

Diagnostic Test for Analyze Students' Conception in Science Education: A Review Article

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Abstract. Diagnostic tests are a form of evaluation in education that has a high level of urgency because diagnostic tests are able to find the level of students' conceptions. So, this study aims to examine the research that has been carried out related to diagnostic tests for evaluation in education, the possibility of further development, and impact on the implementation of evaluation in education. This research is a review study to analyze research trends regarding diagnostic tests for evaluation in education, the possibilities for their development, and their impact on education. Based on the results of the research and the descriptions, this is certainly an opportunity to conduct research related to diagnostic tests to analyze the level of students' conceptions in science education. The research related to diagnostic tests for evaluation in the field of education is still very much needed. Opportunities that can be further developed related to related research are the development of diagnostic test materials, forms of diagnostic tests, to the research subjects of the diagnostic tests themselves. This will certainly have an impact on the development of educational evaluation which not only provides alternative evaluation tools for teachers, but also provides clear information about the level of students' conceptions, even to analyze the misconceptions possibility in students, as well as providing information to teachers about the feedback that must be given to the students.

Key words: Diagnostic Test; Conception; Science; Education; Review Article

INTRODUCTION

Curriculum changes will always occur in the world of education. Many activities must be carried out in the implementation of learning in the classroom. Measurement and assessment are aspect that must be considered during the implementation of learning in the classroom. Measurement and assessment are one of the teacher's activities in determining the success of learning in the classroom, to providing feedback to students.

Diagnostic tests are a form of evaluation that can be carried out by teachers. Through diagnostic tests, teachers can obtain various information such as learning outcomes to find out the level of students' conception, even if there are misconceptions in students. With this diagnostic test, teachers can easily evaluate and provide appropriate feedback to students. Diagnostic tests take many forms, ranging from two-tier, three-tier, four-tier, and so on.

Some topics in science learning always provide misconceptions of novice students, and there is a wide variety of diagnostic assessments that researchers used to identify student misconceptions in science (Astuti et al., 2021; Azqiya & Rahayu, 2021; Barton, 2018; Munggarani et al., 2021; Soeharto et al., 2019; Soeharto, 2021; Varun & Krishnan, 2021). Where the misconception becomes an obstacle to the new concept that will be accepted by the student

(Amer & Aldesoky, 2021; Amer & Alnaja, 2017; Dellantonio & Pastore, 2021; Mustofa & Asmichatin, 2019; Neidorf et al., 2020; Qian & Lehman, 2017; Tawde et al., 2017; Vitharana, 2021). In addition, diagnostic tests are also capable of informing the depth of understanding of a material by students (Rahayu & Hariyono, 2019).

Diagnostic tests are a form of evaluation in education that has a high level of urgency. This is because diagnostic tests are able to find the level of students' conception, and also to find misconceptions that occur in students, so teachers can easily evaluate the learning process and find the right feedback for students.

Based on the foregoing, it is clear that diagnostic tests for evaluation in education have their own urgency. Of course, there have also been many studies that discuss diagnostic tests, especially in the implementation of evaluation in education. So, this study aims to examine the research that has been carried out related to diagnostic tests for evaluation in education, the possibility of further development, to impact on the implementation of evaluation in education.

METHODS

This research is a review study to analyze research trends regarding diagnostic tests for evaluation in education, the possibilities for their development, and their impact on education. This

stage of research is to search for related research articles, filter related research articles, classify related research articles, and analyze related research articles.

The articles that have been obtained through the Publish or Perish software was 994 articles. As for the 994 articles, it was re-screened with a focus on articles that discussed diagnostic tests for the analysis of misconceptions in science education (including physics, chemistry, as well as biology). In the end, the number of articles to be studied in more depth is 78 articles.

The first stage is the search for articles related to diagnostic tests. This article uses Harzing's Publish or Perish software. This research is limited to diagnostic tests for the science learning process. The second stage is to filter out the articles that have already been found. Screening is based on articles about diagnostic tests applied for evaluation in education. The third stage is the classification of articles that have gone through the filtering stage. The classification of articles is carried out on the basis of several categories. The category is the classification of research articles based on the test materials in the diagnostic test, the form of the diagnostic test, the location of the study, the subject of the study, the publication, and the year of publication. This categorization aims to find out the research that has been done before according to the category, so that in the end it can help in finding possible probabilities that can be studied and re-done for further research. The fourth stage is to analyze the articles that have been filtered and classified. The analysis at this stage focuses on the results of related research that has been carried out, the possibility of further development, and its impact on the implementation of the evaluation.

