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Software Testing Based on McCall's Quality Theory on Academic Information System Study Plan Cards, University of Muhammadiyah Purwokerto

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Abstract

The development of technology is currently growing rapidly, one of which is in the manufacture of software and information systems. But often software that is made or developed to meet basic functional needs only, there are several qualities that need to be considered that will determine the quality and performance of the software built. University of Muhammadiyah Purwokerto is one of the universities in Purwokerto that has used an Academic Information System, one of which is the Study Plan Card, in which there are sub menus to meet the academic needs of students. Testing the quality of the UMP KRS is based on McCall's quality theory, the McCall method has the most complete and in-depth criteria, there are several aspects that are studied in the McCall method. This study focuses on product operations, namely factors related to the nature of software operations with 5 quality factors. The purpose of the test is to determine the quality and utilization of the KRS system at the University of Muhammadiyah Purwokerto, so that errors or problems that occur in the system can be identified which will be corrections for developers to improve the performance and quality of the KRS system that has been made, the average results obtained The quality of the UMP KRS is 46.68% which is in the fairly good category, with the highest factor being the integrity factor 71.6% which is in the good category, while the lowest quality factor is efficiency with a percentage of 26.48% which is in the poor good category.

Keywords : KRS, McCall, Software Quality Testing

Introduction

Muhammadiyah University of Purwokerto is one of the universities in Purwokerto that has used Academic Information System (SIA) software as a tool in providing information needed by students, lecturers, employees, in academic activities. This Academic Information System has quite complete menu features, one of which is the Study Plan Card (KRS) feature. In the KRS feature menu, there are various sub menus such as: KRS entries, KRS changes (already paid), temporary KRS entries, intermediate KRS changes, intensive English KRS entries, KRS printing, exam card printing, KHS printing, exam cards (D1 program). English), test scores (D1 program. English), print the D1 program certificate concept. In English, the UMP KRS feature has been implemented for a long time, but there has never been a quality test of the UMP KRS feature, so it is not known whether the UMP KRS feature really has good quality and meets the needs of students in the academic field or not.Symbols/signs must be clear and distinguishable, such as the use of the number 1 and the letter l (as well as the number 0 and the letter O). In this manuscript it is not allowed to use bullets and numbering. At the end of this paper the two columns must be balanced. You should also enable the widow or orphan control to ensure that there is not a single line at the end of the column section.

Software quality testing on the Purwokerto Muhammadiyah University Study Plan Card was carried out using McCall's quality theory. One of the factors that will be used is the product operation factor, which is a factor related to the operational nature of the software with 5 test quality factors (correctness, reliability, efficiency, integrity, usability) and 11 tested criteria (completeness, consistency, traceability, accuracy). , error tolerance, execution efficiency, storage efficiency, access control, training, operability, communicativeness), this study does not involve access audit criteria, because UMP has never audited information systems, one of

which is the KRS feature, so it cannot be distributed questionnaires to auditors. because at UMP there is no auditor yet. System testing is an activity aimed at a system to determine the quality of the software on the system, the purpose of software testing is to determine the capabilities of the software and evaluate errors such as errors or other problems that occur when the system used, this will help developers to improve the performance of the system created so that it will produce a system that helps facilitate the user. Software quality is needed in system development, because quality will affect software performance. The software has good performance, so it takes precise exploration of user needs, McCall's method can be a benchmark for testing and measuring software quality, this method has been widely used and is quite good for testing software quality. Yenila (2021) states that the McCall method has the most complete and in-depth criteria, there are several aspects studied in the McCall method including product operation, product revision and product transition. McCall's quality theory has good accuracy in software testing.

The data in this study were obtained from respondents' statements, namely students from all study programs at the UMP faculty by taking samples using Isaac and Michael's theory, using an online questionnaire made with google form. Then the calculation of the results of the respondent's statement will be calculated based on the quality of McCall's theory, so that it can be seen how the quality of the UMP KRS features. With the software quality testing on the Academic Information System Study Plan Card of the University of Muhammadiyah Purwokerto using McCall's quality theory, it is expected to be able to know the quality and user utilization of the KRS feature of the University of Muhammadiyah Purwokerto, so that errors or problems that occur in the system can be identified, which will be a correction for developers to improve and improve the performance and quality of the KRS features that have been made, so that the UMP KRS features will be more helpful and easier for students.

Methodology

Type of research

This type of research uses a quantitative approach, using McCall's quality theory to calculate the respondent's data so that the quality of the Study Plan Card (KRS) feature in the Academic Information System of the University of Muhammadiyah Purwokerto is known based on the product operation factor.

