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| RESEARCH ARTICLE

Mathematical Performance Assessment Instrument at SMK Mega Link Majene, Indonesia

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| ABSTRACT
One of the stages of assessing skills in mathematics is using a performance appraisal instrument, scoring guidelines, and analyzing the quality of the instrument. Mathematical performance assessment tests are carried out through practical methods to assess the learning process on matrix material. This research develops a math performance assessment test on maple application skills, especially on matrix material. The performance assessment test includes using the maple application to understand concepts and solving matrix problems that are carried out before and during the process of practical activities using the maple application. Based on the results of the research analysis obtained, aspects of how to open maple applications in general, there are few mistakes made by students. They include the use of pallets, typing directly, the use of linalg without mistakes, the use of the evaluatem command without, and the correctness of the work.

| KEYWORDS

Performance appraisal test, Maple, Math skills

| ARTICLE INFORMATION

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1. Introduction

Aspects of assessment at the elementary and secondary education levels include (1) attitude aspects, aiming to obtain descriptive information related to student attitudes or behavior, (2) knowledge aspects, aiming to measure students' level of mastery of knowledge; and (3) skills aspects, aiming to measure students' ability to implement the knowledge they have acquired to solve a problem. Of the three aspects that have been stated, the skill aspect does not get the teacher's attention, even though students in the assessment process need an authentic assessment.

In Indonesia, students' mathematics learning outcomes are still relatively low. This is based on the Program for International Student Assessment (PISA) test results which are presented in detail in the following graph.

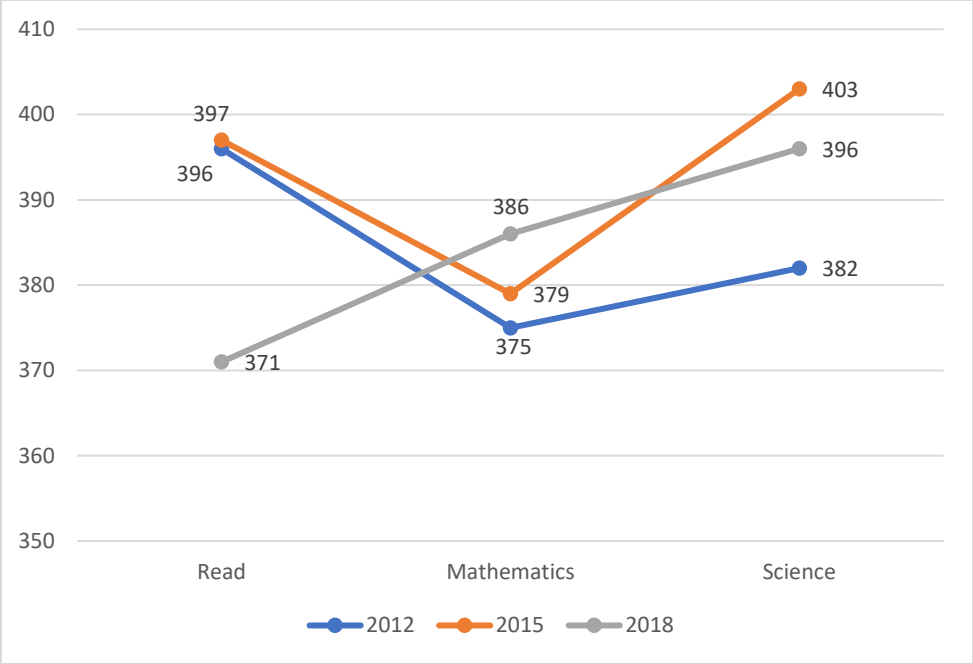

Figure 1. Indonesia's PISA scores for 2012, 2015 and 2018

Figure 1 shows that the average score for reading mathematics, mathematics and science is still below the OECD average score. This is very concerning for the Indonesian people. One of the recommendations is that information and communication technology (ICT) optimization must be utilized for more effective learning.

The results of observations made at Mega Link Majene Vocational School on the subject of mathematics revealed that it does not maximize the assessment of student skills, even though SMK students will be more easily directed to practice mathematics because the characteristics of SMK students are practice-based learning. Therefore, the steps that can be taken in developing mathematical performance assessment instruments are utilizing ICT, one of which is the application of maple. The use of maple applications in learning is expected to help teachers develop students' competency skills in mastering performance appraisal processes and products.

