Trend exploration of the use of cognitive assessment techniques by high school science teachers

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Abstract. This study aims to describe the frequency of use of cognitive assessment techniques based on the length of the teaching of high school science teachers. The length of teaching indicates experiences that support teacher professionalism. A survey method was conducted on eighteen teachers from three outstanding schools. The research sample was determined purposively. Data collection was carried out using questionnaires and data analysis using descriptive statistics. The results showed that the dominant assessment technique used by high school science teachers was the written test, which was an average of 32 times in one semester. The group of teachers with a teaching length of 11 to 20 years used a more diverse range of assessment techniques than groups with other teaching lengths. Descriptively, it can be said that the frequency of use of various cognitive assessment techniques is related to the length of teaching teachers with the tendency to use written tests. However, the conclusions of this study cannot be generalized. Therefore, further research is needed with a representative research sample on the same topic. Besides, teachers and/or researchers can also investigate the combination of using assessment techniques to increase the effectiveness and efficiency of science learning.

1. Introduction

The formal learning program includes learning and assessment activities that are interrelated and continuous. Assessment is considered as a separator as well as a link between learning activities so that assessment is often the focus of attention for many learning providers. Assessment is an important part of learning that provides information to support better subsequent learning [1]. Miller, Linn, and Gronlund [2] explain that educators and schools use assessment to support student learning success. On the other hand, the success of learning can be identified by the existence of assessments at the class, school, national and international levels. The assessment system is part of the eight national education standards in formal education in Indonesia [3]. Sanjaya [4] states that learning activities that involve the assessment of learning outcomes are aimed at developing children's potential. One of the dimensions of children's abilities that need to be developed through learning is the cognitive dimension [5]. In this case, Pantiwati [6] explains that there is a relationship between the type of assessment and the cognitive abilities of students so that it can be said that the assessment affects the achievement of the development of students' cognitive abilities. Thus, teachers and other learning managers need to take advantage of
assessment to increase the effectiveness of learning. One of the sciences used for the implementation of learning is science. Learning science seeks to provide learning experiences to students about nature and its meaning.

Many studies are focused on science education, regarding several factors that influence student learning success, one of which is the ability to understand students in formative learning [7]. Formative assessment can increase student motivation and learning outcomes [8]. In a formative context, assessment is carried out while learning is still ongoing in order to provide feedback as information for the teacher for learning and for students to review the learning process [9]. Besides, learning and assessment need to provide specific positive stimulation in the form of providing learning experiences to students [10]. Learning experiences are important for students to make the learning process more meaningful so that their abilities or potential can develop more optimally. In this case, teachers need to set learning objectives, describe the learning design, and choose appropriate assessment instruments and procedures to support learning success [11].

Denny, Hallam, and Homer [12] describe that in learning assessment, teachers can use various types of instruments to record student learning outcomes. Mardapi [13] adds that especially for student cognitive assessment, various types of assessment can be used to obtain data/information on student learning outcomes. This type of assessment is often referred to as a "bill" which can be applied to measuring the cognitive domain as one of the learning objectives. Variations in the types of assessment may affect the effectiveness of obtaining data or information on student learning outcomes. Pantiwati [6] explains that there are differences in students' cognitive abilities in learning between students who are assessed using authentic assessment and students who are assessed using conventional assessment. Brookhart and Walsh [14] add that the variety of assessments can affect student motivation in learning. Teachers, as learning implementers as well as assessors, are required to have adequate abilities in constructing and using assessments in the teaching and learning process in the classroom. The usefulness of this assessment depends on the level of competence of the teacher who manages learning [15]. The level of mastery of teacher competencies greatly affects the implementation of learning. One of the competencies referred to is the ability of teachers in the management of learning, including the management of assessments. To become a competent teacher requires a good academic background and sufficient field experience. Fadilah and Suparwoto [16] explain that the teacher's background affects the implementation of learning.

The description above indicates that there is an influence of the teacher's competence, background, and academic experience on the implementation and quality of the learning being held. Given the importance of assessment to obtain information related to the success of learning, including in science learning and by paying attention to the variety of assessment techniques, the frequency of use of assessment techniques by science teachers is important to research. Information about the frequency of use of assessment techniques can be used as an illustration of trends or trends in the use of assessment techniques, especially in formal learning. The tendency to use various assessment techniques in terms of length of teaching can also be a picture of teacher professionalism.

2. Methods
This study uses a quantitative descriptive approach with a survey method. The research subjects were eighteen high school science teachers who were determined based on purposive sampling technique. The consideration of taking the research sample is that school achievement is classified as a high category, and the length of the teaching of the teachers varies. Data were collected by filling out a questionnaire about cognitive assessment techniques that can be used by teachers in science learning. Data analysis used descriptive statistics where the relationship between the frequency of use of assessment techniques and the length of the teaching of the teacher is presented in a cross table.

