of the job training by the expertise competencies or not.

To increase competence skills learners in the workforce, then the school must choose many places of the job training industry by the respective expertise of program participants. Therefore it is necessary that information systems can assist the school in selecting the job training industry by producing the decision support to determine the feasibility of the job training industry for use in the following period. The feasibility of job training industry that is purposed in this research is determined by the alignment of competency expertise on the job training industry with the program expertise of participants and other supporting criteria. That system is called “Sistem Pendukung Keputusan Kelayakan Tempat Praktik Kerja Industri (SPK-KTP)” or System Assessing The Feasibility of Job Training Industry. In decision-making, this system used the method of Simple Additive Weighting (SAW). In addition, the system is also equipped with features to manage the administrative activities of the job training industry, to recap the daily journal, and to recap the supervising report.

Thus the need to utilize advances in technology to develop the information system that can help the school to manage the administration on the job training, to recap the daily journal, to recap the supervision report, and to provide decision support to determine the feasibility of the job training industry used in the next period. This system will be equipped with the calculation of the decision-making support feature to determine the feasibility of the job training industry. Decision support system (Turban, 2007:755) is a conceptual framework that used for the decision-making support of the process, usually by modeling and quantitative model to analyze the solution. The stages of decision-making based on the opinion of Turban, Aronson, Liang, and Sharda (Turban, 2007:15) consist of: (1) Intelligence is defining the problem; (2) Design is creating, analyzing, and developing the solutions; (3) Choice is choosing among alternative actions that are available; and (4) Implementation is adapting to the selected alternative.

Based on the research by Pratiwi, Lestari, and Agushinta (2014) stated that the SAW method could solve the problem with multi criteria and decision support system which use this method consists of some criteria than the value of each criterion used to get the best alternative. In addition, the research by Adriyendi (2015) stated that SAW method is also known as the assessment method that is best and simplest the decision-making support method. In research by Adreyendi (2015) also stated that the basic logic of the method is to obtain the weighted summation of each alternative ranking performance on all attributes. While research by Melia (2016) stated that the SAW method produces a decision or recommendation of the alternative based on the criteria of high value.Therefore, it is done creation or development of decision support system to determine the feasibility of the job training industry that can help the school in providing recommendations the job training industry by the criteria of the school.

Decision-making support method that is used by the system is Simple Additive Weighting (SAW). Tzeng and Huang (2011:55) stated that SAW method is an easy method used to decide on the problems with some of the criteria because the linear summation function can represent the preferences of the decision maker. SAW method was chosen because it is based on value criteria and weighting the preference that has specified. Additionally SAW can also choose the best alternative from some alternatives that exist due to the ranking process after determining the weights for each attribute. In this case, the alternative is the industry that will be selected based on specified criteria. According to Nandang Hermanto (2012), the calculation process by SAW method of the decision determination is quick, and the result is precise.

Then with a decision-making support system is expected to facilitate the school in deciding to determine the feasibility of the job training industry with the result of the decision are more valid and objective. One of a kind supporting methods of decision-making is Simple Additive Weighting (SAW).

This research aims to produce a product in the form of a decision support system to determine the feasibility of the job training industry that it has been equipped with the management of calculation to produce the decision-making support. The result of calculation on this system is used to determine the feasibility of the job training industry that can be recommended to next period. The system that produced the supporting decision to determine the feasibility of the job training industry does not exist on other research.

Research of Metodology

This research use research and development method with the development model of this information system is Waterfall Model. The steps of Waterfall Model (Pressman, 2001:29) include analysis, design, code, and test. The flow of Waterfall Model steps can be seen in Figure 1:

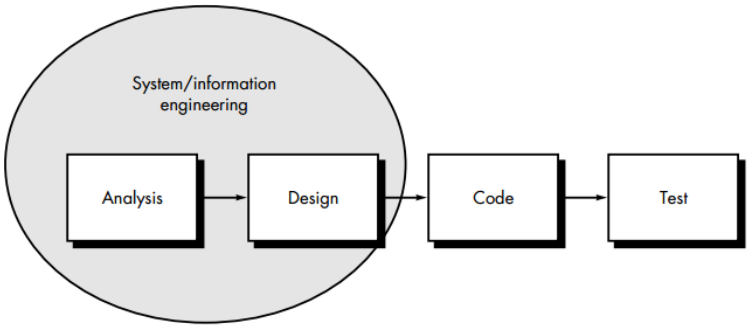

Figure 1. The Steps of Waterfall Model

Based on Figure 1, the Waterfall Model stages is as following detail:

