

Investigating science learning assessment standards on Indonesian 2013 curriculum

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Abstract

Keywords:
Assessment
Standards;
Attitudes
Assessment;
Knowledge
Assessment;
Science Learning;
Skills Assessment;

Learning assessment is an activity that aims to collect and process information to measure the achievement of students' learning process. The results of this assessment are then used as a basis for evaluating the learning process to improve learning in the future. The assessment process in the 2013 curriculum was carried out thoroughly on three aspects, namely attitudes, knowledge, and skills, which in its implementation still encountered several obstacles. This study aims to conduct a thorough investigation of 3 aspects of the science learning assessment standards in the implementation of the 2013 curriculum. This type of research is a mixed method with a convergent parallel design. The survey method was carried out by providing questionnaires to 65 science and biology teachers at the elementary, middle, and high school levels through a google form. The exploratory study was conducted with interview techniques through a purposive sampling of nine teachers representing each level of education. Based on the results of the survey, it was found that teachers need special attention to be able to train and improve disciplinary attitudes, and critical thinking skills of students at every stage at school levels. The results of a thorough investigation into the assessment standards in science learning show that there are several indicators need special attention from teachers to be trained more intensely and improved, those are critical thinking, metacognitive and student self regulatory/independence. The assessment obstacle faced by teachers is mainly the adjustment of time in the assessment process with basic competencies which must be completed.

To cite this article:

Paraniti, A.A.I., et al. (2023). Investigating science learning assessment standards on Indonesian 2013 curriculum. *Thabiea : Journal of Natural Science Teaching*, 6(2), 169-181.

Introduction

The learning process and assessment are two important things that are always carried out by educators, education units, and the government which aim to collect and process the information on the achievements of the student learning process. The results of this assessment are then used as a basis for evaluating the learning process to improve learning in the future. Teacher proficiency in educational assessment is seen as a core competency for all teachers (Smaill, 2020), which ultimately determines an effective education (Black & Wiliam, 2018). Assessment of learning in Indonesia based on the 2013 curriculum involves a comprehensive assessment of three aspects, namely attitudes, knowledge, and skills through an assessment of learning approach, assessment for learning, and assessment as learning (Kemdikbud, 2016). Learning assessment can be carried out at the end of the lesson to measure student competence

so it's called as summative assessment, and during the learning process as a formative assessment. Such assessments will give the teacher an idea of how the pedagogical process has taken place and how to perfect it, while students can also reflect on their learning and how strategies can be carried out to improve their learning outcomes (Chen & Bonner, 2020; J. Setiawan et al., 2021).

Research in the field of assessment emphasizes more on the development of assessment instruments. Various types of assessments have been widely developed to measure students' abilities in science. A multidimensional framework development instrument was developed to measure the competence/science literacy of junior high school students (Intasoi et al., 2020), development of a diagnosis of misconceptions in biology learning (Kantahan et al., 2020), inference-making and reasoning in biology (IMRB) assessment (Cromley et al., 2021), development of science literacy instruments (Fives et al., 2014; Gormally et al., 2012; Indrawati & Sunarti, 2018; Mun et al., 2015), instruments for measuring the scientific attitude of students (Sole & Anggraeni, 2017), multiple intelligence-based portfolio assessment instruments (Mediartika & Aznam, 2018) and HOTS-based tests (Widyaningsih et al., 2021). However, no research has been found that examines thoroughly from the aspects of assessing attitudes, knowledge and skills carried out by teachers. Thus, a thorough investigation of the three aspects of science learning assessment standards in the implementation of the 2013 curriculum is very important to be carried out in order to be able to map the assessment process based on established standards, understand the dominant problems in the assessment aspects and solutions to solve them. The achievement of good quality education can ultimately be fulfilled through this research which can be used as a guide in carrying out a good assessment process.