The data that have been obtained and have been classified are then analyzed quantitatively and qualitatively to find the probability of further development in the future. In addition, another analysis carried out is to analyze the impact of its implementation in evaluation in the realm of education.

RESULTS AND DISCUSSION

The results of searching for articles through the Publish or Perish software obtained 994 articles. As for the 994 articles, it was re-screened with a focus on articles that discussed diagnostic tests for the analysis of misconceptions in science education (including physics, chemistry, as well

as biology). In the end, the number of articles to be studied in more depth is 78 articles.

Test Material in Diagnostic Test

The results of the classification of research related to the material in diagnostic tests are evenly distributed. The list of material tables is as follows:

Table 1. Classification of diagnostic test materials.

Material	Number of Studies
Science	7
Physics	2
Chemistry	1
Geometric Optics	5
Chemical Reactions	3
Temperature and Heat	7
Effort and Energy	5
Mechanical Waves	1
Acids and Bases	2
Characteristics of Objects/Particles	2
Fluid	5
Cell	3
Harmonic Motion	2
Dynamic Electricity	2
Atomic nuclei	1
Milieu	2
Vector	1
Ionization Energy	1
Human Anatomy	1
Equilibrium of Rigid Objects	1
Wave	1
Sound Waves	1
Circular Motion	2
Kinetic Theory of Gas	2
Genetics	2
Static Electricity	1
Motion System	1
Photosynthesis	3
Magnet	1
Plant Life	1
Nutrient	1
Gravitation	1
Newton's law	1
Momentum and Impulse	1
Electrolyte and Non-electrolyte	1
Virus	1
Mole	1
Water	1
Earth	1

The classification results show that the diagnostic test materials that have been analyzed are evenly distributed on various materials, with

the most materials being science material in general and temperature and heat material in particular as many as 7 studies.

Diagnostic Test Form

The results of the classification of research related to the form of diagnostic tests are spread into various forms. The distribution of the forms of diagnostic tests is as follows:

Table 2. Classification of diagnostic test forms.

Forms of diagnostic tests	Number of Studies
Two-Tier	9
Three-Tier	23
Four-Tier	28
Five-Tier	5
Six-Tier	1
Other	12

The classification results show that the forms of diagnostic tests that have been analyzed are divided into various forms. A total of 9 studies in the form of a one-tier test, 23 studies in the form of a three-tier test, 28 studies in the form of a four-tier test, 5 studies in the form of a five-tier test, 1 study in the form of a six-tier test, and 12 studies in other forms.

Publication

The results of research classifications related to research publications are spread in various journals or proceedings. The distribution of diagnostic test research publications is shown in the following table:

Table 3. Classification of Diagnostic Test Publications.

Publication	Number of Studies
Advances in Social Science, Education and Humanities Research Proceedings	2
AIP Conference Proceedings	2
Scientific Periodicals of Biology Education	2
Chemistry Education Research and Practice	1
Curricula: Journal of Teaching and Learning	1
European Journal of Physics Education	1
Scientific Journal of Physics Education Al-BiRuNi	1

Journal of Physics Education Innovation and Scientific Research	1
Golden Childhood Education Journal	1
ICE Conference Proceedings	1
Ilkogretim Online	2
Impulse: Journal of Research and Innovation in Physics Education	1
Indonesian Review of Physics	1
Physics Education Innovation	5
International Education Studies	1
International Electronic Journal of Environmental Education	1
International Journal of Advanced Scientific Research and Management	1
Journal for the Education of Gifted	1
Journal of Baltic Science Education	1
Journal of Biological Education	1
Journal of Physics: Conference Series	17
International Journal of Science Education	1
Indonesian Journal of Science and Mathematics Education	1
Journal of Turkish Science Education	3
Journal of Educational and Learning Dimensions	1
Journal of Biology Learning: A Study of Biology and Its Learning	1
Indonesian Journal of Science Education	2
Journal of Physics Education	1
Journal of Physics and Scientific Education	1
Journal of Physics Education Research and Development	1
Journal of Science Education Research	1
KIU Journal of Social Sciences	1
International Journal of Advanced Science and Technology	1
International Journal of Education in Mathematics, Science and Technology	1
Proceedings of Integrative Science Education	1
Journal of Natural Science and Integration	1
International Conference on Science Education (ICoSEd) Proceedings	1
PAPSI Interational Research Conference Proceedings	1
Periodico Tche Quimica	1
Physical Review Physics Education Research	1
Physics Communication	1
Research in Science & Technological Education	1
Research in Science Education	1
International Research Journal of Engineering, IT and Scientific Research	1
Review of International Geographical Education	1