3. Results and Discussion
3.1. Results
An overview of the trends or trends in the use of cognitive assessment techniques in high school science learning can be seen in Table 1 to Table 4.

### Table 1. Frequency of use of cognitive assessment techniques in high school science learning

| Assessment Techniques | Schools | Total |
|-----------------------|---------|-------|
|                       | A       | B     | C     |       |
| Written Test          | 25      | 30    | 42    | 32    |
| Oral Test             | 3       | 2     | 6     | 4     |
| Assignment            | 6       | 6     | 11    | 7     |

Note: The data listed in the table are the average values for the frequency of using assessment techniques per semester.

Based on Table 1, it is known that the frequency of using cognitive assessment techniques in high school science learning for one semester at school A, B, and C. From these results, it shows that the written test is the most dominant technique used in cognitive assessment.

### Table 2. Frequency of use of cognitive assessment techniques in high school science learning based on the length of the teaching of the teacher

| Assessment Techniques | ≤ 10 Years | 11 – 20 Years | > 20 Years |
|-----------------------|------------|---------------|------------|
| Written Test          | 25         | 39            | 26         |
| a. Quiz               | 5          | 8             | 7          |
| b. Pre-Test           | 5          | 5             | 5          |
| c. Post-Test          | 7          | 8             | 6          |
| d. Daily Test         | 8          | 18            | 8          |
| Oral Test             | 2          | 4             | 3          |
| Assignment            | 5          | 8             | 6          |

Note: The data listed in the table are the average values for the frequency of using assessment techniques per semester.

Based on Table 2, it can be seen that based on the length of teaching which consists of 3 categories, namely ≤ ten years, 11-20 years and more than 20 years, the frequency of using assessment techniques varies during one semester. In the category of ≤10 years of teacher teaching with the written test assessment technique obtained an average of 25 times per semester. The written test assessment technique consists of quizzes, pre-test, post-test and daily tests each with an average of 5 times, and the pre-test has obtained an average of 5 times, the post-test has obtained an average of 7 times, and daily tests have obtained an average of 8 times. Two oral tests and an average of 5 assignments were obtained. In the category of teacher teaching duration of 11-20 years, the written test assessment technique was used 39 times on average. For the written test, the quiz category has obtained an average of 8 times, and the pre-test has obtained an average of 5 times, the post-test has obtained an average of 8 times, and the daily tests have obtained an average of 18 times. Oral tests obtained an average of 4 times, and assignments obtained an average of 8 times. In the category of teacher length> 20 years, the written test assessment technique has obtained an average of 26 times. The written test for the quiz category has obtained an average of 7 times, and the pre-test has obtained an average of 5 times, the post-test has obtained an average of 6 times, and the daily tests have obtained an average of 8 times. The oral test was carried out three times, and the assignment has obtained an average of 3 times. From these results, it can be seen that written tests are predominantly used by groups of teachers of various levels of teaching length. Groups of teachers most widely use written tests with a teaching length of 11-20 years. It is also known that the group of teachers with a teaching length of 11-20 years uses the most varied assessment techniques compared to other groups.
Table 3. Frequency of the use of cognitive assessment at lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS) levels in high school science learning based on the length of the teaching of the teacher

| Level of Cognitive | The frequency of assessments based on the length of the teaching of the teacher |
|-------------------|--------------------------------------------------------------------------------|
|                   | ≤ 10 Years | 11 – 20 Years | > 20 Years |
| LOTS              | 17         | 25            | 17         |
| HOTS              | 15         | 26            | 19         |

Note: The data listed in the table are the average values for the frequency of using assessment techniques per semester.

Based on Table 3, it is known that the frequency of use of cognitive assessments at the LOTS level in terms of length of teaching science teachers ≤ ten years has obtained an average of 17 times, teaching length of 11 to 20 years has obtained an average of 25 times, and teaching length of more than 20 years is obtained. An average of 17 times. At the HOTS cognitive level, the length of teaching science teachers was less than ten years, it was obtained an average of 15 times, 11 to 20 years of teaching has obtained an average of 26 times, and the length of teaching over 20 years has obtained an average of 19 times. It indicates that the teacher group with a teaching period of 11-20 years is a productive group of teachers in the use of learning assessment in both the LOTS and HOTS categories. The average is obtained from several cognitive assessment techniques used, namely written tests, oral tests and assignments for one semester.

