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Implementation of Formative Assessment in Physics Learning to Improve Students' Conceptual Understanding

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Abstract

This research examines the application of formative assessment to physics learning to increase students' conceptual understanding. This literature review includes publications from 2014 to 2024 taken from Google Scholar and GARUDA, with 14 articles taken with appropriate criteria. The research results show that using technology-based formative assessments, such as Google Forms, TikTok videos, multimedia modules, and web-assisted assessment systems, effectively increases students' conceptual understanding and motivation. This approach provides fast and precise feedback, identifies misconceptions, and supports students' scientific argumentation abilities. Overall, applying formative assessment and integrating technology in physics learning is important in deepening students' understanding of concepts.

Keywords: formative assessment; physics learning; understanding

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INTRODUCTION

The learning process used by teachers to raise students' intellectual, moral, and various skills urgently needs to be developed in the 21st century. These abilities include creative thinking, problem-solving, knowledge creation, and understanding subject matter well (Menéndez et al., 2019; Syahputra, 2018). A proper assessment must follow the 21st-century learning process. The vision of 21st-century assessment is to have the ability to apply knowledge in depth in various situations (Geinsinger, 2016; Haug & Mork, 2021; Pellegrino 2014; Winaryati, 2018).

The learning implementation plan, especially assessment, is an important element in the Indonesian Minister of Education and Culture Regulation Number 103 of 2014. Teachers must prepare techniques and steps to conduct comprehensive assessments and measurements. If the teaching materials come from different teachers, they must also work together with other teachers (Festiyed, 2015). Teachers can conduct assessments using formative assessment. Variations in learning experiences are needed to achieve the expected results (Lee et al., 2020). Teachers must apply learning and assessment based on

learning characteristics in the 21st century.

Assessment is a collection of actions taken to gather information and then make decisions based on that information (Gaylard Baleni, 2015; Kusairi, 2012). Formative assessment is an evaluation method used in science learning, such as science and physics, to determine student learning outcomes. This formative assessment does not give students a score but emphasizes feedback to evaluate their learning outcomes (Andersson & Palm, 2017; Benben & Bug-os, 2022; Sari et al., 2019).

Formative testing is an assessment, evaluation, or test carried out to improve learning (Asamoah et al., 2022; Fukuda et al., 2022; Irons & Elkington, 2021). By conducting formative evaluations in a short time, teachers can use this information to foster subjects in each learning (Yan & Pastore, 2022) by increasing the similarity between three elements: the knowledge base of the subject being studied, the type of concept being studied, and the learning method used (Leenknecht et al., 2021; Sudakova et al., 2022). However, many teachers continue to carry out assessments during learning. This can lead to problems such as unintegrated learning, which can hinder students' understanding of concepts (Morris et al., 2021; Van Orman et al., 2024) .

Formative evaluation allows students to assess how well they achieve learning objectives (Hindriyani et al., 2020). In learning, teachers often combine formal and informal formative assessments to improve students' understanding of concepts (Arrafii & Sumarni, 2018; Sari et al., 2019). This is because formative assessment can significantly change learning outcomes that improve students' conceptual understanding (Ramadhani, 2021; Schildkamp et al., 2020).

Students' conceptual mastery is included in understanding the material (Mbonyiryivuze et al., 2022). Because physics is a graded subject, basic physics concepts must be learned from the beginning. In addition, teachers must consider how they teach and how students understand concepts (Akhsan et al., 2020). As a result, efforts are needed to increase students' excellence in asking questions so that their understanding of concepts is informative and constructive. Concept mastery includes the ability to understand, comprehend, apply, classify, and generalize. Therefore, teachers need to know how proficient their students are in concepts. (Aksari et al., 2021; Elmahdi et al., 2018; Mufit et al., 2023).

Although formative assessment has been widely recognized as an effective strategy for improving students' conceptual understanding in various disciplines, its application in physics learning still faces several challenges. Previous studies have often focused on general approaches to formative assessment without paying adequate attention to how these strategies can be adapted to the unique characteristics of physics courses, which involve abstract concepts and high-level mathematics. Many studies discuss formative conceptually, but only some provide clear guidance on assessing this practically in the physics classroom. Specific Effectiveness on Conceptual Understanding. Most studies measure the effectiveness of formative assessment based on improving general learning outcomes but rarely discuss in depth how this approach contributes directly to improving students' conceptual understanding in physics.