Scientiae Educatia: Journal of Science Education	1
Universal Journal of Educational Research	1
Unnes Science Education Journal	3
WaPFI (Physics Education Vehicle)	1

proceedings of the Journal of Physics: Conference Series (indexed by Scopus) as many as 17 studies.

Year of Publication

The results of the research classification related to the research year are spread from 2017 to 2021. The distribution of diagnostic test research years as shown in the following graph:

The classification results show that the related research publications that have been analyzed are scattered in various journals or proceedings with the most publications in the

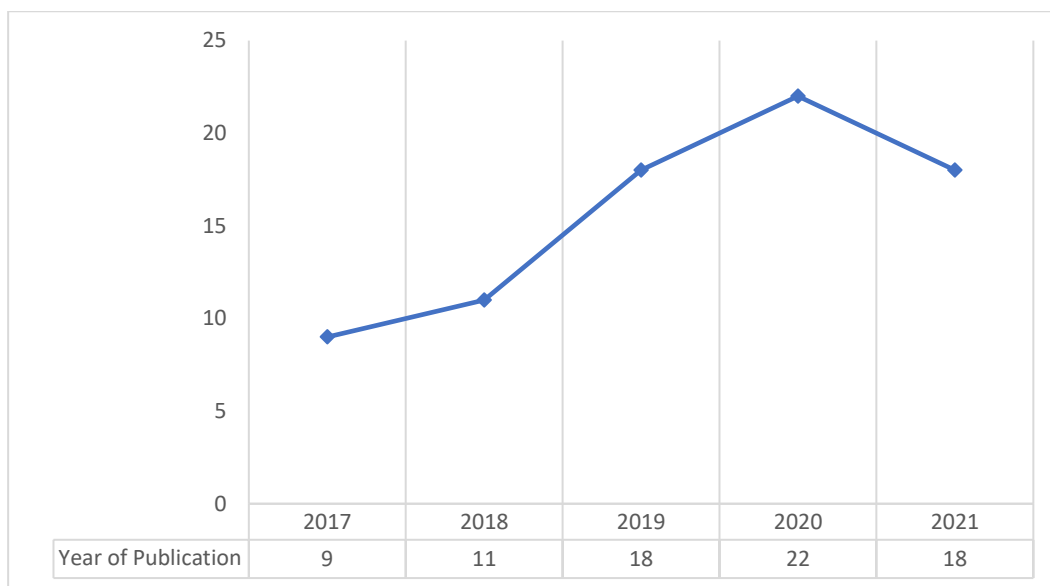


Figure 1. Classification of years of publication of diagnostic tests.

The classification results show that the research years that have been analyzed are spread from 2017 to 2021. In 2017 there were 9 studies related to diagnostic tests for evaluation in the field of science education, in 2018 as many as 11 studies, in 2019 as many as 18 studies, in 2020 as many as 22 studies, and in 2021 as many as 18 studies.

Discussion

This study reviews studies related to diagnostic tests for evaluation in education. Search results found 994 studies related to diagnostic tests from 2017 to 2021. All research obtained has been indexed by Google Scholar. However, after further deepening, in the end there were only 78 studies left. The 78 studies are the main focus because they relate to diagnostic tests and their application to analyze misconceptions in science education. The rest of the research is not used because it addresses other areas, such as the field of medicine.

The classification results show that the diagnostic test materials that have been analyzed

are evenly distributed on various materials, with the most materials being science material in general and temperature and heat material in particular as many as 7 studies.

