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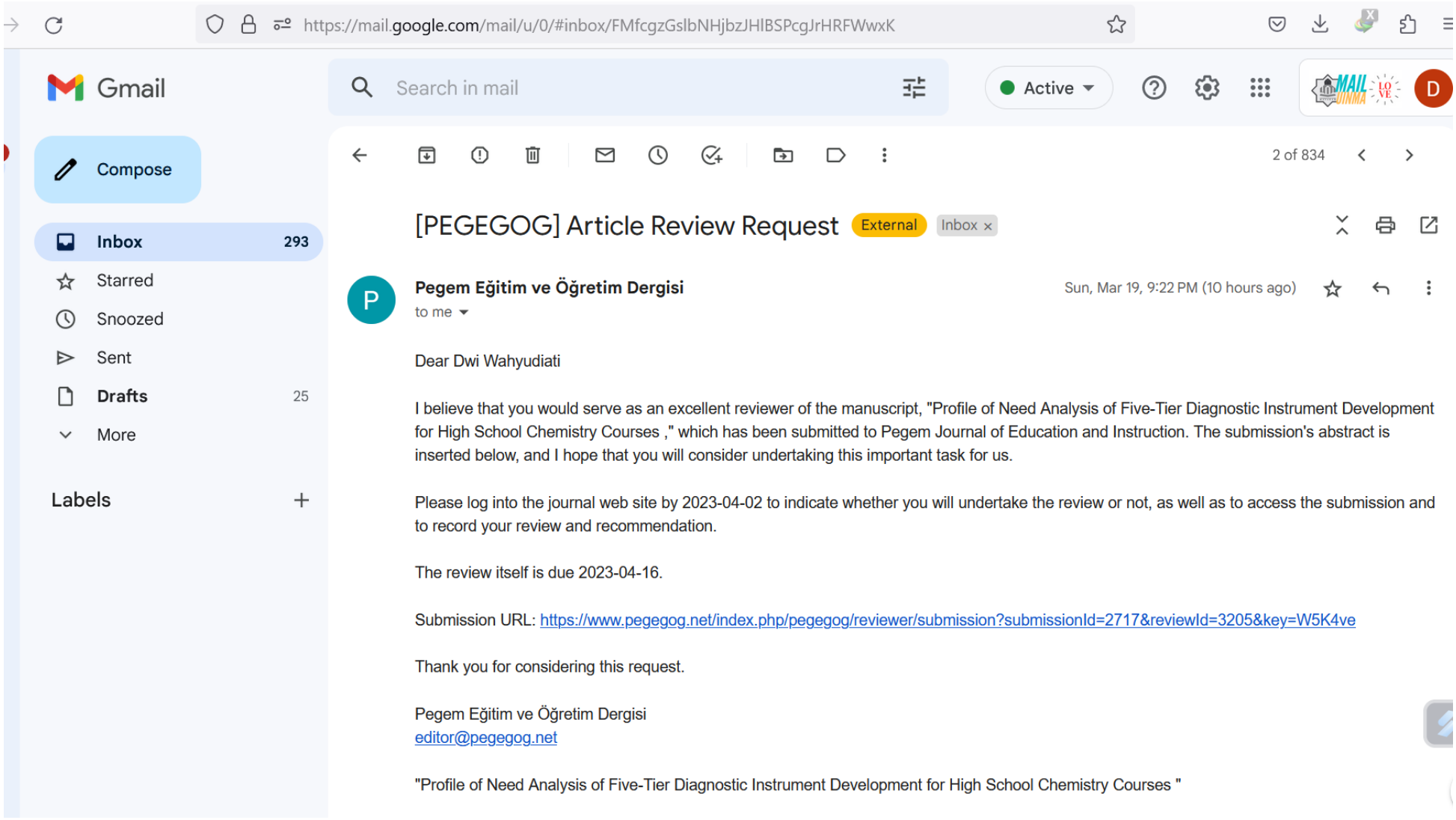