Maple is a mathematical application combining numerical and symbolic computing abilities, visualization (graphics) and programming. Research has been carried out by Fissore et al. (2020), stating that the maple application can help solve complex math problems because it has simple commands and language that is easy to understand. Therefore, students can analyze the results of maple output in solving math problems so that student learning outcomes in mathematics have increased.

Another study conducted by Lockwood, DeJarette, and Thomas (2019) found that using computers in learning mathematics is a practice desired by students. While teachers use computers in learning mathematics, there are still many things that can be explored. Therefore, research related to the use of ICT in mathematics learning is still very interesting to study, especially in developing students' skills in learning practical mathematics.

Based on what has been stated, the researcher is interested in conducting research by developing an instrument for assessing students' mathematical performance on skills in using maple applications in matrix material at SMK Mega Link Majene.

2. Literature Review

2.1 Mathematical Skills

There are three assessment areas of learning outcomes in educational units: attitudes, knowledge, and skills. The 2016 Permendikbud concerning assessment standards states that skills assessment is an activity carried out to measure students' ability to apply knowledge in certain tasks. Skills assessment has 5 stages, detailed in Figure 2 below.

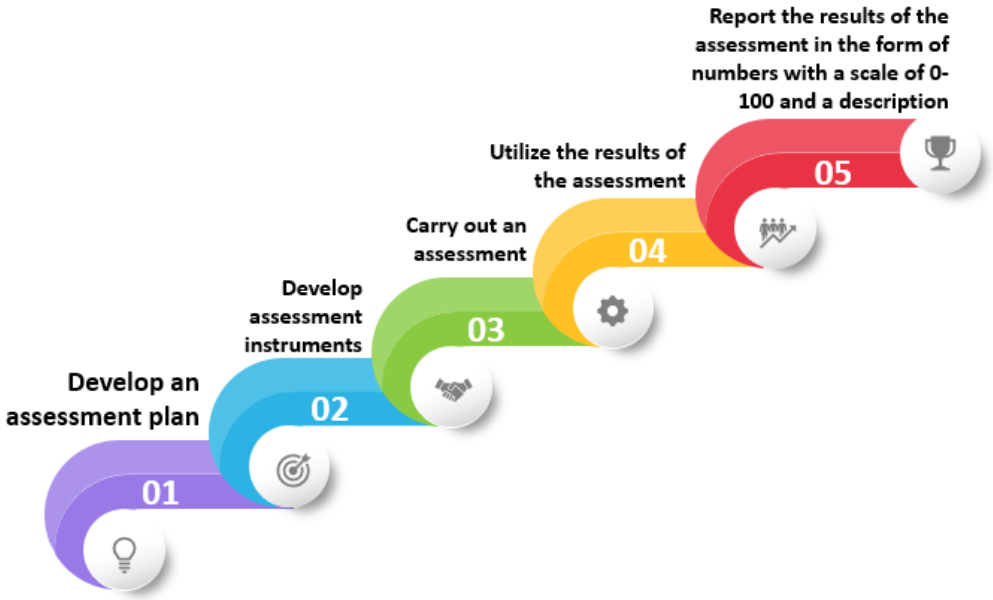

Figure 2. Stages of Skills Assessment

While the procedure for assessing the learning process and learning outcomes by students is carried out in the order described in detail in Figure 3 below.