The above findings suggest that there is still material that may be required for diagnostic test research. For example, in quantum mechanics in physics, the circulatory system in biology, and others. This is certainly an opportunity for further research in research related to diagnostic tests that serve to analyze the level of students' conception and possibility of students' misconceptions in science. Where the material on the diagnostic test uses material that has not been studied by previous research.

The results of the classification of research based on the form of diagnostic tests are divided into 6 types of research. A total of 9 studies in the form of a one-tier test, 23 studies in the form of a three-tier test, 28 studies in the form of a four-tier test, 5 studies in the form of a five-tier test, 1 study in the form of a six-tier test, and 12 studies in other forms. The four-tier test form is the most widely used form of test in research, followed by

the three-tier test form. The six-tier test form is the least used form of test in research related to diagnostic tests for evaluation in education.

These findings provide clarity that many researchers have been able to develop diagnostic test instruments in the form of three-tier to four-tier. The only form of diagnostic test for which there is still little research is the six-tier test. This is certainly an opportunity for researchers to conduct research and development related to diagnostic tests for evaluation in the field of education, with diagnostic tests developed in six-tier form.

However, researchers also need to examine the needs of the number of tiers used. Isn't it that two-tier or three-tier alone is enough to analyze the level of students' conception and possibility of students' misconceptions in science. If so, then this is another opportunity in the future that researchers can compare the effectiveness of each existing form of test in analyzing the level of students' conception and possibility of students' misconceptions, especially on science material.

The results of the research classification based on publications show that the research is spread in various journals and proceedings. The most publications are found in the proceedings of the Journal of Physics: Conference Series (indexed by Scopus) with 17 studies. In addition, the proceedings of the Journal of Physics: Conference Series (indexed by Scopus) have become a publication site for many publications related to diagnostic tests to analyze misconceptions on science material.

The results of the research classification based on the research year are spread over the last

5 years (2017 to 2021). The most research related to diagnostic tests to analyze misconceptions in science material occurred in 2020 as many as 20 studies. However, it can be seen from the graph that the number of studies related to diagnostic tests to analyze the level of students' conception and possibility of students' misconceptions in science material has increased every year. Although in 2021 there was a slight decline.

However, it is undeniable that increasingly, research related to diagnostic tests to analyze the level of students' conception and possibility of students' misconceptions in science materials is becoming increasingly in demand. Of course, by realizing this, it is an opportunity for other researchers to increase research output related to diagnostic tests to analyze the level of students' conception and possibility of students' misconceptions in science material.

Based on the results of the research and the descriptions above, this is certainly an opportunity to conduct research related to diagnostic tests to analyze the level of students' conception and possibility of students' misconceptions in science education. Some of these opportunities include further research in the form of the development of diagnostic tests on quantum physics or circulatory system materials (one of the materials that has not been studied in diagnostic test research). In addition, research development can also be developed in the form of diagnostic tests in the form of six-tier tests.

The analysis continued by mapping related research into VosViewer. The mapping results look like the following image:

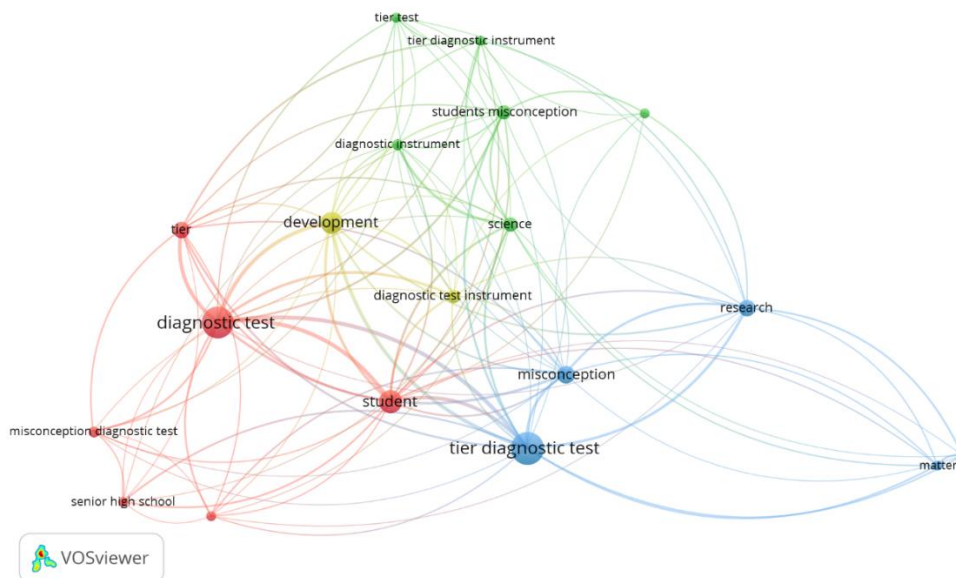


Figure 2. Mapping from VosViewer Related Diagnostic Tests.

