Analysis of the ability of junior high school students’ performance in science in STEM project-based learning

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Abstract. The challenges in 21st century demands the high competitiveness. The way of thinking ability, determine how it work ability and choose instrument be part of the skills will need in the 21st century. The competence it can be supported by learning involving the student performance skills. Based on the preliminary studies at one junior high school in Bandung found that the learning involving of performance skill is low. This is supported by data from respondent in received the opportunity to make devise a sketch in of learning especially based on practices or projects, the results are 75% students said rarely and 18.75% students said never. In addition seen also how the student activities in project based learning in class the results stated that 68.75% of students said less, and 6.25% of students said never. Therefore, we did a result to uncover profile performance on the design process and the performance process of junior high school student performances to the matter optical by using STEM project based learning. From this result. From the research obtained the average score classes in the activities of the design process is as much as 2.49 or dipersentasikan become 62.41 % are in the good category and the average score classes in the process of the performance of activities receive is 3.13 or 78.28 % are in the good category.

1. Introduction
Along with the fast development of science and technology in the 21st century, the global competition become increasingly. The ability to form a younger generation that has integrity in the face of the challenge era. Binkley et al [1] reveals the ten skills required in the 21st century have been identified into four groups namely the way of thinking, way of work, tools for working, and living in the world. In 2020-2035 Indonesia could potentially have population of productive opportunities ranged from 70%, it presents its own challenges for Indonesia to prepare a generation that have competitiveness especially against the challenges of the 21st century.

This research begins with a preliminary study to see the carried out of learning which involves the performance of students at a junior high school in the city of Bandung. Retrieved data that 75% of respondents (students) States rarely and 18.75% answered never had the opportunity to make design drawings/sketches in particular learning based practice/projects. 68.75% of the respondents stated rarely and 6.25% of other respondents answer has never had the opportunity to conduct project-based learning. It indicated that the learning process which involves the performance of the students is still low. The purpose of this research is to know the profile of the junior high school student performance through project-based learning in the STEM. The performance is divided in two stages, namely the activities design process and performance process and then the acquisition of this profile submitted as
information or an overview for educators or educational unit to determine alternatives learning science (Physics). One of the competencies emphasized at the national curriculum is a psychomotor competence. These competencies can be guided through the process of learning activities that involve the ability of student performance.

The performance is an achievement of certain jobs which eventually can directly reflected from the resulting output. The resulting output in the form of physical. The performance as the quality and quantity of the achievement of the tasks, whether committed by individuals, groups or institutions/organizations.

The graduates of the STEM will have skills in finding solutions to problem solving in the real world, any STEM graduates had a global competitiveness and economic vitality of a nation. Therefore this STEM-based learning can be one of the alternatives in order to answer the challenges of the 21st century. Through project-based learning are expected to STEM the formation of students who have skills in particular the ability of good performance [2], [3].

William. D wrote that STEM is an integration of science, technology, engineering and mathematics into an interdisciplinary subjects in all schools [4]. STEM (Science, Technology, Engineering STEM is learning approach that builds the students not only reliable in theory but how to apply the theory to solve the problem. The approach provided through learning is the learning approach STEM focus on finesse and skill in learning any material in schools that will be owned by the learners. STEM graduates will have the skills to find solutions to problem solving in the real world, any STEM graduates had a global competitiveness and economic vitality of a nation. Furthermore, Bybee defined the approach STEM is one way to unify science and engineering as well as a combination of strategies and the implementation of the formation of concepts and the application of the idea of the learning of science [5].

2. Methods
The methods used in this research is the pre-experimental design in order to know the effect of a variable against another variable in the absence of a control variable. As for the design used in this study i.e. One-Shot Case Study design. This design gives preferential treatment in a group and subsequently observed. This research was conducted at the junior high school students are subjected to a junior high school in the city of Bandung.