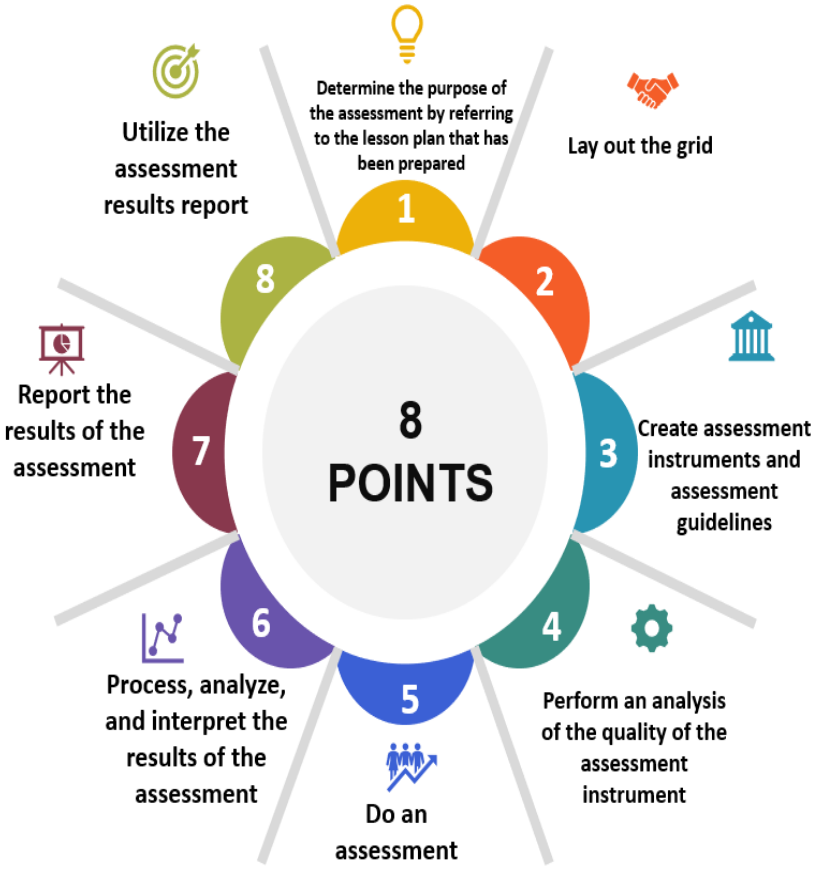

Figure 3. Process Assessment Procedures and Learning Outcomes

In 1966, Simpson began to develop skill abilities and, in 1972, conveyed seven main categories for psychomotor abilities from the simplest to the most complex, namely (1) perception, (2) readiness, (3) imitating, (4) familiarizing, (5) proficient, (6) natural, and (7) original. Apart from Simpson, in 1970, Dave also studied psychomotor abilities. Dave divides motor skills into 5 levels that reflect the ability to perform a skill. The five levels are (1) imitating, (2) manipulating, (3) precision, (4) articulation, and (5) naturalization (Nakata: 2011, Hoque: 2016, Mishra, Barrans, Pislaru: 2009, and Salas-Pilco: 2020).
The level of the psychomotor ability category from Simpson and Dave is proven to be used to measure the level of achievement of students' abilities as a result of learning in the psychomotor domain. Abstract skills, such as writing, reading, counting, drawing, and composing in language, society, and religion, involve less physical, motor, and kinesthetic and involve more abstraction, innovation, and creativity. In addition to concrete skills, experts develop abstract skills. Abstract skills were developed by Jeffrey H. Dyer, Hal Gregersen, and Clayton M. Christensen and are known as Dyer's taxonomy, including Associating, Questioning, Observing, experimenting, and Networking. (Usher, Barak, and Haick: 2021). (Morad, Ragonis, and Barak: 2021).

2.2 Maple Application

Maple is known as computer algebra, keyboard and screen replacing the traditional pencil and paper mathematical calculations. Interactive computer programs, called algebraic computer systems, make it possible to calculate not only with numbers but also with symbols, formulas, equations, and so on. Many mathematical calculations, such as differentiation, integration, expansion series functions, and matrix inversions with symbolic entries, can be performed quickly, emphasising precise results and without much human effort (Heck: 2003). The results of research conducted by Barana and Marchisio (2016) revealed that maple is able to recognize all mathematical formulas in all their equivalent forms.

Mathematical performance assessment tests on maple application skills, especially on matrix material, are carried out through practical methods to assess learning processes and final products. In the practical assessment of using the maple application, the process performance assessment includes using the maple application to understand concepts and solve matrix problems that are carried out before and during the process of practical activities and assessing the performance of the final product, namely the product after the practice of using maple applications on the matrix material. There are several ways to write matrices in maple, including using pallets and typing directly at the prompt.

2.3 Performance Appraisal Instrument

The performance appraisal instrument in this study is an evaluation tool to measure the capability of processes and products carried out in practical activities using maple applications on matrix material. In preparing the performance assessment instrument, it is equipped with an assessment rubric which is the benchmark for assessing the quality of students' mathematical performance in carrying out practicums using the maple application on matrix material. The results of observations during practice, both from process performance and product performance, form the basis for assessing students' skills in using maple applications on matrix material.

Research conducted by Yang and Li (2018) describes the importance of measuring student performance, student progress and student potential in learning activities. So that teachers can find out how students are performing, what factors will affect student performance, in what ways students can make progress, and whether students have the potential to perform better. In line with Oberg's research (2009), a performance appraisal instrument is needed because it authentically assesses students' abilities, skills, knowledge, and interests. Therefore, the performance appraisal instrument is an important instrument for evaluating learning.