Based on the picture above, it appears that diagnostic tests have a relationship with misconceptions and science materials in learners. However, it can be seen from the figure that the line of relationship between diagnostic tests, the level of students' conception and possibility of students' misconceptions, and science materials is still very thin. This can be interpreted to mean that there is still little research related to these variables.

The existence of diagnostic tests is able to provide analytical information about the level of students' conception and possibility of students' misconceptions in science. In addition, in the implementation of the learning process, diagnostic tests as an evaluation tool provide clear information to the teacher about the condition of the students. Where this allows the teacher to determine the feedback that should be given to the student in question. In addition, with diagnostic tests, teachers can obtain information about the initial condition of students, so that later teachers can determine the appropriate learning achievement goals.

Measurement and assessment are very vital procedures for the development of the learning process (Al-Shargabi, 2019; Damilola, 2020; Katea, 2022; Sharma et al., 2016). The assessment of students' knowledge is seen as a bridge between the learning and teaching processes (Mihelič & Zore, 2021). Measurement and assessment can have an impact on learning and teaching as educators are increasingly being demanded for the purposes of improvement, accountability or curricular development (Davis et al., 2018; Mastagli et al., 2020; Miguel et al., 2018; Nikou & Economides, 2021). Currently, the development of online assessments and evaluations (Podsiad & Havard, 2020) that are eligible for online education is urgently needed, especially during this Covid-19 pandemic (Kumaş & Kan, 2021). Evaluation is a reason to make decisions about the learning process that has been implemented, plan the next lesson and monitor progress (de Jesus Elias Correia & Cid, 2021; Díaz López, 2018; McClain et al., 2018; Misiejuk et al., 2021; Sozer et al., 2019; Tobase et al., 2017). The establishment and improvement of mechanisms, the measurement and assessment of teachers will effectively improve the concept of the material, and also the effects of the educational curriculum itself (Liu & Ma, 2021)

The diagnostic test has been shown to be able to find out the level of students' conception and possibility of students' misconceptions in

science that occur in students. Student misconceptions can be well measured and evaluated in the presence of this diagnostic test (Azis et al., 2020; Efriani et al., 2019; Erwinsyah et al., 2020; Fakhriyah & Masfuah, 2021; Janah et al., 2021; Kesuma et al., 2020; Laliyo et al., 2021; Métioui & Trudel, 2021; Nahadi et al., 2018; Soeharto et al., 2019; Soeharto, 2021; Versteeg et al., 2019). Various misconceptions on a number of materials can be analyzed ranging from diagnostic tests such as harmonic vibration, temperature and heat, parabolic motion, to basic mathematical concepts (Kanwal & Farooq, 2021; Maison et al., 2021; Negoro & Karina, 2019; Septiyani & Nanto, 2021). Not only misconceptions in students, diagnostic tests can also provide information about the misconceptions that the prospective teacher has (Abdullah, 2020; Kiray & Simsek, 2021; Palisoa et al., 2020; Prayitno et al., 2020; Suwono et al., 2021; Taban & Kiray, 2021; Zulfia et al., 2019). Diagnostic tests are even often used to place students into appropriate courses and are usually used in mathematics and science departments in universities (Burkholder et al., 2021).

CONCLUSION

The results of the analysis show that the need for research related to diagnostic tests for evaluation in the field of education is still very much needed. Opportunities that can be further developed related to related research are the development of diagnostic test materials, forms of diagnostic tests, to the research subjects of the diagnostic tests themselves. This will certainly have an impact on the development of educational evaluation which not only provides alternative evaluation tools for teachers and to know the level of students' conception in science material, but also provides clear information about possible misconceptions in students, as well as providing information to teachers about the feedback that must be given.

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