Method

This type of research is a mix method with a convergent parallel design through survey methods and exploratory studies (Aruan et al., 2016; Creswell, 2002; Yuniarti et al., 2021). The survey method was carried out by providing questionnaires to 103 respondents (science and biology teachers) at the elementary, middle and high school levels throughout Bali through a google form recorded in the alumni group of biology education at the Mahasawasti University of Denpasar and the results were as many as 65 respondents filling out the questionnaire that had been distributed. The exploratory study was conducted with an interview technique through purposive sampling of nine teachers representing each level of education. Data collection on is carried out by the distribution of online questionnaires referring to *Standar Kompetensi Lulusan Pendidikan Dasar dan Menengah* (Table 1).

Table 1. Dimension dan Indicator of Online Questionnaire

Dimension	Indicator
attitude	Honest
	Discipline
	Responsibility
	Tolerate
	Mutual Aid
	Polite
	Interaction With the Social Environment
	Confidence
Knowledge	Factual
	Conceptual
	Procedural
	Metacognitive
Skill	Creative
	Productive
	Critical Thinking
	Self-regulatory/independence
	Collaborative
	Communicative

The exploratory aspects emphasized in structured interview techniques refer to: 1) The emphasis of a comprehensive assessment of each dimension in Table 1; 2) the assessment techniques carried out are: a) attitude assessment techniques through observation, self-assessment, assessment between friends, educator journals/notes, b) knowledge assessment techniques through summative and formative, c) skills assessment techniques through practicums, projects, and products, and 3) problems during the assessment in the 2013 curriculum. Data analysis was carried out descriptively by tabulating each respondent's opinion and calculating the percentage using the formula:

$$P = \frac{x}{n} \times 100\%$$

with: P = percentage (%), x = number of opinions, n = number of respondents

Results and Discussion

Assessment of Attitude on Indonesian Curriculum

The results of the survey on the assessment of the attitudes of 63 science teachers in Bali were reviewed from various indicators contained in the standards of the 2013 curriculum assessment process such as: 1) honest; 2) discipline; 3) responsibility; 4) tolerant; 5) mutual aid; 6) courtesy; 7) confidence in interacting with the social environment, 8) confidence in obtaining results as stated in Table 2 below.

Table 2. Results of Student Attitude Assessment Analysis

No	Indicator	Percentage of Good Category Achievement	Information
1	Honest	76,1 %	Improved
2	Discipline	65 %	Trained & improved
3	Responsibility	79,3 %	Improved
4	Tolerate	84,1 %	Maintained & improved
5	Mutual Aid	88,8 %	Maintained & improved
6	Polite	88,8 %	Maintained & improved
7	Interaction With the Social Environment	73%	Improved
8	Confidence	71,4%	Improved

Based on the results of the survey, indicators of courtesy and cooperation are the attitude indicators with the highest category, only 12.2% or 7 students have a category below good (enough and less), while indicators of student discipline attitudes really need to be improved because in the opinion of teachers only 65% of students or 41 students who have a good disciplinary attitude the remaining 35% (22 students) are still in the sufficient and less categories. Other indicators of attitudes such as self-confidence, interaction with the social environment, honesty and responsibility also still need to be improved. Based on the results of the interview, the teacher stated that the honesty of students, especially in taking the test when the evaluation of learning was felt to be lacking, this was known by the teacher's assessment of the observation of the learning process and the comparison of test results during direct learning and online learning. Test results when students learn online tend to be high and do not match the daily abilities of students when discussing in class both offline and online. It is also conveyed in studies conducted by (Anugrahana, 2020) one of the factors that become an obstacle in online learning is monitoring the honesty of students in working on evaluations.

At first science learning was dominated by men, but in the last 20 years gender disparities in science learning have begun to decrease, for example in one of the countries, namely the United States in 2000 43% of engineering master's degrees were achieved by women and increased to 50% in 2015. For doctoral programs, more than 50% of doctoral degrees are achieved by women in the fields of health and biology, but the disparity is still seen in the achievement of doctoral degrees in physical sciences (Hanson et al., 2020). This shows that the attitude of students towards science, one of which depends on the interest of students in terms of the type of science learning. Next Karamustafaoğlu & Bayar, (2017) in his study found that there was a statistically significant relationship between students' attitudes towards science and students' self-regulation strategies and motivational beliefs.