Research variables

The variable studied is the Study Plan Card (KRS) feature in the Academic Information System of the University of Muhammadiyah Purwokerto.

Population and sample

This study uses a population of all active UMP students from all faculties with the determination of the research sample using calculations with Isaac and Michael's theory.

Data collection method

Online Questionnaire

Distribute online questionnaires via a google form link with valid and reliable questions to UMP students in all faculties. based on sample calculations according to Isaac's theory. In this case, to simplify and speed up data collection, online questionnaires were distributed by asking for help from: Head of study program for each faculty through a letter of application, head of HMPS for each study program, head of UKM, head of PMI, students at the Darussalam Islamic boarding school in Purwokerto, and friends from the same class. and junior level through the questionnaire link distributed via whatsapp.

Result

Making questions in the online questionnaire

This question contains the description, function, process of the Study Plan Card (KRS) feature when used by students, based on product operation factors consisting of 5 factors. So that data is obtained based on respondents' answers about the system, whether it is appropriate or not. Respondents' answers were made based on the Likert scale, namely (Strongly agree, Agree, Neutral, Disagree, Strongly disagree). The questions made consist of 25 questions which are shown in Table 1 as follows:

Table 1. The questions made consist of 25 questions

Faktor	Criteria and questions
	Comletness
	1. Does each sub menu in the UMP KRS feature meet the needs of students?
	2. Does every sub menu on the KRS UMP feature work properly when used?
	Consistency
	3. Do the appearances and table designs in the sub menus of the UMP KRS system have the same thing?
	4. Does the sub menu on the KRS UMP feature have the same form and button design?
Correctnes	5. Is the language used in each sub menu of the UMP KRS feature consistent (not changing) on each page?
	6. Does each sub menu in the UMP KRS feature have a consistent display design (color, font, layout) on every page?
	Traceability
	7. Is each sub menu in the UMP KRS feature able to search for data (grades, schedules, list of courses, etc.) that students need?
Reliability	Accuracy
	8. Is each sub menu in the UMP KRS feature able to display information and data according to student needs?
	9. Does each sub menu in the UMP KRS system provide information and accurate and error-free data?
	Error tolerance
	10. Will each sub menu in the UMP KRS feature give an error message when the data entered by the student does not match?
	11. Is the error rate that occurs in the UMP KRS system low?
	12. Will every sub menu in the KRS UMP feature work again after experiencing a system failure caused by a server down?
	Execution efficiency
	13. Does every command executed in the sub menu of the KRS UMP feature run quickly?
Efficiency	14. Can students access the UMP KRS feature at any time?
	Storage efficiency
	15. Will every sub menu in the KRS UMP feature that has been accessed have its history (history) stored?
	Access control
	16. Are student accounts on the system protected?
Integrity	Is the login process on the system running properly?
	18. Is the logout process on the system running properly?
	Training
	19. Is a student
	new, every can
	easily
	operate the KRS UMP feature?
	20. Is there a user manual or help menu for each sub menu of the UMP KRS feature?
	21. Is there a contact menu available in the UMP KRS feature to provide suggestions, criticisms, and student complaints when using the system?
Usability	22. Are some of the sub menus in the UMP KRS feature used very often?
	23. Is each sub menu on the KRS UMP feature easy to use?

	Communicativeness 24. Is the language used in each sub menu of the UMP KRS feature easy to understand? 25. Can every text, symbol, color on each sub menu of the UMP KRS feature be clearly legible?

Testing the validity and reliability of the questions

Determination of sample validity and reliability of items.

Budiastuti (2018) states that the general standard put forward by statisticians (Hair et al., 2006a; Pituch & Steven, 2016; Tabachnick & Fidell, 2012) is that the number of samples needs to be determined based on the number of research variables (items/indicators) namely that the minimum five respondents one variable (5:1 ratio). By taking sample based on a ratio of 5:1, where each question item is multiplied with 5 respondents. Number of questions made is 25 x 5 = 140 respondents divided by 27 study programs in 11 faculties, so that for sample validity testing and Questionnaire reliability is needed at least 5 respondents in each study program. Create a link to the validity questionnaire and Online questionnaire created using the google form shown in Figure 1 as follows: question reliability

Fig 1. Determination of sample validity and reliability of items.

