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Teachers' Perception of Science Generic Skills in Chemistry Learning

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Abstract. Science generic skills (SGS) cannot be separated from conceptual lessons. These skills used to measure the generic ability of science that students have. Therefore, the assessment instrument the appropriate to measure the skills are needed and the teacher's perception about SGS instruments are important to know. The aim of the study was to evaluate the high school perception about SGS related to the assessment of SGS in chemistry learning. This study used qualitative analysis methods and samples from 5 chemistry teachers selected by random sampling. A semi-structured interview procedure was used to collect data. The results of this analysis indicate that the concept of teacher perception of SGS was still weak. In fact, this aspect of mindset was rarely noticed by teachers because of the factor of ignorance. For them, science learning was an activity that was important to memorize a concept or perform count operations. This can be seen from the way teachers teach science materials, especially by focusing on learning the training of formulas, exercises about counting and memorize the concept. This will affect the suitability and accuracy in teacher selection of SGS in Indonesia.

INTRODUCTION

The basic skills that need to be grown in learning are generic skills (GS) [1]. A skill that is general, flexible, not only important for the field involved but also for solving real problems. Generic skills can be used for various concepts and solutions of various problems. GS is sometimes referred to as meta-skills, character skills or learning how to learn skills, core skills, transferable skills, key competencies, graduate skills [2, 3, 4]. GS was also conceptualized as skills that help the student to understand their strengths and weaknesses and to help them learn on their own [5]. GS will not produce good results if they are not supported by effective facts [6]. GS is the best when learners are the purpose of instructional and explicitly [7]. Once this may be apparent, but it will still be more and more popular. The extent to which students develop the skills that determine how they solve problems, write reports, work together in time, conduct themselves, review other participants' performance, learn new knowledge, and manage stress when they have to learn again [8]. Studied conception of the teaching of generic attributes and found that academic staff might not have fully understood curriculum initiative statements, which resulted in a mismatch between expectation and practice[9]. Higher education researchers recognize the student learning perspective, through which learning has explained the interaction between how students perceive the learning environment and their learning approach. Of course, this may influence desirable learning outcomes [10, 3]. These generic skills need to be inculcated through academic life, but it needs to be systematically and effectively implanted through teacher assistance as the main agent of intervention. Such effectiveness will depend heavily on teachers' understanding of skills and the strategies used to develop GS [11]. Teachers are expected to have a good understanding of GS, they can transfer it to their students and they can measure GS tasks then evaluated appropriately [12]. From these result of the evaluation, teachers can develop a method of teaching GS to their students.

METHODS

The method of this study used qualitative analysis. The sample of this study consisted of five chemistry teachers with teaching experience of more than 10 years. Data were collected by semi-structured interviews with seven questions are listed in **Table 1**.

Table 1. The question of the interviews

Number of Question	Question
1	What do you know about SGS?
2	How do you teach SGS to students in chemistry learning?
3	What SGS indicators that are trained to students?
4	How do you assess student's SGS in chemistry learning?
5	What are SGS indicators assessed in chemistry?
6	What is the difficulty in assessing SGS?
7	Whether generic skills are important in chemistry learning?

From the interview, the data are classified based on the conformity of the answers. Data was presented in table form for each question. Data analysis was done by linking the interview result.

RESULTS AND DISCUSSION

The results from semi-structured interviews are shown in the following tables 2-8. The answered of question number 1 are listed in Table 2.

Table 2. The Answered Question of Number 1

Category	Frequencies	Chemistry Teachers' Ideas
Scientific method	1	SGS is a process skill in a scientific method as an SPS
Theoretical understanding	2	SGS is a student's ability to understand science
Learning approaches	2	SGS is a learning approach used to direct students to discover something new about facts and concepts

Table 2, chemistry teachers' opinion about SGS shows that one chemistry teacher an understanding that SGS is a skill using the scientific method is the same as the science process skills. Two chemistry teachers understand the SGS as a concept, and the remaining two chemistry teachers understand SGS as a learning approach. This fact shows that the chemistry teachers still have a weak understanding of SGS. Ignorance prevents them from engaging in GS development for the student, even when they had GS expertise [8].

The answer to question number 2 is listed in Table 3.