3. Methodology

3.1 Types of research

This research used the research and development (Research and Development) model of Dick and Carey through the stages of the Mc. Kenney cycle. The following is the figure 4 research flowchart.

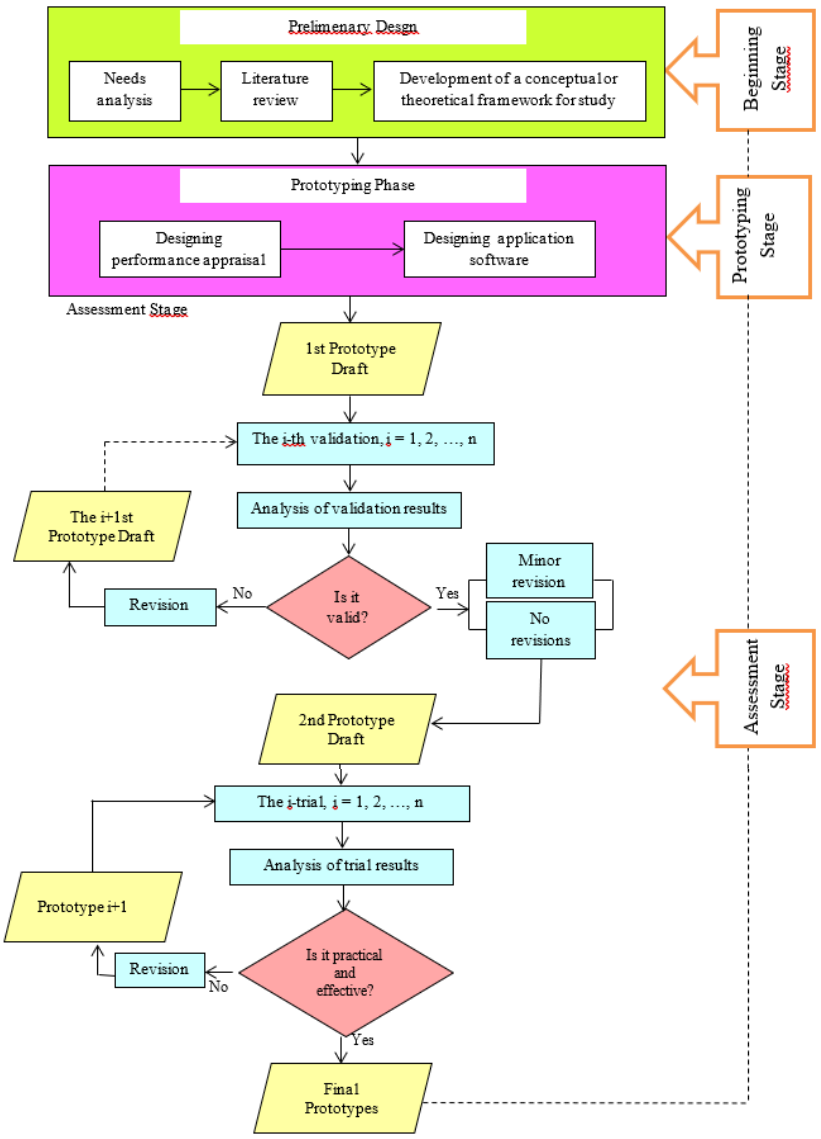

Figure 4. Research Flowchart

Based on figure 4. The stages of this study were (1) needs analysis to produce a prototype for the development of students' mathematical performance assessment instruments on the skills of using the maple application on matrix material, (2) testing the validity of the prototype for developing students' mathematical performance assessment instruments on skills using maple applications on matrix material, and (3) trials to see the practicality and effectiveness of developing instruments for assessing students' mathematical performance on the skills of using maple applications on matrix material.

3.2 Research subject

The subjects in this study were 31 students at SMK Mega Link Majene, consisting of 9 boys and 22 girls.

3.3 Research instruments

The research instruments are (1) performance tests to measure students' skills in practice using applications on matrix material. (2) the teacher's observation sheet to observe the practice of applying maple applications. (3) student observation sheets to observe student activities during the practical process of using the maple application (4) student response questionnaires; Response questionnaire to the process of using the application practice.