Therefore, this review is necessary to fill the existing gap by reviewing the literature that explicitly discusses how formative assessment is implemented in physics learning and how this approach impacts students' conceptual understanding.

Physics systematically studies the relationship between natural phenomena and phenomena (Ariska et al., 2021;

Evolusi et al., 2012). This type of science focuses on understanding concepts. In physics learning, understanding concepts is an urgency that shows whether students have understood the material well and will achieve optimal learning outcomes (Puspitasari et al., 2021). The purpose of learning physics is for students to understand the concepts, laws, principles, and theories of physics that are useful in solving real-life problems (Rahmita & Wasis, 2022; (Rosuli et al., 2019). However, the lack of conceptual understanding causes many students to experience conceptual misunderstandings. In order to understand laws, principles, and theories, students must understand the concepts correctly. Many students memorize formulas but need help understanding the Physics concepts taught by the teacher.

In this research, a literature review was carried out to identify trends and patterns in using formative assessment in physics learning. The literature review approach using visual analysis tools such as VOSviewer is more effective than traditional review methods because it can comprehensively map relationships between studies.

Thus, the novelty of this research lies in using VOSviewer as a visual analysis tool to identify patterns and trends from literature data obtained, for example, from Google Scholar and Garuda. This combination enriches the analysis results because it involves visual mapping that cannot be achieved only by using Google Scholar or Garuda separately.

This study applies formative assessment to improve students' conceptual understanding of physics learning (Maknun, 2020). Physics was chosen as the focus because of the complexity of the concepts that students must understand and the importance of deep understanding to succeed in this subject. With formative assessment, students can better understand and apply physics concepts in various contexts.

METHOD

In writing this article, the Systematic literature review method is used. Systematic literature review systematically discusses previous research and perceives, sorts, and critically assesses the research findings (Rother, 2007; Xiao & Watson, 2019; Zamista, 2022). The steps taken to conduct a literature review are 1) Selecting a topic and formulating a hypothesis; 2) Searching for articles to be used in the literature review; 3) Analyzing the findings of the articles that have been obtained; 4) Writing a literature review of the articles that have been obtained

The article was collected by searching for sources in Google Scholar and GARUDA databases. The article was searched using the keywords "formative assessment, physics learning, and conceptual understanding." Before conducting a literature review, determine the research question as the topic to be discussed in this literature review. The question to be discussed is, "How can formative assessment improve conceptual understanding in physics learning?" The selected articles were published within the last 10 years (2014-2024). After screening, 14 articles were obtained to be discussed. The list of articles obtained based on the topics to be discussed can be seen in Table 1.

Table 1 List of articles

No	Author(s)	Year	Category
1	Irma ZU	2022	National Journal
2	Niasari M	2021	National Journal
3	Soamole	2023	National Journal
4	Deke O, Jewaru AAL, Kaleka YU	2022	National Journal
5	Azizah HN, Efendi R, Karim S	2020	National Journal

No	Author(s)	Year	Category
6	Taqwa MRA, Febriyanto MA, Misbakhussuduri A		
7	Amiroh D, Kusairi S, Sugiyanto	2020	National Journal
8	Kamar N, Kusairi S, Zubaidah S		National Journal (Sinta 4)
9	Ediyanto	2016	National Journal (Sinta 2)
10	Maulidyah RL, Zainuddin A	2022	National Journal (Sinta 3)
11	Ramadhani DP, Nurhaliza P, Mufit F, Festiyed	2021	National Journal (Sinta 3)
12	Bulunuz N, Bulunuz M	2017	National Journal
13	Rahmawati S, Kusairi S, Sutopo	2019	National Journal (Sinta 5)
14	Nuha SH, Kusairi S, Sujito	2017	Prosiding Nasional

RESULTS AND DISCUSSION

This research used sources from articles published from 2014-2024. The articles obtained were the results of searches on Google Scholar and GARUDA. After selecting articles meeting the established criteria, 14 were collected to be discussed. The physics material and school levels of the collected articles can be seen in Table 2.