Calculating the validity and reliability of the questions

Calculating the value of the validity of each item using the IBM SPSS 25 application, the results shown in Table 2 are as follows:

Table 2. Calculating the validity and reliability of the questions

Total Pearson correlation	Sig.(2-tailed)	N
,632**	0,000	164
,628**	0,000	164
,571**	0,000	164
,468**	0,000	164
,599**	0,000	164
,601**	0,000	164
,552**	0,000	164
,620**	0,000	164
,703**	0,000	164
,484**	0,000	164
,602**	0,000	164
,528**	0,000	164
,671**	0,000	164
,511**	0,000	164
,548**	0,000	164
,685**	0,000	164

,627**	0,000	164
,558**	0,000	164
,661**	0,000	164
,624**	0,000	164
,547**	0,000	164
,545**	0,000	164
,643**	0,000	164
,651**	0,000	164
,652**	0,000	164

The value of r table for N = 25 is 0.396, from the results of the validity test in Table 2, the value of the Pearson correlation is more than 0.396, if using the minimum value limit of validity, which is 0.30, all items made are valid.

Table 3. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
0,922	25

The results of the reliability of the questions shown in Table 3 are 0.922 which is included in the very good category and according to statistics it is also reliable because it is more than 0.71.

Determine the number of research samples

Data related to the number of active students regarding the items. The UMP obtained from the Bureau UMP student numbers are 11096 from 11 faculties and 27 study programs. Determination of the number of samples is calculated based on the theory of Isaac and and Michael with an error rate of 5% (95%).

$$S = \frac{\lambda^2.N.P.Q}{d^2(N-1)+\lambda^2.P.Q}$$

Diketahui :

$\lambda^2 = 3,814$

$N = 11096$

$P = 0,5$

$Q = 0,5$

$d^2 = 5\%\ (0,05)$

$$S = \frac{3,814x11096x0,5x0,5}{0,05^2(11096-1)+3,814x0,5x0,5}$$

$S = 371$

Based on the above calculation, the number of samples for testing the UMP KRS system is 371 students divided by 11 faculties, so a minimum of 34 students is needed in each faculty of the University of Muhammadiyah Purwokerto. Distribute online questionnaires that are valid and reliable. To simplify and speed up data collection, questionnaires were distributed by asking for help from: Head of study program for each faculty through a letter of application (see attachment 2), head of HMPS for each study

program, head of UKM, head of PMI, students at the Darussalam Islamic boarding school in Purwokerto, and friends. one generation and junior level through the questionnaire link distributed via Whatsapp.

Determine the weight of each factor and criteria

The data obtained are 402 respondents from 27 study programs in 11 UMP faculties, which means that they have met the previously determined sample criteria, namely 3/1 respondents based on isaac theory, before determining the weight of each criterion and factor, first determine the average value of each item. questions that have been answered by 402 respondents, which are shown in Table 4 as follows:

Table 4. Determine the weight of each factor and criteria

question item number	the average value of each item
1	3,90
2	3,86
3	3,70
4	3,74
5	3,93
6	4,01
7	4,03
8	3,97
9	3,56
10	3,63
11	3,39
12	3,76
13	3,68
14	4,04
15	3,49
16	3,86
17	4,01
18	4,13
19	3,73
20	3,50
21	3,50
22	3,86
23	4,02
24	4,06
25	4,15

Determine the weight of the criteria

The weight of the criteria is determined based on comparison formula worth onequation (12) is as follows: $\frac{1}{2}$ - $\frac{1}{2} = \cdots \ldots \ldots \ldots (1)$

The weight of the criteria is calculated using the equivalent comparison formula shown in equation (1), which compares the weights used, namely 0.1-0.4 with the Likert scale used for each item, so that a value for each criterion weight is obtained from 0.1-0 ,4 which is used as the determination of the weight of each criterion using the if formula in Microsoft Excel $\frac{1}{5} - \frac{0.1}{0.4}$

$$a1 = \frac{0,5}{0,4} = 1,25$$

1.25 = 0.1 (Very unimportant)

2.5 = 0.2 (Not important)

3.75 = 0.3 (Important)

5 = 0.4 (Very important)

The weight of the criteria is obtained using the if formula in Microsoft Excel with the comparison logic above, namely if the average value is more than equal to 5 then the weight is 0.4. If the average value is more than equal to 3.75 then the weight is 0.3. If the average value is more than equal to 2.5 then the weight is 0.2. if the average value is more than equal to 1.25 then the weight is 0.1. then the weight value of each criterion is obtained as shown in table 5 as follows:

Table 5. then the weight value of each criterion is obtained

Criteria number	Criteria weight
1	0,3
2	0,3
3	0,2
4	0,2
5	0,3
6	0,3
7	0,3
8	0,3
9	0,2
10	0,2
11	0,2
12	0,3
13	0,2
14	0,3
15	0,2
16	0,3
17	0,3
18	0,3
19	0,2
20	0,2
21	0,2
22	0,3
23	0,3
24	0,3
25	0,3

Determine the weight of each factor

Factor weights can be determined by first finding the average value of each criterion, the results are shown in Table 6 as follows:

Table 6. Factor weights can be determined by first finding the average value of each criterion

Factor	average value criteria
Correctness	0,27
Reliability	0,24
Efficiency	0,23
Integrity	0,3
Usability	0,25

The formula used to determine the weight of each factor is the if mada microsoft excel formula with logic, if the average value of the criteria is more than equal to 0.4 then the weight is 0.4. If the average value of the metric is more than equal to 0.3 then the weight is 0.3. If the average value of the metric is more than equal to 0.2 then the weight is 0.2. If the average value of the metric is more than equal to 0.1 then the weight is 0.1. So that the weight of each fact is shown in Table 7 as follows:

factor	factor weight
Correctness	0,2
Reliability	0,2
Efficiency	0,2
Integrity	0,3
Usability	0,2

Quality factor testing

This study only focuses on production factors which consist of 5 quality factors, namely Correctness, Reliability, Efficiency, Integrity. Usability, with the overall results of the study as follows :

Correctness quality testing

Table 8. Testing the quality of Correctness

Comletness	criterion weight	average value
1. Does each sub menu in the UMP KRS feature meet the needs of students?	0,3	3,90
2. Do each sub menu in the KRS UMP feature work properly when used?	0,3	3,87
Consistency		
3. Do the appearances and table designs in the sub menus of the UMP KRS feature have anything in common?	0,2	3,70
Correctnes		
4. Does the sub menu in the KRS UMP feature have the same form and button design?	0,3	3,74
5. Is the language used in each sub menu of the UMP KRS feature consistent (not changing) on each page?	0,3	3,93

6. Does each sub menu in the UMP KRS feature have a consistent display design (color, font, layout) on every page?	0,3	4,01
7. Is each sub menu in the UMP KRS feature able to search for data (grades, schedules, list of courses, etc.) that students need?	0,3	4,03

The weights and average values for the Correctness factor are shown in Table 8, then calculations are carried out to determine the value of each criterion as follows:

Completeness = (w1.c1) + (w2.c2)

= (0,3.3,90) + (0,3.3,87)

= 1,17 + 1,16
= 2,33

Coonsistency = (w3.c3) + (w4.c4) + (w5.c5) + (w6.c6)

= (0,2.3,70) + (0,2.3,74) + (0,3.3,93) +(0,3.4,01)

= 0,74 + 0,74 + 1,17 + 1,20

= 3,85

Tracebility = (w7.c7)

= (0,3.4,03)
= 1,20

Based on the calculations on each metric and criteria above, the results obtained, completness got a value of 2.33 which means quite good, traceability got a value of 3.85 which means good, consistency got a value of 1.20 which means not good. In this case, the consistency metric needs improvements related to display design, table design, and form and button design.

Jadi nilai Fa1 diselsesaikan dengan cara :

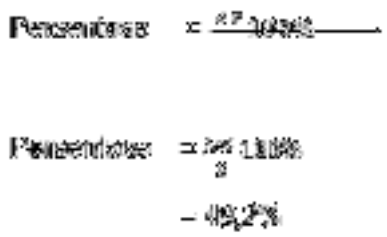
$$Fa1 = \frac{opesse + rce + osc}{3}$$

$$= \frac{2,33+3,85+1,20}{3}$$

$$= \frac{7,38}{3}$$

$$= 2,46$$

The value of factor quality is converted into a percentage using the equation:



The percentage of correctness factor quality obtained is 49% which is included in the fairly good category.