3.4 Data collection technique

The data collected in this study are (1) quantitative data from expert validation results, the Dissemination of prototypes for the development of mathematical performance assessment instruments for the skills of using maple applications on matrix material

that has been designed is carried out to several experts (validators). (2) quantitative data on skills assessment results through performance appraisal tests; given before and after the practice of using maple applications on matrix materials. (3) qualitative data on student activities; using the observation sheet. (4) qualitative data on learning management; using the observation sheet. (5) quantitative data on student responses; using a questionnaire and given at the end of the lesson.

3.5 Data analysis technique

1. Analysis of the validity of the development of a mathematical performance assessment instrument for the skills of using maple applications in the matrix material.
2. Analysis of the practicality of the development of a mathematical performance assessment instrument for skills in using maple applications in the matrix material.
3. Data analysis on the effectiveness of the development of a math performance assessment instrument on skills in using maple applications in the matrix material.

The analysis of effectiveness includes 3 components of effectiveness:

a. The performance appraisal test uses a range scale. It consists of 6 aspects of the assessment, namely how to open the maple application, how to use pallets, how to type directly, how to use linalg, how to use the evalm command, and the correctness of work results.

Table 1. Levels of the Mathematics Performance Test Rubric

No.	Levels	Criteria	Score
1.	Level 4	Superior	$80 < S \leq 100$
2.	Level 3	Skilled	$70 < S \leq 80$
3.	Level 2	Skilled Enough	$60 < S \leq 70$
4.	Level 1	Less Skilled	$50 < S \leq 60$
5.	Level 0	Unskilled	$0 \leq S \leq 50$

b. Student response data, the criteria set are a minimum of 50% of students giving a positive response to a minimum of 70% of the number of question/statement items in each aspect.
c. Student activity, the criterion used is the minimum value of student activity in the "active" category.

4. Results and Discussion

4.1 Results

Stage 1: preliminary design

A needs analysis was carried out on the math skills of SMK Mega Link Majene students, resulting in theoretical studies related to performance tests, applications to develop students' math skills, material selection, and student grade levels.

Stage 2: prototyping.

This stage produces a prototype performance test instrument using maple applications, performance assessment rubrics, teaching materials in the form of maple application modules for students, observation sheets, and student response questionnaires.

Stage 3: assessment

The prototype that has been produced in stage 2 is then validated. The following is the average value of V from V1 (first validator) and V2 (second validator).

Table 2. Instrument Validation Analysis

Validator	Performance test	Performance appraisal rubric	Module	Student observation sheet	Teacher observation sheet	Question naire
V.1	3,5	3,65	3,5	3,65	3,55	3,75
V.2	3,8	3,85	3,75	3,75	3,65	3,85
Instrument Validation Analysis V	3,65	3,75	3,625	3,7	3,6	3,8
Criteria	valid	valid	valid	valid	valid	very valid

Based on the validation results, it was obtained that the draft prototype was feasible to try out in class X students of SMK Mega Link Majene. Analysis of the trial results obtained:

1. Practical

A qualitative analysis of the assessment results from observers observing the teacher's ability to manage the practice of using maple applications has been carried out. The observer makes observations at each meeting and determines the average value of the teacher's activities. The analysis results show that teachers managing maple learning practices are in the "high" category.

2. Effective
   a. Performance test analysis

   The results of the analysis of the mathematics performance tests of SMK Mega Link Majene students using the maple application are presented in the following table.

Table 3. Assessment of Mathematical Performance in Using the Maple Application

Subject	How to open maple apps	How to use pallets	Direct typing	How to use linalg	How to use the evalm command	The truth of the work	achieved score	Score
1.	3	4	3	3	3	3	19	79
2.	4	4	3	3	3	4	21	88
3.	3	3	3	2	2	2	15	63
4.	3	3	3	3	3	3	18	75
5.	4	4	4	4	4	4	24	100
6.	4	4	4	4	3	3	22	92
7.	3	3	3	2	3	3	17	71
8.	3	3	3	3	4	4	20	83
9.	3	2	3	2	3	3	16	67
10.	4	3	4	3	3	3	20	83
11.	4	3	3	2	3	3	18	75
12.	4	3	3	3	3	3	19	79
13.	4	3	4	3	3	4	21	88
14.	4	3	3	3	3	3	19	79
15.	4	2	3	2	2	3	16	67
16.	4	3	3	3	3	4	20	83
17.	3	3	3	3	3	3	18	75
18.	3	3	4	4	4	4	22	92
19.	4	4	4	4	4	4	24	100
20.	4	4	3	3	3	3	20	83
21.	3	3	3	3	3	3	18	75
22.	3	3	3	2	3	3	17	71
23.	3	3	3	2	2	3	16	67
24.	4	4	4	3	3	4	22	92
25.	3	3	4	4	3	3	20	83
26.	3	4	4	3	3	3	20	83
27.	4	4	3	3	3	4	21	88
28.	4	4	4	4	4	4	24	100
29.	4	4	3	3	3	3	20	83
30.	3	3	3	2	2	2	15	63
31.	3	3	3	3	3	3	18	75