1. The analysis is the stage that conducts the information collection to understand the needs, behavior, performance, and interface at the system will be created.
2. The design is the stage that conducts the design system by the result of the analysis.
3. The code is the stage of coding to create a system that is by design.
4. The test is the stage of the testing system that was created to measure the level of feasibility.

The Result of Research And Discussion

The Result of Research

The result of this research is the system assessing the feasibility of the job training industry or it is called “Sistem Pendukung Keputusan Kelayakan Tempat Prakerin (SPK-KTP)” that is used to manage the administration on the job training, to recap the daily journal, to recap the supervising report, and to provide the decision support to determine the feasibility of the job training industry used in the next period as a result of the job training evaluation. SPK-KTP is a web-based information system. SPK-KTP has three levels of the user that are administrators, the supervising teachers, and participants who can access it.

Development of this system use Waterfall Model with the following stages:

Analysis

This stage is done by the method of interview and literature. The interview method is used to determine the function of the system needs that will be created, while the literature method is used to collect the information that is needed to create the system. The result of this stage is the identification of the needs of functional and non-functional on the system that will be created.

Design

This stage is done by the design of flowchart, Entity Relationship Diagram (ERD), database, Data Flow Diagram (DFD), the display of the interface, and the calculation of SAW method. The design of the SAW method calculation on the system that will be created consist of the description of criteria, the weighting criteria, the category criteria, and the sub criteria with its value. The criteria and the weighting criteria can be seen in Table 1.

Table 1. The Criteria and the Weighting Criteria

No.	The Criteria	The Weighting Criteria	The Category Criteria	The Data Acquisition
1.	The suitability of the work type with the program expertise. (K1)	0,4	Benefit	From the result of the questionnaire have been answered by the supervising teacher.
2.	The support facilities of competency expertise in the job training industry.(K2)	0,2	Benefit	From the content of the supervising report has been added by the supervising teacher.
3.	Duration of employment for participants of the job training. (K3)	0,1	Benefit	From the content of daily journal has been added by the participants.
4.	The liveliness of the job training industry against the implementation activities of the job training. (K4)	0,3	Benefit	From the result of the calculation total journal sum division between each participant with the total participants at the job training industry.

For the description of the sub criteria and the value of the sub criteria from each criterion can be seen in the following tables. Description of the sub criteria from the criteria for the suitability of the type of work with the program expertise (K1) can be seen in Table 2.

Table 2. Sub Criteria K1

Sub Criteria	Value	Description
Not Appropriate	1	Total score of the questionnaire regarding the suitability of industry with the program expertise that is acquired by the supervising teacher is < 15.
Appropriate	2	Total score of the questionnaire regarding the suitability of industry with the program expertise that is acquired by the supervising teacher is between 15 to 20.
Very Appropriate	3	Total score of the questionnaire regarding the suitability of industry with the program expertise that is acquired by the supervising teacher is between 21 to 25.

Description of the sub criteria from the criteria of the facilities support program expertise in the job training industry can be seen in Table 3.

Tabel 3. Sub Criteria K2

Sub Criteria	Value	Description
Incomplete	1	Facilities industry supported <3 of the competency expertise.
Complete	2	Facilities industry supported >= 3 of the competency expertise.

Description of the sub criteria from the criteria of duration employment for participants of the job training can be seen in Table 4.

Table 4. Sub Criteria K3

Sub Criteria	Value	Description
Lazy	1	Duration of employment for participants of the job training is < 4 hours per day.
Diligent	2	Duration of employment for participants of the job training is between 4 to 6 hours per day.
Very Diligent	3	Duration of employment for participants of the job training is > 6 hours per day.