Table 4. Frequency of the use of written tests in high school science learning based on the length of the teaching of the teacher

| Form of Written Test | The frequency of assessments based on the length of the teaching of the teacher |
|---------------------|--------------------------------------------------------------------------------|
|                     | ≤ 10 Years | 11 – 20 Years | > 20 Years |
| Short Fill          | 0          | 13            | 5          |
| Multiple Choice     | 9          | 7             | 9          |
| True-False          | 0          | 1             | 1          |
| Matchmaking         | 1          | 2             | 0          |
| Essay               | 16         | 17            | 10         |

Note: The data listed in the table are the average values for the frequency of using assessment techniques per semester.

From Table 4, it is known that the frequency of using a variety of written tests on the length of the teaching of teachers from three schools that are ≤ ten years old uses a multiple-choice test with an average of 9 times, matchmaking with an average of 1 time, and an average description of 16 times. For the length of teaching 11 to 20 years, the short test has obtained an average of 13 times, and multiple-choice was obtained an average of 7 times, true-false obtained an average of 1 time, matchmaking has obtained an average of 2 times, description obtained an average of 17 times. Moreover, for the length of the teaching of more than 20 years using short filling was obtained an average of 5 times, multiple-choice was obtained an average of 9 times, true-false were obtained an average of 1 time and descriptions were obtained an average of 10 times. These results indicate that the group of teachers with a teaching length of 11-20 years used the written test format the most frequently and varied compared to other groups. The average is obtained from several written test formats used by science teachers for one semester.

3.2. Discussion

Based on the results obtained, it can be explained that the dominant assessment technique used is the written test 32 times in one semester. It is because the written test has the advantage that it can measure students' abilities or behaviour objectively, can measure the ability to organize ideas, and students can explore answers in their language. The frequency of using cognitive assessment techniques in high
school science learning based on the length of the teaching of the teacher shows that the length of teaching teachers between 11-20 years is more dominant using various cognitive assessment techniques. The frequency of the use of cognitive assessments at the LOTS and HOTS levels in high school science learning based on the length of the teaching of the teacher seems to be balanced in the 11-20 years of teaching, the use of HOTS and LOTS tests is obtained 25 and 26 times in one semester. The frequency of the use of various written tests in high school science learning based on the length of the teaching of the teacher from the various written test formats used shows that the length of time the teachers taught in the 11-20 year category were more dominant in using short filling and descriptions.

Teaching experience according to [17] states that the tenure of teachers in carrying out their duties as educators in certain units is following an assignment letter from an authorized institution (local government or education provider group). The teacher's experience is also related to the competence of a teacher which is supported by the Regulation of the Minister of National Education Number 16 of 2007 concerning academic qualification standards and teacher competencies regarding four competency standards that are pedagogic competence, teacher's ability to manage student learning includes mastery of student characteristics, learning theory, organizing learning, the benefits of information technology, facilitating the development of the potential of students, being able to communicate effectively, being able to carry out assessments and evaluations of the learning results obtained and to reflect to improve the quality of learning. It is in line with the opinion of effective teachers according to Rosenskine and Steven (1996) in [18] characterized by six activities that teachers must do, namely: carrying out daily evaluations, presenting learning material, providing practical instructions in mastering the material, providing feedback and corrections. So that the length of teaching the teacher can improve the intellectual potential and professionalism of the teacher, this can also affect the assessment techniques used by the teacher.

There are several assessment techniques used by teachers, one of which is a written test where the written test is a test where students must answer questions by providing written answers [19]. The choice of test form can be determined with the aim of the test, the number of test-takers, the time available to check the student answer sheets, the material covered and the subjects being tested [20]. Thus, giving the test given by the teacher depends on the suitability of the technique with the conditions of students in learning. When Judging from the cognitive test level, it is divided into two Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS), in the thought process it illustrates that students must develop and prepare themselves in facing the real world and go through simple learning in the form of facts and content, so that not only is LOTS a thinking skill that is considered important but also HOTS thinking skill as an educational goal [21]. Thus, teachers are required to develop a variety of tests that are used with high-level cognitive levels.

4. Conclusion

Based on the research results, it can be concluded that the dominant cognitive assessment technique used by high school science teachers is the written test. Judging from the length of teaching teachers, the group of teachers who used a more diverse assessment technique was the group of teachers who taught between eleven and twenty years. Descriptively, it can be said that the frequency of use of various cognitive assessment techniques has a relationship with the length of teaching teachers with the tendency to use written tests. From these findings, high school science teachers are advised to use a variety of cognitive assessment techniques proportionally in one semester. The limitation of this research is that the conclusions obtained cannot be generalized. Therefore, it is necessary to have further research with a representative research sample with the same research topic. Besides, teachers and/or researchers can also investigate the combination of the use of assessment techniques over a while (for example, within one semester) that is appropriate to increase the effectiveness and efficiency of learning.

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