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Profile of Need Analysis of Five-Tier Diagnostic Instrument Development for High School Chemistry Courses

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Abstract

This study aims to determine the need for a multitier diagnostic instrument to identify misconceptions and their causes, as well as multiple representation profiles.The data analysis technique used in this research is descriptive analysis technique. The subjects used in this study were several chemistry teachers in East Java totaling 67 teachers who were taken by random sampling. Data was collected through a questionnaire distributed using google forms media. The results of the analysis found that a diagnostic assessment on chemistry subjects was made up to the macroscopic, submicroscopic, and symbolic levels with a percentage of 93%, it was necessary to apply a diagnostic assessment on all chemistry learning topics with a percentage of 61%, a diagnostic assessment on chemistry subjects was required to be made on a multitier basis. level 5 with a percentage of 79%.

Commented [av1]: In the abstract, the research objectives are still ambiguous, such as misconceptions about what subjects are the object of research? What is studied from grade 1 to grade 3 high school material? Should be described in more detail in the goal so that it becomes more comprehensive.

The research instrument used was developed by the researcher himself? Before use, has the feasibility of the research instrument been tested (validity and reliability)? Please complete it so that the instrument used shows a level of feasibility and validity in accordance with scientific principles.

Analysis of research data using descriptive statistics? Please explain in more detail regarding the descriptive analysis in question!

Keywords: Diagnostic Assessment, Five-Tier, Chemistry Lesson.

Introduction

Education plays an important role in spearheading the progress of the nation, therefore educators are required to be more creative and innovative in preparing students to face the challenges of the times through quality education. Quality in education can be improved through learning components such as good lesson planning, quality learning processes and implementation of learning evaluations. However, in practice, the evaluation of learning outcomes is often neglected (Yulianti & Andriani, 2014). Implementation of learning evaluation is needed because it can be used as a guide for educators to find out learning difficulties for students (Mubarak et al., 2016).

Misconceptions in students can be identified using diagnostic tests (Abidin & Retnawati, 2019). Diagnostic assessment is a process to identify the competencies, strengths and

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weaknesses of students, so that learning can be designed according to the competencies and conditions of students. Diagnostic tests that can be used to identify misconceptions have various forms, such as interviews, open-ended questions, multiple choice tests or graded questions (two-tier, three-tier, four-tier, and five-tier tests) and others (Soeharto et al., 2019). According to Gurel et al. (2015) states that each type of diagnostic test has its own drawbacks. The use of interview tests takes a lot of time, requires special skills in interviews, data analysis is rather difficult and complicated, and difficult to use in large numbers [12]-[10]. The disadvantages of using an open test are that there is a possibility of biased answers, it is difficult to evaluate results and analyze student answers(Gurel et al., 2015), while the multiple choice test cannot provide in-depth information about students' answers. The development of the multiple choice test was carried out to correct the weaknesses in the previous test. The deficiencies in the two-tier to four-tier tests were corrected in the five-tier test.

Added drawing levels to the test (Anam et al., 2019), Five-tier test provides space for students to find out the concepts they are thinking of and measure the differences in the level of knowledge of students so that it can assist in detecting the level of students' misconceptions. The format in the five-tier test consists of: 1) main questions; 2) level of trust; 3) the reason for the answer; 4) self-confidence level; 5) picture/representation of answers. The development of the five-tier test format aims to produce valid diagnostic instruments, be more specific in clarifying students' conceptual understanding, and reveal a more detailed profile of students' conceptual understanding (Setiawan & Jaelani, 2021). Overall, the five-level diagnostic test is the best instrument in providing a clear picture of the concepts that are experiencing misunderstandings and the causes of misunderstandings that occur in students (Putra et al., 2020).

