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The Analysis of Prospective Physic Teacher Ability in Planning of STEM Approach Learning

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Abstract:

This study aims to describe the ability of prospective physic teachers in planning learning with the STEM approach. This capability is determined through the lesson plan analysis that has developed. Each lesson plan that has been developed is then analyzed and given a score in accordance with the rubric of assessment, then the data is analyzed through a quantitative approach. Based on the data it can be concluded that in general the ability to plan STEM learning for students who are physics teacher candidates is still dominated by students with low and moderate levels. There are 9 students who are ready to implement STEM learning or around 25%. In addition, it can also be concluded that the ability to plan student STEM learning, in general, is dominated in the Explanation stage and Exploration stage in the medium category. The lowest score obtained by the Evaluation stage and Elaboration stage with an average score of 1.69 and 2.5 respectively. Improvement of STEM pedagogical skills is needed to ensure an increase in the quality of education in general and prepare quality human resources in the future. The enhancement of STEM's pedagogical skills can be done through integrated learning, special training, and encouraging students to be actively involved in scientific communities.

***Keywords**: Prospective Physic Teacher, STEM Approach*

1. Preliminary

Science and Mathematics is one of the compulsory subjects in Indonesia. This course starts from elementary school to high school education [1][2][3]. This is because these subjects are very closely related to daily life as well as the basis of technological development. In this case, the frontline in education to form humans who are ready to compete are teachers or prospective teachers, especially in the field of physics. Prospective physic teachers in Indonesia have a difficult task because they must be able to prepare

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their students to face the challenges of the current industrial revolution. Furthermore, the development of the industry when making competition in the world in various aspects is very strict [4][5][6]. The digital and industrial revolution's effect has, certainly, has been significant in almost entirely parts of humanity, lifecycle, companies, and service [7]. The biggest challenge of people is to take advantage of available technology, provide great prospects to service or make new products, and enormous efficiency developments although circumventing hazards and difficulties in improved redundancy and bigger affluence rapports. Indirectly, almost all aspects of human life today are always associated with science, technology, engineering, and mathematics or what we often hear as STEM [8][9][10][11].

Currently, the STEM employment in Indonesia is really still in the concept and still lack of the study outcome that demonstrates if some positive effects can be demonstrated by STEM in enhancing student success or the students' understanding from level cumulative about STEM [12][13]. In this case, it was revealed that there was a paradigm that became the basis in developing the 2013 curriculum in Indonesia by changing the mono-pattern to become a multi-pattern in discipline field. This paradigm shows that the 2013 curriculum has some room to be able to instill STEM in its education system. Moreover, in the structure and contents of the 2013 curriculum at the secondary school level, science and mathematics can be the best subjects for implementing STEM education. The subject is one of the subjects that is considered at the secondary school level and is considered as a basis for increasing innovation in the field of technology, even further in economic terms. Instilling STEM education in students in Indonesia is something new because there is a need for efforts to make STEM learning alternative learning to meet current needs.

STEM as an approach in learning has many benefits, including encouraging students to have a scientific attitude, think critically, and creatively [14][15][16][17]. In addition, STEM learning is also able to improve student learning outcomes and be able to solve problems in everyday life [18][19]. Thus, it can be understood that learning with the STEM approach has many advantages for students. Through STEM learning, students will be trained and supported to develop their full potential optimally.

As an approach to learning, STEM is one of the innovations in learning [20]. The innovation of this learning approach is still new and still very interesting to discuss and debate. Because this learning approach is still relatively new so it is still not the teacher and student-teacher candidates who know, understand, and implement STEM-based learning. However, when learning with the STEM approach is developing rapidly and becomes a framework for learning innovation.