Description of the sub criteria from the criteria of the liveliness of the job training industry against the implementation activities of the job training can be seen in Table 5.

Table 5. Sub Criteria K4

Sub Criteria	Value	Description
Inactive	1	The result of the average journal that has added based on the group supervision in the related industry is < 30 journals.
Less Active	2	The result of the average journal that has added based on the group supervision in the related industry is between 31 to 39 journals.
Active	3	The result of the average journal that has added based on the group supervision in the related industry is 40 journals.
Very Active	4	The result of the average journal that has added based on the group supervision in the related industry is > 40 journals.

Code

This stage is done by encoding program to create SPK-KTP. SPK-KTP is created by using the programming language PHP (Hypertext Preprocessor) for data management and Bootstrap template to the user interface.

The display of main page SPK-KTP can be seen in Figure 2:

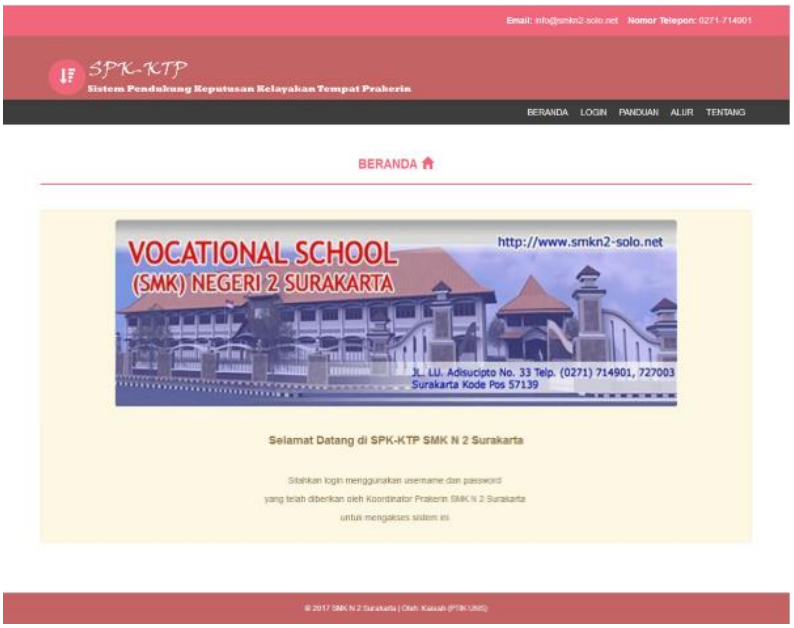

Figure 2. The Display of Main Page SPK-KTP

Test

This stage is done by testing system to measure the level of feasibility SPK-KTP as a product that is produced by this research. Aspects of assessment that are used to measure the level of this feasibility system used the aspect assessment quality software from McCall (Parwita, W.G.S. & Putri, L.A.A.R., 2012:92-93). Not all aspects of McCall are used to test the product on this research. Then the selected aspects are developed into some of the indicators.

Testing the system is done by several stages that include Black-box testing, White-box testing, Alpha testing, and Beta testing. For Black-box testing and White-box testing are done by the developer of this system, whereas the Alpha testing is done by an information system and an expert substance of the job training. Then the Beta testing is done by three teachers and ten students of Class XI TKJ SMK N 2 Surakarta. Types of data on this research are the qualitative and quantitative data. The technique of data analysis that is conducted on this research use the quantitative descriptive analysis techniques, which are by analyzing quantitative data that is obtained from the questionnaire test expert and test field in the form of a result percentage of the calculation with equation (1):

$$\text{The Percentage of The Feasibility}(\%) = \frac{\text{The amount of obtained score}}{\text{The amount of the maximum score}} \times \mathbf{100}\% \quad (1)$$

(Source : Sugiyono, 2010:134)

The result of the calculation is then interpreted by an approximate sentence with classification. The classification feasibility of the product is presented as in Table 6:

Tabel 6. The Classification Feasibility of The Product (Arikunto. 2009:44)

Percentage	Category
81% - 100%	Very Feasible
61% - 80%	Feasible
41 % - 60%	Less Feasible
21% - 40%	Unfeasible
< 21%	Very Unfeasible