Table 3. The Answered Question of Number 2

Frequencies	Chemistry Teachers' Ideas
5	Practical work in the laboratory
3	Science projects
4	Presentation
5	Discussion
2	Visiting industry

Table 3, chemistry teachers' ideas about teaching SGS to students in chemistry learning shows that the majority of chemistry teachers believe that SGS can be trained to students through laboratory practice, discussion and presentation and science projects. However, Chemistry teachers argue that discussions, industry visits, and presentations can be used by SGS as a learning method. This argument does not follow the SGS definition. SGS cannot be trained with discs, presentations, industry visits, and lecture methods. In addition, the case of GS teaching also points out that the translation of teacher beliefs into teaching behaviors is mediated by socio-cultural elements embedded in their schools [8]. The study showed that while teacher motivation and expertise could trigger the translation of teacher beliefs into GS-teaching behaviors, such initial efforts were often diminished by their institutional context where working conditions were not favorable for GS teaching and their GS teaching was not meaningfully recognize [8].

The answer to question number 3 is listed in Table 4.

Table 4. The Answered Question of Number 3

Category	Frequencies	Chemistry Teachers' Ideas
Scientific method	1	Practical skills in the laboratory such as direct observation, formulating problems, hypothesizing, designing, experiments, analyzing data, drawing conclusions and communicating
Skills using equipment	1	Skills in using experimental tools in the laboratory
Concept	1	Understanding of scientific concepts in chemistry
Learning activities	1	Students' active performance in the learning process
Collaboration	1	Students' work together in completing the experimental task

Table 4, chemistry teachers' ideas about SGS indicators that are trained to students this suggests that chemistry teachers train SGS to students as a scientific skill included in laboratory practice. However, some teachers who instructed SGS were not quite right. They training SGS by improving students' skills in using laboratory equipment, when in fact, SGS is not just about the skills of using the equipment, they also teach SGS only as a conceptual understanding. These skills form a basis for one to build the capabilities for learning how to learn so that they can apply them to pick up advanced knowledge as well as solving problems encountered in their daily lives[13].

The answer to question number 4 is listed in Table 5.

Table **5.** The answered question of number 4

Category	Frequencies	Chemistry Teachers' Ideas
Observation of practice	2	Observation from laboratory
Paper and pencil test	2	Written test about conceptual understanding
Observation class	1	Observations during learning in the classroom

Table 5, chemistry teachers' ideas about how to assess student's SGS in chemistry learning shows that two chemistry teachers assessed SGS through observation during laboratory practice, two chemistry teachers used written tests, and one teacher assessed SGS through classroom observation. This form of assessment is in line with their understanding of SGS. Observations during laboratory practice in the laboratory are appropriate for assessing SGS, but a written test of conceptual understanding is not. Written tests cannot be used to assess the SGS if the question indicator does not refer to the SGS. Meanwhile, classroom observations are not appropriate for assessing SGS. The other study findings show that there is a lack of learning strategies and collaboration and self-management capabilities acquired as expected from the learning target, nor examined through the assessments in the current education. An examination is indeed not a good venue to access some generic skills[13].

The answer to question number 5 is listed in Table 6.

Table 6. The Answered Question of Number 5

Category	Frequencies	Chemistry Teachers' Ideas
Scientific Method	3	Practical skills in the laboratory such as direct observation, formulating problems, hypothesizing, designing, experiments, analyzing data, drawing conclusions and communicating
Skills using equipment	1	Skills in using experimental tools in the laboratory
Concept	1	Understanding of scientific concepts in chemistry to solve the problem

Table 6, chemistry teachers' ideas about indicators are assessed in chemistry shows that chemistry teachers assess SGS based on the learning activities undertaken in the SGS training. The majority of chemistry teachers rated the SGS indicators as a step of scientific skills in laboratory experiments as well as Scientific Proses Skills. A chemistry teacher assesses SGS only through skills in using laboratory equipment, and two chemistry teachers incorrectly rated the SGS by assessing the conceptual understanding and attitude of students during the learning process. Knowledge generation requires strong GS, or higher-order thinking skills (HOTS), including analytic reasoning, problem-solving, and writing, and education serves as a vehicle for nurturing students by teaching GS and measuring the progress with respect to the desired goals [13].

The answer to question number 6 is listed in Table 7.