One of the most important emotional aspects is attitude. Scientific attitudes have a correlation with the achievement of student learning outcomes where good scientific attitudes shown by students achieve optimal learning outcomes (Hasanah et al., 2020). The attitude of students in Indonesia towards science in general has been good in terms of 3 aspects: 1) the adoption of a scientific attitude; 2) enjoying/enjoying studying science and 3) career interest in science (Astalini et al., 2019). However, she stated that there are still obstacles in student science learning in terms of these 3 aspects. Solutions that can be offered to improve students' attitudes towards science, among others, in the learning process teachers must be able to

demonstrate the relevance of science learning topics in everyday life (Movahedzadeh, 2011). The use of various innovative learning models can also improve students' attitudes towards science, such as the discovery learning model (Widiadnyana et al., 2014), practicum-based learning (Ulfa, 2016), 5E and 7E learning models (Puspita et al., 2018; Rahmah et al., 2019), Problem Based Learning Model (Azmi et al., 2017), project-based learning (Astawa et al., 2015), problem solving model (Purwanti & Manurung, 2015), contextual learning model (Merta, 2013), inquiry learning model (Siregar, 2019), virtual practicum-based learning (Gaffar, 2016) and the use of hybrid learning models (Movahedzadeh, 2011).

Countries with populations that have science literacy are essential to a nation's ability to solve complex problems (Hanson et al., 2020). Based on the results of the author's interview with nine high school biology teachers, it was found that all biology teachers in high schools spread across several regions in Bali such as Denpasar, Badung, Gianyar, Buleleng and Karangasem had carried out attitude aspect assessment using attitude assessment instruments. 80% of the teachers have carried out such assessments on each student not only limited to students whom the teacher assesses as very prominent or lacking in the aspect of understanding knowledge, but the assessment is carried out on each student equally. Teachers in general have conducted attitude assessments using several assessment techniques such as direct observation, assessment using instruments either self-evaluation of students directly or through attitude assessment techniques assessed by their friends, however, some teachers have to use attitude assessment techniques directly through observation during learning by paying attention to the discipline and activeness and enthusiasm of students in the process Learning. The dimensions of the attitude assessment carried out by the teacher have assessed the spiritual and social aspects. Especially in biology learning, aspects of students' scientific attitudes are generally assessed by teachers through practicum learning. Some teachers also sidelined the problem of online learning during the pandemic by providing virtual practicums.

A scientific attitude can develop high curiosity, so that it can make decisions, develop to find answers, approach problems by thinking openly, practice solving problems, are objective, honest, conscientious, able to cooperate, and enjoy researching. Steps to develop a scientific attitude with the scientific method that includes: observations, making experiments, collecting data, and concluding findings. Based on various studies related to students' scientific attitudes, it can be concluded that a meaningful learning process can be achieved if students have a positive attitude towards science learning, this certainly requires the teacher's pedagogical ability by applying various innovative learning models. This is supported by the results of the interview that 90% of teachers strongly agree and state that students with good attitude scores tend to have good knowledge scores.

Assessment of Knowledge on Indonesian Curriculum

The teacher's understanding of various types of knowledge (factual, conceptual, procedural and metacognitive) contained in the 2013 curriculum is a manifestation of teacher professionalism. These various types of knowledge can then be trained by teachers according to the topics taught and can be assessed for achievement through an assessment of learning approach, assessment for learning and assessment as learning. The results of the knowledge assessment survey conducted by science teachers in Bali can be further observed in Table 3 below.

