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Problem Solving Skill:
What is the Difference between Practitioners and Experts?

Ismet[1,*], Nyimas Aisyah[2], Effendi Nawawi[3], Muhamad Yusuf[1], Meilinda[4]

[1]*Physics Education Department, Universitas Sriwijaya, Palembang, South Sumatra, Indonesia*
[2]*Mathematics Education Department, Universitas Sriwijaya, Palembang, South Sumatra, Indonesia*
[3]*Chemistry Education Department, Universitas Sriwijaya, Palembang, South Sumatra, Indonesia*
[4]*Biology Education Department, Universitas Sriwijaya, Palembang, South Sumatra, Indonesia*
**Corresponding author Email: ismet@fkip.unsri.ac.id*

ABSTRACT
Problem-solving is an important skill for students so that it should be an important element of learning design at every level of education. This study has a goal to analyze the perceptions of practitioners (novice) and experts about problem-solving skills. A total of 10 experts and 53 practitioners who are teachers or lecturers in science (biology, physics, chemistry) and mathematics education were recruited as the subjects of the study. The data were collected through open-ended questionnaires using Google Form and analyzed descriptively. It was found that practitioners and experts share the same idea about the definition and importance of problem-solving skills. The difference is that practitioners mainly view that problem-solving skills can be provided more with the daily life of students, while experts view that these skills can be provided with engineered problems. Both also have different choices of learning models. Practitioners tend to choose a familiar model with a syntax of solving a problem by the students, while experts choose more than one model. They think that various existing models and the teacher's ability to design the implementation in learning are needed to provide problem-solving skills. Practitioners view that problem-solving skills are important but difficult to teach because of the time and the students' inadequate prerequisite skills to do the learning. The results of this study can be a reference in developing the learning curriculum for pre-service science and mathematics teachers in the future

Keywords: *Problem solving skill, Perception, Practitioners, Expert.*

1. NTRODUCTION

Problem-solving skill is defined as a person's ability to engage in cognitive processes when understanding and solving problems for which the method of solving is not readily available [1]. Problem-solving skill is one of the important skills provided to prospective teacher students because, in addition to developing thinking skills, it also trains students' ability to manage learning to develop thinking skills.

Attempts have been made to develop student problem-solving skills through the development of learning models, such as problem-based learning and problem-solving models. However, it seems that the results are not optimal. A 2016 workforce skills survey reported that college graduates still lacked problem-solving skills [2].

The difficulty of students in solving problems is due to their tendency to question things that are low-level factual rather than analyzing abstract things, it is difficult to consider systematic evidence in formulating arguments, and are proficient to carry out a procedure but lack of providing reasons why it should be [3-5]. Another cause is the perception of the teacher/lecturer on problem-solving skills, in some studies, it was found that teachers in China consider providing problem-solving skills to mean directing students to imitate the process of solving a problem that has been presented with a new problem that must be solved [6], in other research, there is a perception that students who are prospective science teachers in Turkey consider that every problem presented to students is a problem that must be solved [7].

The other study found that teachers at a school in Indonesia, have the perception that problem-based learning requires students to have a strong basic concept before problem-solving learning occurs [8]. Bunimovic [9] found that teachers in Israel perceive that providing problem-based learning does not have to be an explicit problem-based learning strategy, but by exposing students intensively to the problem it will automatically make students have good problem-solving skills, and the

main difficulty of problem-solving skills is the difficulty of students to interpret sentences in a given problem-based question.

Research on the perception of teachers and lecturers on problem-solving skills as aforementioned, no one compares the perception among teachers who are practitioners in schools and lecturers and experts who are the practitioner and researcher who has knowledge and experience both in research and teaching problem-solving skills. It is believed that teachers' perceptions in understanding problem-based learning will influence the approach that teachers take to their students [10-12].

This research aims to determine what the teacher's perception as a practitioner and lecturer/researcher as an expert on problem-solving skills are. The findings will be valuable for developing a curriculum in providing prospective teacher students' problem-solving skills and pedagogical aspects, especially in Mathematics and Science.