Table **7.** The Answered Question of Number 6

	Frequencies	Chemistry Teachers' Ideas
An instrument of assessment	2	The assessment is subjective because no special assessment instrument to assess all indicators of SGS
Students ability	1	Skills using equipment in the laboratory
Assessment method	2	Understanding of scientific concepts in chemistry

Table 7, Chemistry teachers' ideas about the difficulty in assessing SGS suggests that the chemistry teacher assessed the SGS based on subjective observations since no special instruments were available for use. Observation instruments cannot be used to accurately assess SGS, so this is not the best and is suitable for assessing SGS. In the meantime, there are teacher misconceptions in understanding SGS, so their assessment of SGS students cannot be used. The practice and development of GS were evaluated using the self-reports provided by the students. These reports described the ways that students engaged and carried out activities in the process of learning in order to acquire generic skills. The level of generic skills identified was compared and analyzed. As the final part of the conceptual framework shows [1].

The answer to question number 7 is listed in Table 8.

Table 8. The Answered Question of Number 7

Category	Frequencies	Chemistry Teachers 'Ideas
Important to assess	2	SGS is very important as the basic needs of students
Not too important to assess	2	SGS not too important to assess because there are many other skills that can represent it
Not important	1	Not important to assess because it is the same as the process skill

Table 7, Chemistry teachers' ideas about the important of SGS there are 2 teachers who stated that SGS is very important to assess because it is part of the basic skills of the students, the two teachers stated not too important to be assessed because there are still many more general skills and many to represent it. One teacher stated that SGS is not important to assess because it is the same as process skill. One teacher thinks that SGS is the same as scientific

proses skills when in reality there is a difference between the two. Thus, there is an exigent need to transform or shift from rote learning practices to reflective learning [3].

From the results of the chemistry teacher's answer to the SGS question and its assessment, teachers do not fully understand about SGS. Some of them can define SGS adequately but cannot mention the skill indicators in SGS. Some chemistry teachers already understand the concept of SGS, but they lack in operational practices in using SGS. Most chemistry teachers train SGS to students through practical work in the laboratory. SGS is considered to be taking place in a science laboratory and practical work is only about the use of the following tools and instructions, although one indicator of SGS is a direct observation that can be done when students do the experiments directly and the use of laboratory tools that is also an indicator of SGS which teachers still have not fully understood. Many skills are related to experimental investigations that are rarely taught explicitly [14]. This happens because teachers assume that students can learn SGS only through experience doing practical work in the laboratory.

This assumption facilitates the acquisition of the operational aspects of SGS but does not promote conceptual understanding of the accuracy of the scientific inquiry process involved in the investigation. Students may be able to observe procedurally, but they have no understanding of the purpose of observation in scientific inquiry. Thus, creativity and originality, which are characteristic of scientific inquiry, will also be difficult to develop in a limited way acquisition of conceptual understanding required in SGS. Chemical teachers should have a strong SGS understanding and demonstrate competencies in SGS both operational and conceptual so that SGS can be effectively and meaningfully taught to students [15]. Chemistry teachers understand that observation can be used as a method of SGS assessment, but in practice, teachers observe without the use of appropriate assessment instruments, so that the skills science process is not accurately and adequately measured. Teachers who rate SPS through written tests but only measure concepts and theories, not SGS.

There are also teachers who measure SGS only from students' accuracy in using tools or instruments. Teachers' difficulties in assessing SGS by observational methods lie in large classes with 30 students. Teachers will find it difficult to accurately assess the SPS of each student. This condition encourages the efficiency and measurement of SGS objectively. One possible solution is to use a written test. The test subject may take a written test even though the tool is often required to complete the test subject. Generic science cannot be separated in practice from conceptual understanding involved in learning and application of science [12]. One role of chemistry teacher as a science teacher is to facilitate and help students to understand the content of scientific knowledge. One of the contents of science is the generic skill of science. Chemical teachers are required to have an in-depth understanding of science, generic skills as well as how to teach generic science. Content and pedagogical knowledge must be integrated to create new knowledge [16].

CONCLUSION

Understanding of teachers about SGS and instrument will affect the learning process that has been planned and evaluated. While the teacher provides diverse learning opportunities for students to develop into a better person, knowing how to make use of these opportunities is prerequisites. Therefore, needed teachers' perception of programs that include elements that help students conceptualize not only their academic discipline but also GS development may be helpful. The process of science cannot be separated in practice from the conceptual understanding involved in learning and the application of science so that the right instrument is needed to measure it. In addition, teachers should know what the students know topics and areas that may be experiencing difficulties.

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