In implementing its learning, STEM can be implemented in a number of integration patterns, namely the silo model, which emphasizes opportunities for students to gain knowledge rather than technical skills. The embedded model, which is a learning process that emphasizes the mastery of real-world based knowledge (contextual) and integrated models, which emphasizes the merging of STEM subjects into one in an integrated manner [21][22]. In the

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implementation of STEM, it is carried out in stages, namely: 1) Arrangement Stage, aims to determine students' initial abilities and readiness in learning; 2) Exploration stage, aims to provide opportunities for students to explore, observe and record results (data collection); 3) explanation stage, aims to explain the concepts being studied; 4) Elaboration stage, aims to provide opportunities for students to be able to use their knowledge in different situations and expand their conceptual understanding, and; 5) Evaluation stage, to see the extent to which students master the concepts that have been learned through a test of learning outcomes [23]. These stages can be implemented in learning.

One important factor for the successful implementation of an approach or learning model is the learning plan. That's because the learning plan is a teacher's guide to achieving learning goals [24][25]. The better the learning plan prepared by the teacher will impact the implementation of learning will also be close to perfection. Therefore, the success of teachers and prospective teachers in implementing STEM learning can also be seen based on the learning plans that they have prepared. Thus, the main objective of the study is to describe the ability of prospective physic teachers in planning learning with the STEM approach during the process of field practice (PPL) that they will go through.

2. Research Methods

This study uses a quantitative approach with respondents being the seventh-semester totaling 36 prospective physic teachers. The prospective physic teachers are asked to develop a learning plan that they will use during the PPL process. Then, each prospective physic teacher is asked to develop three learning plans using different approaches or models. The last, three lesson plans will be collected and analyzed.

Learning plans that have been collected by prospective physic teachers are then analyzed and assessed using an assessment rubric. The rating rubric has a range of grades 1-5, point 5 (very good), point 4 (good), point 3 (moderate), point 2 (less), and point 1 (very less). The assessment is carried out on all aspects of the STEM learning stages, namely: 1) The arrangement Stage; 2) The exploration stage; 3) The explanation stage; 4) The elaboration stage, and; 5) The evaluation stage. The score used as the basis for decision making is the average score of the three learning plans that have been developed by prospective physic teachers. Thus, the maximum score for each learning plan developed is 25 points and the minimum score is 5 points. Based on the scores obtained, then categorized into three categories to see the readiness of prospective physics teacher students to carry out STEM learning. As for the analysis of the STEM learning aspects, it is based on the maximum score obtained by each aspect. As already mentioned, each aspect has a maximum score of 5 points and the lowest score is 1 point. Based on the scores obtained, then grouped into low groups (score 1-1.7), moderate groups (1.8-3.36) and high groups (3.0-5) can be seen in Table 1.

Table 1. Interpretation of the score category

No	Score Range	category	Interpretation

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1	17-25	High	good and ready
2	9-17	Moderate	lacking and not ready
3	1-8	Low	not good and not ready

3.Results and Discussion

3.1. Research result

Table 2. Categorization of the ability of prospective physics teacher to plan STEM

No	Score Range	Students Number	Percentages (%)	category
1	17-25	9	25,00	High
2	9-17	13	36,11	Moderate
3	1-8	14	38,88	Low
	Total	36	100	

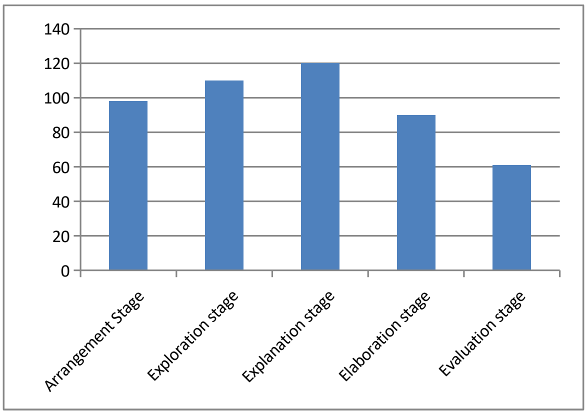
Based on Table 2 above, it can be seen that in general the ability to plan STEM learning for prospective physics teacher students is still dominated by students with a Low level of 38.88%, then students with moderate category abilities are 36.11%. While there are 9 students who are ready to implement STEM learning or around 25%. Based on the above situation, the effort to increase STEM learning ability for students is a necessity.