2. METHOD

This research used a qualitative descriptive design with the respondents were mathematics and science teachers of junior and senior high schools in South Sumatra, a province in Indonesia, as practitioners, and lecturers from many universities in Indonesia, as experts in teaching problem-solving skills. The lecturers were selected that had more than 15 years of tenure, also they were involved with several studies that correlate with problem-solving skills. Data collected from August to October 2020 by using an open-ended questionnaire. The questionnaire was sent to respondents via email that contains the link to a Google form page. Data were analyzed from 53 teachers' and 10 experts' responses to the questionnaire. Both teachers and lecturers were asked to respond to the same questionnaire. Table 1 describes the content of the questionnaire.

Table 1. Details of the problem-solving skills item in the questionnaire

No	Items
1	Definition of problem-solving skill
2	The urgency of providing problem-solving skills to students
3	Kinds of problems that can be presented to equip problem skills to students when learning in class
4	The context that can be presented in learning that provides problem-solving skills
5	Content that can be presented in learning that provides problem-solving skills
6	Effective models to equip problem-solving skills
7	The reason for choosing a learning model to equip problem-solving skills
8	The weakness of the model chosen to equip problem-solving skills

3. RESULT AND DISCUSSION

3.1. Result

Based on the results of an online questionnaire distributed with the composition of the questions as shown in Table 1, the following data were obtained: In the first question about the definition of problem-solving skills, there were three key sentences found in both the practitioner and expert groups. The three sentences are in the form of a) skills in identifying problems and finding solutions; b) skills that require higher-order thinking skills such as critical, creative, logical, and systematic thinking; c) Skills that require high content mastery.

The definition states that problem-solving skills are skills that are related to the skills to identify and solve problems is the dominant definition put forward by practitioners and experts (33%), while skills that require higher-order thinking skills such as critical, creative, logical, and systematic thinking (23%) the third statement was only put forward by two practitioners without experts, while the rest was a combination of statements one and two.

On the second question, 100% of practitioners and experts agreed that problem-solving skills were important to provide students and students with. The reasons put forward by practitioners and experts regarding this item are in Table 2.

Table 2. The reasons for the importance of equipping practitioners and experts with problem-solving skills

Practitioners		Expert	
Responses pattern	%	Responses pattern	%
Means to train students' thinking processes	40	So that students are accustomed and able to face daily and future problems	90
To be able to answer questions, especially story questions.	25	To be able to solve problems in the subject matter	10

So that students can answer daily problems	23		
To make learning more interesting	13		
To be able to make decisions in the future	9		
For promotion	2		

In the third question about the form of the problem that can be presented to provide problem-solving skills in the practitioner, the group is divided into five answer patterns. The most dominant answer is the problem that is presented in everyday life (34%). The second dominant answer is a fictitious problem that can trigger students' thought processes (17%), although practitioners call it a fictional problem, it does not mean that this problem is a generic problem based on content as in the teacher's statement in Figure 1.

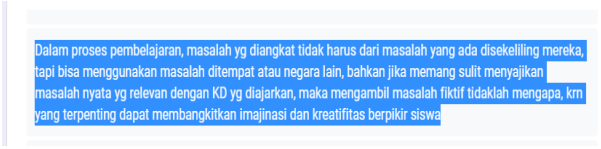


Figure 1. The practitioner's statement about the presentation of a fictitious problem

The practitioner's answer as in Figure 1 makes it clear that the pattern is the same as the first type, namely problems that exist in everyday life. Only 2 of 53 practitioners stated that all subject matter content, especially science and specific environmental content, could be presented in learning that provided problem-solving skills. Meanwhile, from the expert group, only two people specifically wrote about everyday contextual problems that existed in life. The dominant experts state that both types of problems, both contextually-based problems that tend to be difficult to find solutions, and content-based engineering problems can be presented to train students' problem-solving skills. The expert's statement can be seen in Figure 2.

The fourth question about the context that can be presented in learning that provides problem-solving skills, the dominant practitioner's present problems that exist in the daily environment of students (70%) such as the state of the school canteen, farming in narrow land, accumulating garbage or the scarcity of water. 15% of practitioners chose contexts related to the environment, both impacts, and solutions, while the rest chose context-based content in related subjects, for example in the field of Science, human disease, biodiversity, or inherited traits in the family were selected. Meanwhile, the expert group did not write a specific context but stated generally that the context presented was a context that had something to do with content and content engineered by the context.