Learning difficulties resulted in decreased interest in learning accompanied by a lack of mastery of concepts by students. According to Chang & Overby (2011) stated that students have difficulty in chemistry compared to other sciences. Difficulties in understanding chemistry are caused by the characteristics of abstract concepts (Permatasari et al., 2022). According to Sunyono in Sari et al., (2018) states that the characteristics of the concept of chemistry are in the form of multiple representations, namely the practice of re-presenting the same concept through various forms, which include verbal mode, visual mode, symbolic, graphic, and numerical to describe the concept on macroscopic, sub-microscopic, and symbolic levels of representation. Students are declared to understand the concept if they have been able to recognize and manipulate concepts in various representations. The concept of chemistry must be represented in various forms. The lack of mastery of multiple representations in chemistry lessons causes students to assume that chemistry consists of broad abstract conceptshard to learn(Üce & Ceyhan, 2019). The need for understanding a lot of concepts, it is possible for students to have an understanding of different concepts or misconceptions. According to Kirbulut & Geban (2014) misconceptions are defined as students' understanding of accepted concepts that are different from scientifically accepted concepts. Misconceptions must be handled quickly and precisely because misconceptions tend to persist and can hinder learning, make learning less meaningful, cause ongoing misconceptions, and can hinder the development of science and technology (Bayuni et al., 2018; Luqman & Abbas, 2019; Permatasari et al., 2022; Putra et al., 2020).

Commented [av2]: The introductory section must be equipped with the urgency of the problem that is used as a research reference, and the relationship between research variables must be explained in more detail so that the research conducted shows a valid relationship between each variable. What misconception is meant? What are the topics of discussion that usually cause misconceptions so that the urgency of this research is clearly revealed.

In addition, it is necessary to reveal the reasons why it is important to conduct this research and to explain the update of this research so that its superiority is clear compared to relevant previous research.

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Method

The data analysis technique used in this research is descriptive analysis technique. Descriptive analysis is a statistic used to analyze data by describing or describing the data that has been collected as it is without intending to make conclusions that apply to the public or generalizations (Sugiyono, 2019)

The subjects used in this study were several chemistry teachers in East Java totaling 67 teachers. The sample was taken by random sampling because the sample was considered representative of the chemistry teachers in East Java.

Data collection in this study used a needs analysis questionnaire distributed through Google Forms. This needs analysis questionnaire is used to determine the need for a multitier diagnostic instrument to identify misconceptions and their causes as well as multiple representation profiles. A needs analysis study can provide and present data that is in accordance with the needs and can be accounted for in a representative manner (Roy Asrori et al., 2021).

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Analysis of research data using descriptive statistics? Please explain in more detail regarding the descriptive analysis in question!

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Findings

Based on the results of the questionnaire distributed to 67 chemistry teachers, it was found that 52 people were female and 15 were male. Based on teaching experience as many as 70.1% of educators become teachers for more than 10 years, 23.9% of educators become teachers for less than 5 years, and 6% between 5-10 years. Based on a closed questionnaire conducted by the teacher, answers were obtained regarding initial information regarding the use of diagnostic tests. These results can be seen in Table 1

Table 1. Questionnaire results include Analysis of Early Knowledge Diagnostic Tests

No	Question	Question Answer
1	Do you know the diagnostic instruments?	54 respondents answered Knowing and 13 Don't know
2	Have you ever/have implemented a diagnostic assessment before learning?	44 respondents answered Yes and 23 Never
3	Have you ever/have you implemented a diagnostic assessment during learning?	45 respondents answered Yes and 22 Never
4	Have you ever/have implemented a diagnostic assessment after learning?	50 respondents answered Yes and 17 Never
5	Is it necessary to use a diagnostic assessment in the learning process?	63 respondents answered Necessary and 4 Not Necessary
6	Is it necessary to make a diagnostic assessment of chemistry subjects at the macroscopic, submicroscopic, and symbolic levels?	62 respondents answered Necessary and 5 Not Necessary
7	Is it necessary for diagnostic assessment to be applied to all topics in chemistry learning?	41 respondents answered Necessary and 26 Not Necessary