Further analysis is related to aspects of STEM learning, the data obtained as shown in Table 3 below:

Table 3. Score learning aspects of STEM prospective physic teachers

No	STEM Learning Stages	Total Score (maks: 180)	Average score (Maks: 5)	Category
1	Arrangement Stage	98	2,7	Moderate
2	Exploration stage	110	3,05	Moderate
3	Explanation stage	120	3,33	Moderate
4	Elaboration stage	90	2,5	Moderate
5	Evaluation stage	61	1,69	Low
	Total	479	13,27	

To be more easily understood, the data in Table 3 above can be presented in the form of a histogram, as shown in Figure 1.



Referring to Table 3 or Figure 1, it can be understood that the ability to plan STEM learning for students is generally dominated in the Explanation stage and Exploration stage aspects with an average value of 3.33 and 3.05 in the medium category, respectively. The lowest score obtained by the Evaluation stage and Elaboration stage with an average score of 1.69 and 2.5 respectively.

3.2. Discussion

Based on the data as presented in table 1 above, it can be seen that in general the

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ability to plan STEM learning for prospective physics teacher students is still dominated by students with a Low level of 38.88%. This data indicates that in general the respondent is not ready to carry out learning using the STEM approach. This can be understood given that respondent is a prospective physics teacher who has been studying physics as a main content/ subject, while STEM demands the ability to elaborate on several subject subjects [26][27]. In addition, one of the factors that is thought to play a role in this situation is the low experience of the respondent, where the respondent is a student teacher candidate who has no experience in developing a learning plan.

Bearing in mind that STEM is an innovation for future learning [20][28][29], as well as a real effort in preparing human resources with interdisciplinary abilities, all prospective teacher students must be seriously trained and prepared to be able to teach with an approach this precisely. Provisioning of prospective teacher students can be done with STEM training specifically or through integration during the learning process. In addition, students also need to be encouraged to actively collaborate with professional teachers, as well as in other scientific communities. This process will provide students the opportunity to have real experience which can then be applied in the learning process in STEM.

Referring to Table 3 above, it can be understood that the ability to plan STEM learning for students is generally dominated in the Explanation stage and Exploration stage aspects with an average value of 3.33 and 3.05 in the medium category, respectively. That means that the ability of prospective physics teacher students has sufficient (moderate) ability to explain physical materials. In addition, it can also be said that the physics teacher candidate students are able to provide opportunities for participants to collect data well.

In addition, the lowest score was obtained by the Evaluation stage and Elaboration stage aspects, with an average score of 1.69 and 2.5 respectively. This shows that the process of evaluating and elaborating learning with the STEM approach is the most difficult aspect for prospective physics teacher students. This situation can be understood because STEM is a combination of several subject subjects so that in making evaluation instruments must also consider these subjects so that the assessment of learning outcomes is more comprehensive. In addition, this finding is also in line with the results of the study [30] that there are still many teachers who have not involved (integrated) technology in learning and have not discussed the level of thinking skills for students optimally

4. Conclusions and Suggestions

4.1 Conclusions

Based on the data and discussion as described above, it can be concluded that in general the ability to plan STEM learning for physics teacher candidates is still dominated by students with low and moderate levels. There are 9 students who are ready to implement STEM learning or around 25%. In addition, it can also be concluded that the ability to plan student STEM learning in general is dominated in the Explanation stage and Exploration stage in the medium category. The lowest score obtained by the Evaluation stage and Elaboration stage aspects with an average score of 1.69 and 2.5 respectively.

4.2. Suggestion

Seeing the importance of the STEM approach in learning, while the level of readiness of prospective teacher students is still relatively low, serious efforts are needed to ensure improvements in the STEM pedagogical abilities. Improvement of STEM pedagogical skills is needed to ensure an increase in the quality of education in general and prepare quality human resources in the future. The enhancement of STEM's pedagogical skills can be done through integrated learning, special training and encouraging students to be actively involved in scientific communities.

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