Reliability quality testing is shown in Table 9 as follows:

Table 9. Testing the quality of Reliability

Accuracy	criterion weight	average value
Is each sub menu in the UMP KRS feature able to display information and data according to student needs? reliability	0,3	3,97
Apakah setiap *sub menu* pada fitur KRSUMP memberikaninfomasi dan datayang akurat dan bebasdari kesalahan?	0,2	3,56
Error tolerance 10. Will each sub menu in the UMP KRS feature work? give an error message when the data entered by the student does not match?	0,2	3,63
11. Is the error rate that occurs in the UMP KRS feature low?	0,2	3,39
12. Will each sub menu in the UMP KRS feature work again after experiencing a system failure that occurs? caused by server down?	0,3	3,76

The weight and average value of the reliability factor is shown in Table 9, then calculations are carried out to determine the value of each criterion as follows:

Accuracy = (w8.c8) + (w9.c9)

= (0,3.3,97) + (0,2.3,56)

= 1,19 + 0,71

= 1,90

Error tolerance = (w10.c10) + (w11.c11) + (w12.c12)

= (0,2.3,63) + (0,2.3,39) + (0,3.3,76)

= 0,72 + 0,67 + 1,12

= 2,51

Based on the calculations on each metric and criteria above, the results obtained, accuracy gets a value of 1.90 which means it is not good, error tolerance gets a value of 2.51 which means it is quite good. In this case, there is a need for improvement in provide information or data that accurate and error free.
So the value of Fa2 is solved in the following way:

$$Fa2 = \frac{1,90+2,51}{2}$$

$$= \frac{4,41}{2}$$

$$= 2,205$$

The value of the quality factor is converted into a percentage using the equation :

$$Persentase = \frac{gp}{} 100\%$$

$$Persentase = \frac{2,205}{5} 100\%$$

$$= 44,1\%$$

The percentage of reliability factor quality obtained is 44.1% which is included in the fairly good category. Efficiency quality testing is shown in Table 10 as follows:

Table 10. Efficiency . quality testing

Execution efficiency	criterion weight	average value
13. Is every commands that are executed on the KRS UMP feature sub menu run quickly? Efficiency	0,2	3,68
14. Can students access the UMP KRS feature at any time? Storage Effeciency	0,3	4,01
15. Will every sub menu on the KRS UMP feature that has been accessed have its history (history) stored?	0,2	3,50

The weight and average value of the Efficiency factor are shown in Table 10, then calculations are carried out to determine the value of each criterion as follows:

Execution efficiency = (w13.c13) + (w14.c14)

= (0,2.3,68) + (0,3.4,01)

= 0,73 + 1,20

= 1,93

Storage efficiency = (w15.c15)

= (0,2.3,50)

= 0,7

Based on the calculations on each of the metrics and criteria above, the results obtained are execution efficiency 1.93 which means not good, storage efficiency 0.7 which means very not good. In this case, it is necessary to improve the level of system loading speed, and provide history on the KRS sub menu page that has been accessed.

So the Fa3 value is solved in the following way :

$$Fa3 = \frac{eco\ cec + orge\ cec}{2}$$

$$= \frac{1,93+0,7}{2}$$

$$= \frac{2,63}{2}$$

$$= 1,315$$

The factor quality value is converted in the form percentage using the equation:

$$Persentase = \frac{g\ p}{} 100\%$$

$$Persentase = \frac{1,315}{5} 100\%$$

$$= 26,3\%$$

The percentage of the efficiency factor quality of the results obtained is 26.3% which is in the bad category.

Pengujian kualitas *Integrity* ditunjukkanpada Tabel 11 sebagai berikut :

Table 11. Integrity quality test

Acces control	criterion weight	average value
Integrity are student accounts on the system protected?	0,3	3,86
17. Is the login process on the system running properly?	0,3	4,01
18. Is the logout process on the system running properly?	0,3	4,13

The weight and average value of the Integrity factor is shown in Table 4.12, then calculations are carried out to determine the value of each metric as follows:

Acces control = (w16.c16) + (w17.c17) +(w18.c18)

= (0,3.3,86) + (0,3.4,01) + (0,3.4,13)

= 1,15 + 1,20 + 1,23

= 3,58

So the value of Fa4 is solved in the following way:

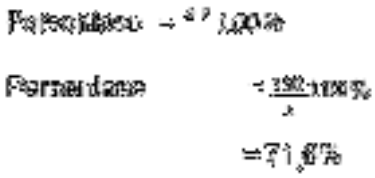
$$Fa4 = \frac{cce\ oro\ 1}{}$$

$$= \frac{3,58}{1}$$

= 3,58

Based on the calculations on each metric and criteria above, the results obtained, access control is 3.58, which means good. In this case the level of security in the UMP KRS system is good.