This system has been through Alpha Testing and Beta Testing to measure the level feasibility of the product. The result of the Alpha Testing and Beta Testing can be seen in Table 7:

Table 7. The Result of Testing

No.	Indicator	The Value of Information System	The Value of Substance of The Job Training	The Value of Supervising Teachers	The Value of Participants
1.	Completeness	100 %	93,3 %	96,2 %	85,1 %
2.	Consistency	80 %	80 %	80 %	86 %
3.	Accuracy	95 %	100 %	93,3 %	82,5 %
4.	Error Tolerance	84 %	100 %	73,3 %	79,3 %
5.	Simplicity	86,6 %	80 %	95,5 %	89,9 %
6.	Instrumentation	100 %	100 %	93,3 %	78 %
7.	Security	100 %	80 %	93,3 %	80 %
8.	Operability	80 %	100 %	100 %	86 %
Average Value		**90,7 %**	**91,6 %**	**90,6 %**	**83,3 %**

The value of the supervising teachers in Table 7 above is the average value of three teachers, and the value of learners is also the average value of ten students. Based on the test result in Table 7, and the average value that is obtained from an expert information system was 90.7%, a substance of the job training was 91.6%, the supervising teachers were 90.6%, and the learners were 83.3%. Therefore, SPK-KTP obtained the total value average of 89.05%.
The sample of data support decision to determine the feasibility of the job training industry can be seen in Table 8:

Table 8. The Sample of Data

No.	Alternative (Name of Industry)	K1	K2	K3	K4
1.	A	21	Complete	1	27
2.	B	19	Complete	6	46
3.	C	22	Complete	7	32
4.	D	22	Complete	3	43
5.	E	22	Complete	5	33

Based on data in Table 8, so the steps of the SAW method calculation in the following:

1. Create a table of matrix data that is converted based on sub criteria such as Table 9.

Table 9. The Matrix Data of Sub Criteria

No.	Alternative (Name of Industry)	K1	K2	K3	K4
1.	A	Very Appropriate	Complete	Lazy	Inactive
2.	B	Appropriate	Complete	Diligent	Very Active
3.	C	Very Appropriate	Complete	Very Diligent	Less Active
4.	D	Very Appropriate	Complete	Lazy	Very Active
5.	E	Very Appropriate	Complete	Diligent	Less Active

2. Create a table of matrix data that is converted based on the value of the sub criteria in Table 10.

Table 10. The Matrix Data of The Value Sub Criteria

No.	Alternative (Name of Industry)	K1	K2	K3	K4
1.	A	3	2	1	1
2.	B	2	2	2	4
3.	C	3	2	3	2
4.	D	3	2	1	4
5.	E	3	2	2	2

3. Create the table of matrix data normalization. In this step need to be done the calculation by using the formula normalization based on the categories of criteria that are benefit or cost. For the criteria including a benefit use the formula as in equation (2):

$$r_{ij}\,(x) = \frac{x_{ij}}{x_{jmax}} \qquad (2)$$

(Source : Tzeng & Huang, 2011:55)

Description:

$r_{ij}\,(x)$ = The rating alternative of row to-i and column to-j (i,j = 1,2,3,...n).

x_{ij} = The data alternative of row to-i and column to-j (i,j = 1,2,3,...n).

x_{jmax} = The maximum data alternative of column to-j (j = 1,2,3,...n).

Whereas for criteria including cost use equation (3):

$$r_{ij}\,(x) = \frac{x_{jmin}}{x_{ij}} \qquad (3)$$

(Source : Tzeng & Huang, 2011:55)

Description:

$r_{ij}\,(x)$ = The rating alternative of row to-i and column to-j (i,j = 1,2,3,...n).

x_{ij} = The data alternative of row to-i and column to-j (i,j = 1,2,3,...n).

x_{jmin} = The minimum data alternative of column to-j (j = 1,2,3,...n).

All the criteria that are used in this calculation are included in the category of benefit. Therefore, the calculation result of the matrix data normalization by using the formula for the benefit criteria can be seen in Table 11.