Table 3. Results of Student Knowledge Assessment Analysis

No	Indicator	Percentage of Good Category Achievement	Information
1	Factual Knowledge	95,2 %	Maintained & improved
2	Conceptual Knowledge	93,6 %	Maintained & improved
3	Procedural Knowledge	88,9 %	Maintained & improved
4	Metakognitive	77,8 %	Improved

These data found that the types of factual, conceptual, and procedural knowledge have been mastered by teachers and applied in the assessment of aspects of knowledge to students, but for metacognitive aspects it still needs to be improved because more than 20% of teachers from the survey results stated that they do not understand the assessment on these aspects, especially in teachers who have not been certified. Based on the analysis of the test documents, it was found that from the four aspects above the assessment of students' knowledge is still dominated by factual, conceptual and procedural knowledge while the proportion of metacognitive knowledge aspects needs to be improved. Students' metacognitive skills are important to be empowered, because students will more easily understand the concepts in biology learning if they have good metacognitive skills (Kurniawati et al., 2015).

Good learning should be able to measure 3 aspects, namely cognitive (knowledge), affective (attitude) and psychomotor (skills) (Ulfa, 2016). In general, the assessment portion is dominated by the assessment of aspects of knowledge, both formative and summative in the form of learning outcomes. Assessment of learning outcomes of cognitive aspects is most widely assessed by teachers because it is related to the ability of students to master the content of the lesson material (Berutu & Tambunan, 2018). Learning outcomes are changes in individuals in terms of cognitive, affective, and psychomotor aspects that they get as a result of a learning process (Azmi et al., 2017) and are used as a benchmark for student success after taking the learning process (Berutu & Tambunan, 2018). Based on the results of a survey of science teachers in Bali, 88.9% of teachers have carried out knowledge assessments in formative and summative forms, however, based on the results of interviews, it is known that teachers tend to feel that knowledge assessment in formative form is considered more useful. Providing feedback in formative assessment is key in student learning outcomes (Nikolaeva & Korol, 2021), formative assessment is further learned can improve students' inquiry skills (Ganajová et al., 2021).

Learning outcomes are influenced by internal and external factors. Internal factors that can influence learning outcomes are factors that come from students which include intelligence, attitudes, habits, talents, interests, and motivation. Factors that come from outside the student's self are called external factors which include family, community, and school (Astiti et al., 2021). Sutrisno & Siswanto, (2016) stated that learning outcomes are influenced by mastery of teacher practice teaching methods, learning media and student learning motivation. furthermore, the study found that teachers who can master teaching methods can ideally foster student learning motivation, especially at the preparatory stage so that students are ready and enthusiastic to start learning. Taiyeb & Mukhlisa, (2015) mentioned that teachers should

increase student learning motivation by paying attention to methods, learning, learning media, and other things to support students in increasing their learning motivation, so that better learning outcomes are obtained. Related to the motivation factor of students, in conducting an assessment aspect based on the results of a survey 94% it was found that science teachers in Bali had made a grid of assessment instruments in aspects of student knowledge, and based on the results of self-assessment through questionnaires in the survey as many as 95.2% of teachers stated that the assessment carried out had supported the learning objectives that had been set. Furthermore, based on the results of observations during the learning process and the analysis of learning device documents, it was found that the suitability between the self-evaluation carried out by the teacher.

In addition to these three factors, there are many other factors that affect learning outcomes including student learning styles (Astiti et al., 2021; Taiyeb & Mukhlisa, 2015). Mastery of learning styles and the accuracy of the use of learning styles by students will greatly help students understand information and absorb the subject matter well, so that learning outcomes will be good. In the learning process, students need to be assisted and directed in recognizing learning styles that suit themselves, so that the objectives of learning can be achieved effectively and become the key to student success in participating in learning activities (Astiti et al., 2021). Berutu & Tambunan, (2018) in his study found that effective study habits positively affect learning outcomes and a strong interest in learning results in high learning achievement and vice versa. To obtain good learning outcomes adequate support of internal and external factors.