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8	Is it necessary to make a diagnostic assessment in chemistry subjects based on multitier level 5 (level five components, namely, a. Answers to questions, b. level of confidence in question answers, c. answers to reasons, d. level of confidence in reasoning answers, e. answers to representations and sources of pictures? answer)?	53 respondents answered Necessary and 14 Not Necessary

Table 2. Questionnaire results include Analysis of Application of Diagnostic Tests

No	Question	Question Answer
1	Do you know the diagnostic instruments?	54 respondents answered Knowing and 13 Don't know
2	Have you ever/have implemented a diagnostic assessment before learning?	44 respondents answered Yes and 23 Never
3	Have you ever/have you implemented a diagnostic assessment during learning?	45 respondents answered Yes and 22 Never
4	Have you ever/have implemented a diagnostic assessment after learning?	50 respondents answered Yes and 17 Never
5	Is it necessary to use a diagnostic assessment in the learning process?	63 respondents answered Necessary and 4 Not Necessary

Discussion

Based on the results of the questionnaire distributed to 67 chemistry teachers, it was found that 52 people were female and 15 were male. Based on teaching experience as many as 70.1% of educators become teachers for more than 10 years, 23.9% of educators become teachers for less than 5 years, and 6% between 5-10 years. Based on a closed questionnaire conducted by the teacher, answers were obtained regarding initial information regarding the use of diagnostic tests. These results can be seen in Table 1

Table 3. Questionnaire results include Analysis of Early Knowledge Diagnostic Tests

No	Question	Question Answer
1	Do you know the diagnostic instruments?	54 respondents answered Knowing and 13 Don't know
2	Have you ever/have implemented a diagnostic assessment before learning?	44 respondents answered Yes and 23 Never
3	Have you ever/have you implemented a diagnostic assessment during learning?	45 respondents answered Yes and 22 Never
4	Have you ever/have implemented a diagnostic assessment after learning?	50 respondents answered Yes and 17 Never
5	Is it necessary to use a diagnostic assessment in the learning process?	63 respondents answered Necessary and 4 Not Necessary

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6	Is it necessary to make a diagnostic assessment of chemistry subjects at the macroscopic, submicroscopic, and symbolic levels?	62 respondents answered Necessary and 5 Not Necessary
7	Is it necessary for diagnostic assessment to be applied to all topics in chemistry learning?	41 respondents answered Necessary and 26 Not Necessary
8	Is it necessary to make a diagnostic assessment in chemistry subjects based on multitier level 5 (level five components, namely, a. Answers to questions, b. level of confidence in question answers, c. answers to reasons, d. level of confidence in reasoning answers, e. answers to representations and sources of pictures? answer)?	53 respondents answered Necessary and 14 Not Necessary

Question number 1 in Table 1 presents prior knowledge regarding the diagnostic assessment by the teacher. Diagnostic assessment is an assessment carried out specifically to identify the competencies, strengths and weaknesses of students, so that learning can be designed according to the competencies and conditions of students. The function of the diagnostic assessment according to Prihatni et al., (2016) aims to monitor the progress and learning outcomes of students, compare the abilities of students, diagnose learning difficulties, provide feedback/improvements to the teaching and learning process, and determine grade increases. The application of the assessment can be done before, during, and after learning.

Questions 2 to 4 in Table 1 present the application of the diagnostic assessment in the learning process that has been carried out by the teacher. From the table above, it is known that the teachers have had initiatives in terms of implementing diagnostic assessments in the learning process either before, during, or after learning. To get an effective test, it is necessary to organize the implementation of the test properly. The application of a diagnostic assessment before learning is used as a first step to find out errors and learning difficulties of students Intan Permata et al (2017) so that understanding can be improved during learning and make learning more effective.

Question number 5 in Table 1 presents initial information regarding the purpose of the diagnostic assessment held by the teacher. The use of diagnostic assessment in the learning process needs to be linked to the objectives of the assessment itself. According to Rahman (2017) the objectives of the assessment are: (1) diagnosing students' strengths and weaknesses in learning, (2) monitoring student progress, (3) determining student ability levels, (4) determining learning effectiveness, and (5) influencing public perception. about learning effectiveness. The purpose of the assessment is none other than to increase effectiveness in learning.