Table 11. The Normalization of Matrix Data

No.	Alternative (Name of Industry)	K1	K2	K3	K4
1.	A	1	1	0,333	0,25
2.	B	0,667	1	0,667	1
3.	C	1	1	1	0,5
4.	D	1	1	0,333	1
5.	E	1	1	0,667	0,5

4. Create the table of the weighting matrix data. In this step has done the multiplication between the result of normalization that is in Table 11 with the weighting of each criterion. For the weighting matrix data on SAW method use equation (4):

$$v_{ij} = w_j \times r_{ij} \qquad (4)$$

(Source : Adriyendi, 2015:10)

Description:

v_{ij} = the value of row to-i and column to-j (i,j = 1,2,3,...n).

w_{ij} = The weighting of column to-j (i,j = 1,2,3,...n).

r_{ij} = The alternative rating of row to-i and column to-j (j = 1,2,3,...n).

The result of the multiplication can be seen in Table 12.

Table 12. The Weighting Matrix Data

No.	Alternative (Name of Industry)	K1	K2	K3	K4
1.	A	0,4	0,2	0,033	0,075
2.	B	0,266	0,2	0,066	0,3
3.	C	0,4	0,2	0,1	0,15
4.	D	0,4	0,2	0,033	0,3
5.	E	0,4	0,2	0,066	0,15

5. The summation of the weighted matrix data. In this step has done the summation of the weighted multiplication result in Table 12. The result multiplication of each criterion is obtained every alternative combined using the equation (5):

$$S_i = \sum_j^m v_{ij} \quad (5)$$

(Source : Adriyendi, 2015:10)

Description:

S_i = The summation result of row to-i (i = 1,2,3,...n).

v_{ij} = The value of row to-i and column to-j (i,j = 1,2,3,...n).

The result that is obtained in this step can be seen in Table 13:

Tabel 13. The Summation of Weighted Matrix Data

No.	Alternative (Name of Industry)	The Summation	The Result
1.	A	0,4 + 0,2 + 0,033 + 0,075	0,708
2.	B	0,266 + 0,2 + 0,066 + 0,3	0,832
3.	C	0,4 + 0,2 + 0,1 + 0,15	0,85
4.	D	0,4 + 0,2 + 0,033 + 0,3	0,933
5.	E	0,4 + 0,2 + 0,066 + 0,15	0,816

6. Sort the result of the SAW method calculation. The list of the alternative order decision that is produced from the calculation using the SAW method is started from the largest value. The list of order can be seen in Table 14.

Table 14. The List of Result Calculation

No.	Alternative (Name of Industry)	The Result
1.	D	0,933
2.	C	0,85
3.	B	0,832
4.	E	0,816
5.	A	0,708

Based on the list of result calculation in Table 14, then the best of the decision-making alternative to determine the feasibility of the job training industry is D with the acquisition value of 0,933.

7. The designation of the result calculation. The category of the job training industry consists of 2 groups that are feasible and unfeasible. The minimum requirements of the job training industry that are said to be feasible can be seen in Table 15:

Table 15. The Minimum Requirements of The Feasible Job Training Industry

Alternative (Name of Industry)	K1	K2	K3	K4
X	Appropriate	Complete	Diligent	Active

Then the value sub criteria on each criterion can be seen in Table 16:

Table 16. The Value of Minimum Requirements

Alternative (Name of Industry)	K1	K2	K3	K4
X	2	2	2	3

The maximum value for K1 based on Table 2 is 3, the maximum value for K2 based on Table 3 is 2, the maximum value for K3 based on Table 4 is 3, and the maximum value for K4 based on Table 5 is 4. The minimum value for each criterion is 1. Calculation of the normalization data for required minimum of the feasible place based on data in Table 16 was as follows:

1) $\boldsymbol{r\,(K1)} = \frac{x_{ij}}{x_{jmax}} = \frac{2}{3} = 0{,}66$

2) $\boldsymbol{r\,(K2)} = \frac{x_{ij}}{x_{jmax}} = \frac{2}{2} = 1$

3) $\boldsymbol{r\,(K3)} = \frac{x_{ij}}{x_{jmax}} = \frac{2}{3} = 0{,}66$

4) $\boldsymbol{r\,(K4)} = \frac{x_{ij}}{x_{jmax}} = \frac{3}{4} = 0{,}75$

Then the weighting for each criterion was as follows:

1) $v_{K1} = w_j \times r_{ij} = 0{,}4 \times 0{,}66 = 0{,}264$
2) $v_{K2} = w_j \times r_{ij} = 0{,}2 \times 1 = 0{,}2$
3) $v_{K3} = w_j \times r_{ij} = 0{,}1 \times 0{,}66 = 0{,}066$
4) $v_{K4} = w_j \times r_{ij} = 0{,}3 \times 0{,}75 = 0{,}225$

The result of weighted data summation on an alternative (name of industry) X is as follows:

$\boldsymbol{S_i = \sum_j^m v_{ij}}$ **= 0,264 + 0,2 + 0,066 + 0,225 = 0,755 = 0,75**

Therefore, the limit value that is used to separate the feasible job training industry or the unfeasible job training industry is 0.75. If the value of an alternative greater than is equal to 0.75 (> = 0.75), then the job training industry or institution is feasible to use for the implementation of the job training in the next period. Whereas if the value of an alternative smaller than 0.75 (< 0.75), then the job training industry or institution are unfeasible to use for the implementation of the job training in the next period. Table 17 is the name of industry list and its category based on the result of the calculation using by the SAW method:

Table 17. List of The Calculation Result Industry Name

No.	Alternative (Name of Industry)	The Result	The Category
1.	D	0,933	Feasible
2.	C	0,85	Feasible
3.	B	0,832	Feasible
4.	E	0,816	Feasible

5.	A	0,708	Unfeasible

Based on the result that is presented in Table 17, then the feasible job training industries used in next period are D with the value of 0,933, C with the value of 0,85, B with the value of 0,832 and E with the value of 0,816. The unfeasible job training industry used in next period is A with the value of 0,708.

Discussion

Decision support system to determine the feasibility of the job training industry or it is called SPK-KTP is used to manage the administration on the job training, to recap the daily journal, to recap the supervision report, and to provide the decision support to determine the feasibility of the job training industry used in the next period which it is as the result of the evaluation of the implementation job training. The decision-making support that is used on this system was the Simple Additive Weighting (SAW) method.

The results of testing to measure the feasibility level of this system were 90,7% of an expert information system, 91,6 % of an expert substance job training, 90,6% of the value of the supervisor teachers, and the 83,3% of the learners. Therefore, SPK-KTP obtained the total average value of 89.05%, and that value is included in that classification very feasible to be used by users based on the classification of feasibility product in Table 6.

Decision support has resulted from this SPK-KTP by the assessment of the job training industry from the coordinator of the job training. The result of the calculation SAW method in making decision support of the feasible job training industry that is used in the following period was accurate and more objective. Therefore, the SAW method can be served as a reference to define decision support of the feasible job training industry used in the following period.

As for the excellence of SPK-KTP from the result of assessment as follows: (1) This system has functions as manager of the job training administration, to recap the daily journal, to recap the supervision report, and management of the evaluation job training are very well, (2) This system has the design of display that is consistent on each of page, (3) the system is appropriately capable of performing processing data, (4) the resilience of the system in the event of an error login or processing data can be categorized either, (5) This system can give the message that is detail if the event of an error login or processing data, (6) This system can protect data on each level of user, and (7) the system is very easy to operate by all level of users.

Conclusion

The product that is produced by this research is decision support system to determine the feasibility of the job training industry. That product is named SPK-KTP.This system is web-based, then it can be accessed by the user via online. The results of testing to measure the feasibility level of this system were 90,7% of an expert information system, 91,6 % of an expert substance job training, 90,6% of the value of the supervisor teachers, and the 83,3% of f the learners. Therefore, SPK-KTP obtained the total average value of 89.05%. Based on the classification of the feasibility product in Table 6, then SPK-KTP included in the product classification that is very feasible to be used. The calculation of SAW method on SPK-KTP produces the decision support to determine the feasibility of the job training industry used in the next period that is accurate and more objective.

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