3. Results and Discussion
In this chapter will be displayed on the profile of students capabilities performance obtained as a result of project-based learning in the STEM. Process performance is carried out consists of two stages of the process activities, that the design process and the performance process. In the implementation of its own students are divided into eight working groups.

3.1. The activities of the design process
The activities of the design process is the process of disclosure of ideas in order to find a solution to the problem as well as the creation of design/image intelligently designed to be realized. The activities of the design process consists of seven aspects of the assessment.
Based on the above figure can be seen that at this stage the students poured into his ideas and media student worksheet. On the student worksheet is given a problem. To solve the problem the student must connect with the knowledge they already have before. Once students find troubleshooting students then determine what tools/technologies that are suitable to use. Then students create design tools that complemented the scale, tools and materials, as well as the steps/processes work to make technology simple.

The design has been made then were assessed through a process of scoring which refers to sections on a scale of 1 to 4. The judgment awarded against seven aspects have been defined and created assessment rubrics. As for the results obtained for activities design process is as table 1:

### Table 1. Activity design process

| Class score | Scoring design process |
|-------------|------------------------|
|             | Aspect 1 | Aspect 2 | Aspect 3 | Aspect 4 | Aspect 5 | Aspect 6 | Aspect 7 |
| Total       | 106      | 121      | 87       | 75       | 79       | 65       | 66       |
| Average     | 3.03     | 3.46     | 2.48     | 2.14     | 2.26     | 1.86     | 1.88     |
| Percentage (%) | 75.75 | 86.5     | 62       | 53.5     | 56.5     | 46.5     | 47       |
| category    | good     | Very good| good     | enough   | enough   | enough   | enough   |

**Note:**
- Aspect 1: the selection of the solution of the problem
- Aspect 2: Image formation of shadow magnification
- Aspect 3: whole Design microscope
- Aspect 4: part design microscope (the top and bottom of the lens holder, part shifts and/or lock section)
- Aspect 5: material selection
- Aspect 6: the selection of tools and machining process
- Aspects 7: Scale part of design microscope

### 3.2. The Activity Performance Process

Activity performance process is the ability in the preparation phase of the project, the implementation of the project and the product. This activity starts from realization of idea that have been made on the design sheet and then poured into the patterns on these products will be used. After completion of the
pattern-making process then the pattern on the material assembled to be intact for products then conducted trials. The activities of the performance process is measured using methods of checklist sheet with reference to the rubric has been made. Process performance is divided into three stages of activity they are the preparation phase and stage of manufacture are assessed during the process of implementation of the third phase is in progress and be scoring against products made after the finished product created. As for the scoring at this stage of the process of this performance made against eleven aspects of tang’s assessment was compiled. The distributed aspect eleventh become two aspects of the stages of preparations, five aspects at this stage of implementation and the four aspects of the scoring product.

![Pattern-Making Process Image](image)

**Figure 2. Example for product (design realization)**

The assessment process has given at the stage of activity performance process undertaken against eleven aspects which are divided into three sub activities. As for the profile at this stage are as follows.

| Class score | Planning | Making | Product | Total |
|-------------|----------|--------|---------|-------|
| total       | 107      | 111.8  | 108.25  | 109.64|
| average     | 3.06     | 3.19   | 3.09    | 3.13  |
| percentage (%) | 76.50   | 79.75  | 77.25   | 78.25 |
| category    | Good     | Good   | Good    | Good  |

3.3. **Comparison of the score and the score design process performance**
The value of the activities of the design process and the process of performance that have been described previously is the accumulated value of the group in a class which is then averaged. As for the comparison of the score based on the score obtained on the design process and the activities of the process performance of each group can be seen in figure 3.
Figure 3. Comparison of the score and the score design process performance

Based on the graph can be seen that the tendency of the average score in each group on the process performance is higher than the average score obtained on the activities of the design process.

3.4. Other findings

Other related findings comparisons between performances on the design process of the performance is the proportionality constant between designs that have been made against the results of the products realized. Based on the resulting output there is a link between the designs of the product are divided into two types. As for the findings shown through pictures and following exposure.