Assessment of Skill on Indonesian Curriculum

21st century learning also demands 4C skills, namely critical thinking skills, creative thinking, collaboration and communication, which in the 2013 curriculum SKL is equipped with productive and independent skills. All the skills that are expected to be developed and trained already represent indicators in measuring students' higher order thinking skills (HOTS). The results of its full student skills assessment survey are presented in Table 4.

Table 4. Results of Student Skill Assessment Analysis

No	Indicator	Percentage of Good Category Achievement	Information
1	Creativity	82,5 %	Improved
2	Productivity	84,1 %	Improved
3	Critical Thinking	36,3 %	Noticed, trained & improved
4	Self-regulatory/independence	71,4 %	Improved
5	Collaborative	87,3 %	Maintained & improved
6	Communicative	85,7 %	Maintained & improved

The skill assessment as shown in Table 4, reveals that students' creative, productive, collaborative and communicative skills show good achievements, while students' independent skills still need to be improved and the astonishing thing is that students' critical thinking skills are still very lacking with the achievement of a percentage of good categories of only 36.3%. The findings in this study show that there is an inequality in the achievement of student

creativity skills with critical thinking skills. Several studies report a correlation between critical thinking ability and creativity (Mayarni & Yulianti, 2020; Siburian et al., 2019).

Based on the results of the interview, it was found that the teacher's understanding of student creativity is more emphasized on the assessment of products in the assignment given by the teacher and not on the skills of creativity in problem solving. This finding is in line with Setiawan et al., (2018) who stated that there is no correlation between critical and creative thinking skills. The empowerment of metacognitive skills has an important role in increasing the capacity for critical thinking (Amin et al., 2020). Metacognition skills are related to the management, planning, process and evaluation of learning based on student awareness so that students will choose the right learning strategy according to the needs and learning topics discussed. Suryaningtyas & Setyaningrum, (2020) mentioned that metacognitive knowledge is the knowledge that students have to their thinking processes and consciously use them during solving problems. As students' level of critical thinking increases, they set more learning goals for themselves, monitor their learning process and utilize strategies aimed at improving the quality of their learning by assessing themselves (Gurcay & Ferah, 2018). The ability of good self-regulation can require the individual to achieve the desired goal, so that this ability will be able to overcome difficulties and be able to take advantage of the strengths and advantages in the individual (Mayarni & Yulianti, 2020).

The survey results stated that more skill assessment techniques are carried out by science teachers through practicum activities. Meanwhile, the interview results complete the information that teachers rarely perform project or product assessment techniques due to time constraints. This condition is exacerbated by the transition of face-to-face learning to online, where the time teachers have to deliver learning well is considered more limited.

The Problem in Assessment of Indonesian Curriculum

Based on the results of the interview, the teacher stated that the main obstacle in carrying out the assessment in accordance with the 2013 curriculum was the limited time even though they had carried out the assessment activities as a whole attitudes, knowledge and skills. This obstacle causes in general teachers to only be able to carry out the attitude assessment process towards each student on average 2 times in 1 semester. In addition to other obstacles such as too many students in 1 class, it is also difficult for teachers to conduct attitude assessments, so in practice teachers tend to see students who are active and who are less active in the learning process. The same thing was also found from a study conducted by Zuhera et al., (2017) which stated that the number of students who were too many and limited time became the difficulty of teachers in conducting attitude assessments. Furthermore, the interview results found that the assessment of student attitudes during the online learning process was difficult to observe because of internet connection constraints. The survey results show that overall teachers have reflected on the online logging process, and based on the results of teacher observations, it was found that there was student demotivation in online learning due to internet connection constraints. Interrupted teacher explanations, or students who are thrown out of the online study room several times (zoom / google meet) reduce students' motivation in learning.

The problem with the aspect of knowledge assessment experienced by teachers is to compile HOTS-based questions, especially for those who have not been certified or new teachers and have not attended much training and self-development. From the cognitive level

of C4 (analysis), C5 (evaluation) and C6 (creating) teacher difficulties are mainly experienced when developing questions at the C6 (creating) level. This is supported by research data from Iskandar & Senam (2015) which states that based on the analysis of final semester exam question documents developed by teachers from all questions, the HOTS development section only contains 13.9% of higher order thinking skills elements with the distribution of elements of analyzing or C4 of 13.2% and evaluating (evaluate) or C5 by 0.7%, while C6 (creating / creating) is not found (0%).