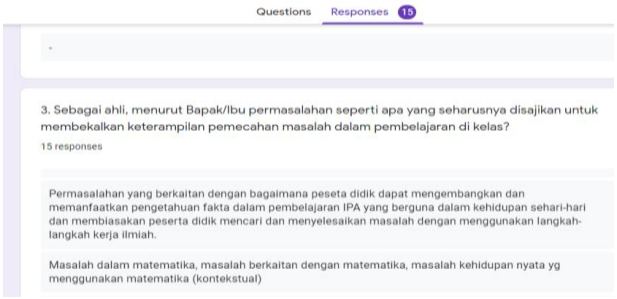


Figure 2. Expert statements about problems that can be presented to train student problem-solving skills

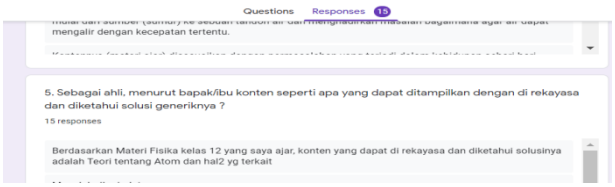
The fifth question is closely related to the content that can be presented in a generic problem that is engineered and the answer is known. In the practitioner group, the content that can be presented is specific content that has a daily context in student life, such as inheritance in the family, the impact of forest fires, natural disasters, the algebraic concept of dynamic electrical content, blood type, the ecosystem as shown in Figure 3.

Figure 3. Critical statements about content that can be presented to equip problem-solving skills

Meanwhile, the expert stated that all content can be presented for problems that can be engineered and know the specific answers, such as the statement in Figure 4.

Statement 6, 7, and 8 are statements related to select the right model for supplying problem-solving skills, the reason for choosing models as well as the weaknesses of the model chosen. Based on the results of the questionnaire, each practitioner chose one reliable model according to them which was the most appropriate and effective for providing problem-solving skills. Among the selected models, PBL was the most preferred model (57%) followed by the contextual learning model, PMRI,

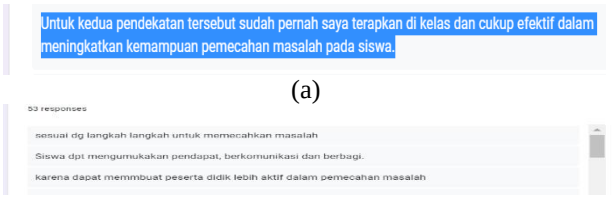
Inquiry, STEM, PjBL, and the scientific approach which were 9% to 6% respectively, while the rest each only chosen by one teacher such as the TPS model, audiovisual model, and even the discussion method. The reason for choosing the model is because there are problems in the syntax of the model, there is a problem-solving phase and it can be based on daily life and develop students' thinking skills. Another reason is that the model has been recognized by the teacher and students and they have been used it as shown in Figure 5.



(a)

(b)

Figure 4. Expert statement about the content that can be presented in a lesson whose problems can be engineered: (a) physics material on atomic theory; (b) all content in mathematics and the flow of electricity in physics



(a)

(b)

Figure 5. The reasons for choosing the model as a learning model to provide problem-solving skills: (a) because the approach chosen has been applied and is effective enough to improve problem-solving skills ; (b) because in the syntax of the selected learning model include a problem-solving phase

Meanwhile, in the expert group, none of the experts mentioned only one model, even some experts stated that there was no single model that was effective depending on the student, teacher, material, and available suggestions. Even so, the expert mentions that several learning models that can provide problem-solving skills that can be used in several models such as PBL, PBI, PjBL or realistic learning as in Figure 6.

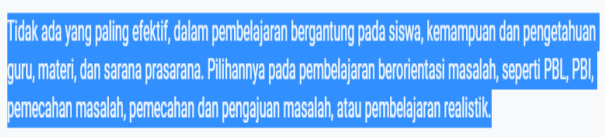


Figure 6. Expert's statement about models that can equip problem-solving skills

Experts choose these models because the model can facilitate scientific theoretical concepts with real-world problems and can solve problems with collaboration and the ability to think critically and creatively. Although the groups of practitioners and experts have differences in terms of choosing the model and the reasons for choosing the model, the weaknesses of the models chosen by practitioners and experts are almost the same, namely the time factor and student ability.