The figure 2 is the figure type 1. Type 1 is a type of product that was made in accordance with a design that had been designed before. On the image to see that product made to approach or similar with a design that have been drawn previously. In addition the agency like the shape of the actual microscope.

Figure 4. Example for product type 2

Figure 5 is a type 2 product which shows the realization of design into products with the addition of components and modification. Design of a simple microscope that originally only formed beam modified into a simple microscope technology forms that resemble the body of the car, namely the existence of the use of two pairs of wheels are mechanically function as sliders to lever House objective lens and ocular lens. Body products handcrafted microscopes are not formed like the shape of the microscope is actually just a principle it works just appropriating.
4. Conclusion

Based on the results of research that has been done regarding the profile of performance grade VIII in project-based learning in the STEM, obtained the overall student performance profiles are indicated by the average score on the activity as: (1) On the activities of the design process are obtained an average score of 2.49 or if in percentage is 62.41% entering on the category either. The average score is the interpretation of the students’ ability in seven aspects that include product capabilities against categories on every aspect involved in the activities of the design process. The aspects of the product solutions that provided students in accordance with the background of the issue and the underlying reasons. The image accompanied the formation of the shadow line but was not accompanied by images of objects and images/eye position. The design of the body of the microscope is drawn in its entirety, include the appearance of the inside of a microscope. Designs made show the top lens holder and lens holder under a microscope but does not show the identity and size. Less appropriate material selection (to be made into less powerful components forming the body of the microscope), but the reason argumentative material selection. The selected instruments mentioned course. The selected tool in accordance with the material being processed. Unspecified machining process. Students make design part of the stretch of the microscope with a network that carries the exact scale of the appointment but had included shooting the folds and include the size of the sheath of the microscope that shows the distance between the two lenses which allows for both lenses are working optimally. (2) On activity performance process score an average grade of 3.13 or 78.28% which also includes a category of good. The average score is the interpretation of the students’ ability on eleven aspects that include product capabilities against categories on every aspect involved in the activities of the process performance. The aspects of the product is the planning stages students complete (design, note the work as well as tools and materials) and the existence of the discussion before you start making. Students contribute/help to prepare the proper tools and materials but do not know which tool should be held/used for the work. Students to draw a sketch with refers to a design that has been made, the scale is adjusted with the design but didn’t use the right tools. Students cut duplex (other material) using the appropriate tool (scissors/cutter, ruler, etc.), the pieces fit the lines of the sketch (except the presence of improvisation), working but not working at/help colleagues. Students are able to fold the pieces of the sketches corresponds to a line of pieces that have been made (except for the presence of improvisation). Cooperate in doing creases but not using the tools in the fold (ruler or otherwise). The part that made it suitable for spliced. Students are able to make the lens holder that can be gripped lenses. The placement of the cradle right lens (not tilted/deviated) but a little resiliency lens blocking the view of the direction of the eye to the object. Students are able to use the tools and materials are arranged, not playing around when his own tool that endanger safety, work place clean and work structurized. Students are able to make the body of the microscope. The body section of the microscope gives space to place the lens holder in the body of the microscope and allows for mounting the lens moves up and down with but less so smoothly. Shift lenses made students less smoothly, cradle the lens on the microscope accompanied the shift lock. Locker not blocking rays of shadow. Lens holder is made with precision (the lens is not easy or shifted). Point of view less appropriate microscope (No straight but still can capture objects). Holder made the right lens position (which was made into an objective and which ones made the ocular lens). The body of a strong microscope/not easy to lose. The microscope was given additional support tools or decoration but the presence of these support tools/decorations bit disturbing work system/the function of microscope.

Based on the above case showed that the ability of the student's performance is already good. In addition to the aforementioned conclusions also pointed out that the capabilities of the performance of pupils on the activities of the higher-performance processes compared to a describing design process activities have been discussed in the previous chapter.

5. References

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