Based on table 3, the results of descriptive statistical analysis were obtained.

Table 4 Performance Appraisal Statistical Data

Statistics	Score
Average value	81
Maximum	100
Minimum	63
Variance	109
Standard deviation	10
Median	83
Mode	83

Based on table 4, the average score of students' skills is 81. This shows that most students exceed the minimum completeness criterion score of 70.

b. Questionnaire analysis
The student response questionnaire analysis results showed a very positive response, with an average value of 95%.

c. Observation sheet analysis
The analysis results of the student activity observation sheet analysis are in the active category. This finding is in line with several researchers, namely Latif et al. (2021) and Ahmad et al. (2021), who use applications as learning media; in general, students are more enthusiastic in responding to learning mathematics.

4.2 ***Discussion***

The results of developing the instruments used in this study were performance tests, scoring rubrics, maple application modules, and observation sheets that met the validity criteria. The instruments are feasible for trials on 31 students of SMK Mega Link Majene. The development carried out refers to the Dick and Carey model through the McKenney cycle. This shows that it is important for researchers to test the validity before conducting trials. The results of research conducted by Maryuningsih et al. (2020), Wulandari et al. (2019) and Hodges et al. (2021) showed that the initial steps in research are to conduct analysis, design, development implementation, and evaluation, which aims to test the validity of the instrument to be used.

The results of the analysis of performance tests on matrix material assisted by the maple application showed an average score of 81 students' skills above the standard score of 70. This shows that the average student's performance test assessment made a few mistakes in the performance assessment process. The performance appraisal score is a score of 4 with no errors, a score of 3 has few errors, a score of 2 has many errors, and a score of 1 does not make.

One of the studies conducted by Ahmad et al. (2018) found the findings of an analysis of student errors when working on questions, namely that students made the most mistakes in mathematical calculation procedures. This shows that students do not fully understand the concept.

The results of the analysis of the mathematics performance tests of SMK Mega Link Majene students show progress at each meeting. The researcher introduced the application of maple, a symbolic and numerical computing computer program, as well as a multi-paradigm programming language, to students. At the first meeting, the researcher instructed the students to install the maple application on their respective computers. In the second meeting, the researcher showed how to solve the matrix by using pallets and typing directly. In this meeting, students worked on questions based on the performance tests that had been divided by the researcher. In the third meeting, the researcher taught students to use the linalg and evalm commands in completing matrix operations.

The results show that the average student has an increase in skills in using the maple application. This is in line with Simpson's theory. Apart from Simpson, in 1970, Dave also studied psychomotor abilities. Dave divides motor skills into 5 levels that reflect the ability to perform a skill. The five levels are (1) imitation, (2) manipulation, (3) precision, (4) articulation, and (5) naturalization (Nakata: 2011, Hoque: 2016, Mishra, Barrans, Pislaru: 2009, dan Salas-Pilco: 2020). Student skills, from the simplest to the most complex, are (1) perception, (2) readiness, (3) imitating, (4) getting used to, (5) being proficient, (6) natural, and (7) original.

5. Conclusion

Using a performance appraisal instrument, scoring guidelines, and analyzing the instrument quality are considered important stages of assessing skills in mathematics. Mathematical performance assessment tests are carried out through practical methods to assess the learning process on matrix material. This research develops a math performance assessment test on maple application

skills, especially on matrix material. The performance assessment test includes using the maple application to understand concepts and solving matrix problems that are carried out before and during the process of practical activities using the maple application. Based on the results of the research analysis obtained, aspects of how to open maple applications in general, there are few mistakes made by students. They include the use of pallets, typing directly, the use of linalg without mistakes, the use of the evaluatem command without, and the correctness of the work.

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