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Question number 6 in Table 1 presents the need for diagnostic tests in chemistry subjects carried out to multiple representations. Students' understanding of chemical concepts is needed in a meaningful way, namely by connecting three levels of representation in chemistry, namely macroscopic, submicroscopic, and symbolic representations. John Stone in Nyachwaya & Wood (2014) revealed that the macroscopic level involves phenomena that can be observed by the five senses, the submicroscopic level involves particles such as atoms, molecules and ions, and the symbolic level involves symbols, chemical formulas and graphics. Rokhim et al., (2020) argues that students tend to have difficulty in analogizing concepts that require more imagination. According to Asih & Ibnu (2018), the low formal thinking ability of students causes difficulties in understanding submicroscopic aspects so that there is the potential for misunderstandings. So it is very important to make a diagnostic assessment of chemistry subjects.

Question number 7 in Table 1 presents the need for a diagnostic test in chemistry subjects. Chemistry is a science that discusses the properties of substances, changes in substances, laws and concepts and theories that accompany changes in these substances (Effendi, 2016). Chemistry lessons are lessons given at the high school level with a wide range of material[21]. Students often have difficulty in learning chemistry this is caused by:Not all concepts understood by students can be observed directly or are abstract. The difficulties experienced by students result in decreased interest in learning in chemistry and can hinder subsequent learning.

Question number 8 in Table 1 presents the need for a diagnostic test in chemistry subjects based on a multitier level 5. Diagnostic assessment is useful for diagnosing students' conceptions of the concepts that have been studied and the reasons behind the answers given (Anam et al., 2019). The multitier diagnostic assessment has developed a lot, such as the five-tier diagnostic assessment, which is an assessment that corrects the weaknesses of the previous multi-tier diagnostic assessment by adding a questionnaire to identify the source of the misconceptions on the fifth level (Bayuni et al., 2018).

Based on the open questionnaire conducted by the teacher, the answers related to the implementation of the diagnostic test were obtained. These results can be seen in Table 2.

Table 4. Questionnaire results include Analysis of Application of Diagnostic Tests

No	Question	Question Answer
1	Do you know the diagnostic instruments?	54 respondents answered Knowing and 13 Don't know
2	Have you ever/have implemented a diagnostic assessment before learning?	44 respondents answered Yes and 23 Never
3	Have you ever/have you implemented a diagnostic assessment during learning?	45 respondents answered Yes and 22 Never
4	Have you ever/have implemented a diagnostic assessment after learning?	50 respondents answered Yes and 17 Never
5	Is it necessary to use a diagnostic assessment in the learning process?	63 respondents answered Necessary and 4 Not Necessary

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Questions 1 and 2 in Table 2 present the way in which the assessment has been carried out by the teacher. To carry out the function of the assessment, the data must be analyzed through an assessment instrument in the form of formal or non-formal methods or procedures, to find out information about students (Firmanzah & Sudibyo, 2021). Based on Soeharto et al (2019) stated that the method of implementing diagnostic assessments has various methods such as interviews, open-ended questions, multilevel questions (two-tier, three-tier, four-tier, five-tier tests) and others (Soeharto et al., 2019). Based on the data obtained, there are still a few chemistry teachers in East Java who use a diagnostic instrument using a multitier assessment. There are various types of multi-tier assessments, such as two-tier, three-tier, four-tier, and five-tier assessments. The development of this multitier assessment is nothing more than to complement the shortcomings contained in the previous instrument.

Question 3 in Table 2 presents the purpose of implementing the assessment that has been carried out by the teacher. From the data obtained, it is known that the application of diagnostic assessment is used to determine understanding of the material/content and to plan appropriate learning designs. Diagnostic assessment is a tool that can detect students' difficulties in understanding the material so that understanding of the material can be known. From the difficulties experienced by students, the teacher can plan an appropriate learning design for the next lesson.