Students' lack of thinking abilities, students are ashamed to discuss and the condition of students who are not used to the applied model is an obstacle and is considered a weakness of the model they choose. Besides the two things above, there is one addition from experts regarding the shortcomings of implementing the learning model, namely the ability of the teacher to develop this learning model. This is not in the practitioner's spotlight because teachers as practitioners tend to choose a model that they already understand and have done before, as shown in Figure 5a.

3.2. Discussion

Teachers play an important role in providing life skills to their students, including problem-solving skills. Teachers' perceptions and knowledge will influence the way they provide these skills to students [13-15]. In research on the perceptions of teachers as practitioners and experts on problem-solving skills, it was found that 100% of practitioners and experts agreed on the importance of providing problem-solving skills to students for their future life. The importance of these skills is also recognized by several curriculum standards in various countries in the world [16, 17]. However, the reasons for the importance of problem-solving skills for both sides are slightly different. The opinion of experts is the same as found by [7] regarding the perception of pre-service teachers in Turkey about problem-solving learning. Meanwhile, teachers as practitioners view problem solving as important for the future of students, and it also makes learning more interesting, is closely related to decision-making skills, and trains students' thinking processes as shown in Table 1.

Decision making is part of problem solving because, in the problem-solving process, decision-making skills are needed. Thus, some researchers argue that these two skills can be the same and can be used together [18]. Meanwhile, others consider that these skills are different [19-21]. Problem solving means preparing an action plan

to eliminate the gap between the current situation and the desired situation while decision-making means defining a solution because it requires goals or targets from various available solutions. In other words, alternative solutions are required to choose the best [19]. It can be concluded that experts perceive that decision-making skills are different from problem-solving skills while 9% of practitioners perceive that both skills are the same.

In the third question about the form of learning problems presented in learning, almost 96% of practitioners mention daily-life problems of students that are ill-structured. This perception is different from that of experts stating that the problems presented to students can be seismic or related to ill-structured or well-structured content. This is in line with that expressed by Van Merriënboer [22] that the phase model cannot describe the complexity of real-life problem-solving skills. In the real world, problem solving is a complex information processing where the problem solver must solve routine and non-routine aspects of a problem at the same time regardless of well-structured or ill-structured problems [23].

Van Merriënboer [22] argues that routine and non-routine aspects should be considered as two interacting systems. Real-life problem solving depends on the interaction between the two systems. The skills used in the routine aspects of a problem are repetitive, highly consistent skills from one situation to another. The skills used in the non-routine aspects are various non-repetitive skills. Hiltrimatrin[8] in her study on 2 mathematics teachers in Lahat and Xenofontos and Andrews [24]who researched a teacher from Cyprus also found that practitioners state that problem-solving learning only provides ill-structured everyday problems.

Because of their understanding that learning providing problem skills only displays ill-structured problems, practitioners find difficulty stating that all content can be presented as learning that can provide problem-solving skills as in expert groups. Therefore, when asked to present selected content to provide problem-solving skills, they only show daily-life content such as inheritance material content in dynamic electrical biology, etc. as in Figure 3. This leads practitioners to mention that one of the difficulties of teaching problem-solving skills is that not all content can be delivered in the form of a problem even though there should be no attempt to separate problem-solving skills from knowledge content [25].

Statements 6, 7, and 8 in Table 1 show that practitioners tend to choose a familiar learning model they have carried out. This is in line with Maslovaty's [26] research on teacher strategy choices in teaching moral dilemmas, showing a positive relationship between the belief, teaching context, and personal background of a teacher with his choice of teaching strategies. Belief in this study can be seen from teacher confidence in the selected model with a syntax that has a problem-solving process such as teacher recognition as shown in Figure 5.

Teaching context means something that exists in the teacher's environment such as school policies, curriculum, and social environment, and influences student learning outcomes [27]. In the context of providing problem-solving skills, teachers view that the model they choose can be applied to actualize contextual learning because, based on their perceptions as practitioners, problem-based learning presents ill-structured real-life problems for students. Meanwhile, the personal background that influences a teacher as a practitioner in determining the appropriate learning model is a habit. It means that they choose their existing model in learning at school as stated by the students in Figure 5.

4. CONCLUSION

Practitioners and experts perceive that problem-solving skills should be taught to students, but the methods and strategies are significantly different depending on their knowledge, belief, teaching context, and personal background.

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