Table 2 List of physics materials and school levels

No	Author(s)	Major	Grade
1	Irma ZU	Static fluid	SMA
2	Niasari M	Work and Energy	SMA
3	Soamole	Temperature and heat	SMP
4	Deke O, Jewaru AAL, Kaleka YU	Thermodynamics	SMA
5	Azizah HN, Efendi R, Karim S	Momentum and impulse	SMA
6	Taqwa MRA, Febriyanto MA, Misbakhussuduri A	Static fluid	SMA
7	Amiroh D, Kusairi S, Sugiyanto	Heat transfer	SMA
8	Kamar N, Kusairi S, Zubaidah S	Heat	SMP
9	Ediyanto	Temperature and heat	SMA
10	Maulidyah RL, Zainuddin A	Motion and vertical motion	SMA
11	Ramadhani DP, Nurhaliza P, Mufit F, Festiyed	IPA and Physics	SMP dan SMA
12	Bulunuz N, Bulunuz M	Equilibrium and torque	SMA
13	Rahmawati S, Kusairi S, Sutopo	Momentum and impulse	SMA
14	Nuha SH, Kusairi S, Sujito	Work and energy	SMA

Using e-formative assessment can increase students' conceptual understanding of static fluid material with moderate influence (Irma, 2022). One of the main factors that supports the effectiveness of e-formative assessment is the provision of fast and accurate feedback, which helps correct misconceptions experienced by students. With immediate feedback, students can correct their mistakes and better understand concepts. The research results show that there is a reasonably large increase in scale in classes given treatment in the form of e-formative assessment, in line with research by Kusairi et al. (2021) and Yin et al. (2014). Formative assessment also provides positive things for student motivation and learning outcomes in physics learning (Irma, 2022; Rosyad et al., 2021).

The Google Form-based formative assessment instrument for business and energy materials had been validated and declared feasible by experts with an average score of 3.36 (Niasari, 2022). This instrument also has a balanced distribution of difficulty levels, with the

majority of questions being at a moderate level of difficulty, which can help measure student understanding effectively.

Developing an e-formative assessment for temperature and heat involves creating questions in Google Form and providing feedback through TikTok videos (Soamole et al., 2024). The feasibility assessment of this e-formative assessment showed very positive results. According to material experts, the TikTok video questions and discussion content were considered very appropriate, with a score of 88.64%. Media experts rated the video 93.18%, emphasizing the video's technical effectiveness and visual impression. Meanwhile, linguists gave an 88.64% rating, indicating that the language used in the questions and TikTok videos was easy for students to understand. Overall, this approach not only supports an interactive and responsive learning process to students' needs but also assures that e-formative assessment with TikTok video feedback is very feasible to use to deepen students' understanding of the concepts of temperature and heat.

Applying EDP-authentic PBL and formative assessment in physics learning resulted in different scores between the pretest and posttest, with N-gain at a moderate level (Deke et al., 2022). Students face challenges in designing scientific arguments, including strengthening claims with rebuttals. This method can be applied to contextual physics material, but special attention is needed to the suitability of the material with the learning method used. Students can more easily create scientific argumentation designs through practical activities and formative assessments in PBL validated by EDP (Nababan et al., 2019). Suggestions for further research include the integration of the STREAM approach to holistically build students' scientific argumentation skills.

The effectiveness of using formative assessment concept checks in physics learning to strengthen students' cognitive abilities (Azizah et al., 2020). The results of statistical analysis using the t-test showed that concept checks were significantly more effective than learning without the assessment. In addition, the calculation of the effect size showed that concept checks greatly improved students' cognitive abilities, although it was in the moderate category. The results obtained are in accordance with Bulunuz's research, which states that formative assessment can significantly improve students' understanding of physics learning (Bulunuz et al., 2014).

The module using the PowerPoint application connected to Google Forms and Google Drive and included images, animations, audio, and videos (Taqwa et al., 2022). One of its main features is integrating static fluid material with Newton's laws and special quizzes to reduce student misconceptions. Validation by 2 media experts and 2 material experts showed that this module was very suitable for use, with percentages of 91.67% and 90.83%, respectively. The assessment by 135 students also showed very decent results, with a percentage of 87.36%. The results show that the multimedia-based electronic module with a formative evaluation of static fluid material is ready to be tested in the field and distributed.