Question 4 in Table 2 presents the application of the assessment that has been carried out by the teacher. One of the subjects in class that can support future development is chemistry (Widarti et al., 2020). In Indonesia, chemistry lessons have a very broad scope of material (Romadhona et al., 2020). However, students have difficulty in chemistry compared to other sciences (Chang & Overby, 2011). One of the difficulties experienced by students is misconception. Identifying misconceptions is the first step in handling misconceptions because handling misconceptions can be done effectively when the misconceptions are clearly identified. The tool that can diagnose students' misconceptions is a five-tier-based diagnostic test. From the research data, teachers need a five-tier diagnostic test based on chemistry lessons to: (1) know the understanding of chemistry concepts, (2) diagnose problems and difficulties experienced by students and their solutions (3) get students' answers more accurately, and (4) designing future learning.

Question 5 in Table 2 presents the expected achievement of the assessment carried out by the teacher.The results of the respondent's answer data argue that a good diagnostic assessment is an easy assessment to find out the shortcomings of students, simple, does not burden the learning process, provides accurate results, and can adapt to situations and conditions.

Commented [av5]: In this section, it is important to reveal the most urgent research findings that distinguish them from previous studies that are equipped with valid reference sources.

Conclusion

Based on the research conducted, it was found that the analysis results required that a diagnostic assessment in chemistry subjects was made up to the macroscopic, submicroscopic, and symbolic levels with a percentage of 93%, required the application of a diagnostic assessment on all topics of chemistry learning with a percentage of 61%, a

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diagnostic assessment was needed in the subject. Chemistry lessons are made based on multitier level 5 with a percentage of 79%. So it can be concluded that a five-tier diagnostic assessment is needed for high school chemistry subjects made up to the macroscopic, submicroscopic, and symbolic levels.

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It needs to be completed with the limitations of the research and recommendations for further research based on the findings of the research that has been done.

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Review results

Title:

1

2 **Profile of Need Analysis of Five-Tier Diagnostic Instrument Development for**

3 **High School Chemistry Courses**

No	Article Section	Comments or suggestions
1	Title	Already met the standard
2	Abstract	In the abstract, the research objectives are still ambiguous, such as misconceptions about what subjects are the object of research? What is studied from grade 1 to grade 3 high school material? Should be described in more detail in the goal so that it becomes more comprehensive. The research instrument used was developed by the researcher himself? Before use, has the feasibility of the research instrument been tested (validity and reliability)? Please complete it so that the instrument used shows a level of feasibility and validity in accordance with scientific principles. Analysis of research data using descriptive statistics? Please explain in more detail regarding the descriptive analysis in question!

3	Introduction	The introductory section must be equipped with the urgency of the problem that is used as a research reference, and the relationship between research variables must be explained in more detail so that the research conducted shows a valid relationship between each variable. What misconception is meant? What are the topics of discussion that usually cause misconceptions so that the urgency of this research is clearly revealed. In addition, it is necessary to reveal the reasons why it is important to conduct this research and to explain the update of this research so that its superiority is clear compared to relevant previous research.
4	Resarch Method	 The research instrument used was developed by the researcher himself? Before use, has the feasibility of the research instrument been tested (validity and reliability)? Please complete it so that the instrument used shows a level of feasibility and validity in accordance with scientific principles. Analysis of research data using descriptive statistics? Please explain in more detail regarding the descriptive analysis in question!
5	Finding	For data analysis, it needs to be equipped with more detailed data that reveals each question and should be equipped with data based on the gender and age range of the research respondents.
6	Discussion	In this section, it is important to reveal the most urgent research findings that distinguish them from previous studies that are equipped with valid reference sources.
7	Conclusion	Is quite relevant to the research findings. It needs to be completed with the limitations of the research and recommendations for further research based on the findings of the research that has been done.
8	References	Need to be completed with reference sources with the last 3 years