The next obstacle felt during the online learning process is the difficulty of teachers in monitoring the honesty of students while taking the test. All teachers agree that there is an increase in student learning outcomes when evaluated through online learning, but this increase in learning outcomes does not make teachers satisfied, on the contrary, from the observation of the learning process, teachers feel that the achievement of learning outcomes does not measure the real ability of students. 4 out of 10 Biology teachers selected to be interviewed stated that the learning outcomes were not considered appropriate because they were not in line with the teacher's observations during the discussion or learning process in class, many students who were not active in the learning process got satisfactory and even very satisfactory scores on the online evaluation. Teachers also compared the results of learning assessments carried out before and after online learning where it was found that there was a fairly drastic increase in certain students when viewed from the learning outcomes.

When viewed from the aspect of metacognitive knowledge from the interview results, it was found that most teachers have not fully understood the various dimensions, indicators or types of instruments that can be accommodated in metacognitive assessment. The metacognitive skills that students already have need to be developed again through metacognitive empowerment carried out by teachers in classroom learning. Metacognitive empowerment can be done through the application of metacognitive strategies in learning such as reading, making concept maps, cooperative learning, self-reflection, and others (Kurniawati et al., 2015). Metacognitive activities include thinking activities to plan, monitor, reflect on how to solve a problem. Metacognition strategies refer to ways to increase awareness of the prevailing thought and learning processes so that if this awareness is realized, metacognitive skills will arise (Siregar, 2019). The development of metacognitive skills is an educational goal because it can help students become self-regulated learners Eggen and Kauchak, 1966 in (Siregar, 2019).

Skill assessment has the main obstacle in terms of time, where teachers generally conduct this assessment at least 2 times and a maximum in accordance with the demands of the existing KD. Other obstacles are the preparation of valid skill assessment instruments, the online learning process of skill assessment (practicum), and the large number of students in 1 class. These various obstacles are from the teacher. Meanwhile, some of the obstacles that come from students in the process of assessing these skills are cognitive ability, spirit, character, motivation, student learning independence and lack of shiva self-confidence.

Conclusion

The results of a thorough investigation into the assessment standards in science learning show that there are several indicators need special attention from teachers to be trained more intensely and improved. The assessment of attitude aspects, student discipline indicators really need to be improved, especially in online learning, while aspects of self-confidence, interaction with the social environment, honesty and responsibility also still need to be improved. Based on the assessment of knowledge aspects, the type of metacognitive knowledge needs to be developed, especially in teachers who have not been certified or new teachers who do not have much experience in participating in personal development training. Assessment techniques The assessment of skill aspects shows that critical thinking skills urgently need to be improved, followed by student independence. Various obstacles experienced by teachers in organizing assessments based on the 2013 curriculum include: 1) time constraints; 2) affective/attitude assessment constraints for too many students in 1 class; 3) limitations in monitoring the online evaluation process in online learning related to student honesty; 4) low teacher creativity in the development of HOTS questions, especially in the cognitive level of C6 (creating/creating) and 5) teacher understanding that is still low in metacognitive knowledge, making it difficult to assess in this aspect. As a recommendation of this study an ideal learning assessment should measure a whole of attitude, knowledge and skills dimensions. The other recommendation is give more opportunities to teachers to participate in activities that develop pedagogical abilities, including especially HOTS and metacognitive skills

Credit Authorship Contribution Statement

Anak Agung Inten Paraniti: Conceptualization, Methodology, Writing (original draft), Writing (review & editing). **I Wayan Subagia:** Visualization, Formal analysis, Supervision **Dewa Ayu Puspawati:** Supervision. **Ni Wayan Ekayanti:** review & editing.

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