The value of the quality factor is converted into a percentage using the equation:

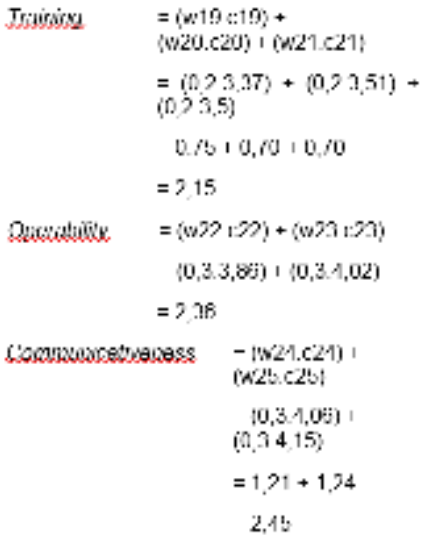


The percentage of the quality of the integrity factor obtained is 71.6% which is in the good category. Usability quality testing is shown in Table 12 as follows:

Tabel 12. Pengujian kualitas *Usability*

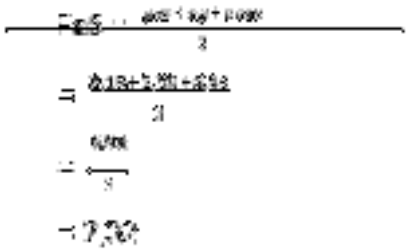
Training	criterion weight	average value
19. Is every new students, can easily operate the KRS UMP feature?	0,2	3,73
Usability		
20. Is there a user manual or help menu for each sub menu of the UMP KRS feature?	0,2	3,51
21. Is there any availability of the contact menu on the UMP KRS feature for provide suggestions, criticisms, and student complaints when using the system?	0,2	3,50
Operability		
22. Are some of the sub menus in the UMP KRS feature used very often?	0,3	3,86
23. Is each sub menu on the KRS UMP feature easy to use?	0,3	4,02
Communicativeness		
24. Is the language used in each sub menu of the UMP KRS feature easy to understand?	0,3	4,06
25. Can every text, symbol, color on each sub menu of the UMP KRS feature be clearly legible?	0,3	4,15

The weight and average value of the Usability factor is shown in Table 12, then calculations are carried out to determine the value of each metrics as follows:

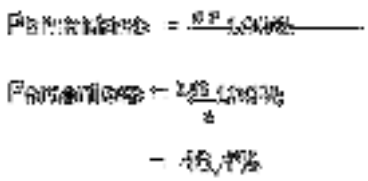


Based on the calculations on each factor and criteria above, the results obtained, training 2.15 which means quite good, operability 2.36 which means quite good, communicativeness 2.45 which means quite good. In this case, each of the resulting criteria has a pretty good score.

So the value of Fa5 is solved in the following way:



The value of the quality factor is converted into a percentage using the equation:



The percentage of usability quality factors obtained is 46.4% which is in the fairly good category.

The percentage value of functionality factor quality (average value) of all factors is calculated using the formula:

$$\sum = \left(\frac{(w1*fa1)+(w2*fa2)+(w3*fa3)+(w4*fa4)+(w5*fa5)+ \ldots\ldots wn}{5}\right) x\ 100\%$$

$$= \left(\frac{(0,2*2,46)+(0,2*2,20)+(0,2*1,32)+(0,3*3,58)+(0,2*2,32)}{5}\right) x\ 100\%$$

$$= \left(\frac{(0,492)+(0,04)+(0,264)+(1,074)+(0,464)}{5}\right) x\ 100\%$$

$$= \left(\frac{2,334}{5}\right) x\ 100\%$$

$$= 46,68\%$$

The quality of the Study Plan Card in the Academic Information System of the University of Muhammadiyah Purwokerto is in total at the level of 40% - 60% = 46.68% which is in the fairly good category. The results of the overall assessment of the quality of the University of Muhammadiyah Purwokerto Study Plan Card based on product operation factors with 5 quality factors according to McCall's theory are shown in Table 4.14 as follows:

Conclusion

Based on the research that has been done on the Study Plan Card feature of the University of Muhammadiyah Purwokerto using McCall's Quality theory by focusing on the product operation factor with 5 quality factors and 11 metrics used, the conclusions obtained are: (i) On the quality factor Correctness obtained a percentage

of 49.2% who entered in the pretty good category. Some things that need to be improved is the design the appearance and design of tables as well as the design of forms and buttons on each sub menu of the UMP KRS feature to be consistent (have in common). (ii) In the Reliability quality factor, 44.1% is obtained which is included in the fairly good category. Some things that need to be improved are so that every data and information displayed is accurate and free from errors, giving an error message if the input data does not match.

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