The formative assessment system with the help of a website for high school students in grade X is one method designed to help teachers conduct formative assessments during the learning process (Amiroh et al., 2020). This system allows teachers to provide assessments regularly and continuously to monitor student progress and adjust teaching as needed. This system is very helpful for students because they can get quick feedback on their understanding and performance during learning, allowing them to know areas that need

improvement immediately. For teachers, this system facilitates rapid learning evaluation so they can identify and address student learning problems more efficiently and assess the effectiveness of their teaching methods. The results of this study are in line with the objectives of formative assessment, according to Bell & Cowie (2001), namely to present information on student learning and teacher teaching.

The development of computer-assisted formative assessment products can determine the level of conceptual understanding of grade VII junior high school students on the topic of temperature and heat (Kamar et al., 2016). Computer-based formative assessment and remediation of students' temperature and heat concepts can obtain more in-depth results.

Completing practice questions using a web-based formative assessment model can provide short, precise, and fast feedback (Ediyanto, 2016). This feedback can help students learn concepts quickly and help teachers identify student problems to be resolved immediately. The advantages of the web-based formative assessment model are that you can see fast and precise feedback and can show where students' mistakes are.

The research of Maulidyah & Zainuddin (2022) discussed multi-representation-based formative assessment on free fall motion and downward vertical motion used to assess conceptual understanding abilities. The representation results in the graph are 56% and verbal 56.5%, which are misconceptions with a moderate category. While the representation in mathematics is 29.8%, and in the picture, 10.2% are misconceptions with a low category. Students' representation abilities will be strong, and they will be able to answer questions consistently if they understand the concept well (Amaliah & Purwaningsih, 2021).

The formative assessments increased student learning outcomes. Formative assessments are generally used to measure students' understanding or mastery of concepts (Ramadhani, 2021). They are used more at the high school level than at the junior high school level. Integrating formative assessments using websites is a widely used method.

The formative assessment was used at the beginning and end of the study. After the students' initial knowledge was demonstrated, experiments on this topic were applied, including the Predict-Explain-Observe-Explain process (Bulunuz & Bulunuz, 2017). After the formative assessment was conducted, students showed a significant increase in their conceptual understanding of the topic.

The formative assessment goes hand in hand with student assignments on momentum and impulse material based on the Scientific Approach assisted by the website increasing (Rahmawati et al., 2019). There is a significant difference ($p = 0.00$-0.05) between the pretest and posttest scores based on the t-test results. The N-gain value is 0.33, which is included in the medium-low category. Meanwhile, the strength of the impact or effectiveness of learning on student concept mastery is calculated using the d-effect size. The d-effect size value is 1.31, which is included in the high category.

The material of work and energy is one of the physics materials that is difficult to understand. This study uses a quasi-experimental method. The test results show that the mastery of physics concepts of the experimental class group of students is higher than that of the control class group of students. This study shows how web-based formative assessment feedback with isomeric items can help students better (Nuha et al., 2017).

The above research shows that formative assessments, especially

technology-based ones, can significantly improve students' understanding of complex physics concepts. By providing fast, personalized feedback, formative assessments allow students to correct mistakes and deepen their understanding quickly. Technology such as Google Forms, TikTok, and multimedia modules also help create a more interactive and responsive learning environment, making it easier for students to understand difficult concepts.

Most research focuses on quantitative outcomes (e.g., pretest and posttest scores) without considering qualitative aspects such as students' perceptions of formative assessments or motivation levels. The research is also limited to certain contexts, such as using e-formative assessment in specific physics topics, so the results may only partially apply to other physics topics.

Some formative assessment methods, such as using TikTok videos as feedback (Soamole et al.,), although innovative, may require technological tools that are not always available in all schools. Additionally, the effectiveness of video-based feedback should be further tested to ensure that the medium truly supports conceptual understanding rather than temporarily capturing students' attention.

Although web-based assessments (Amiroh, 2020; Kamar et al., 2016) provide speed in feedback, limited access to adequate technology in some schools may limit their widespread implementation. Each formative assessment method has different advantages depending on the context and learning objectives. The most effective methods are those that can provide fast and precise feedback, such as e-formative assessments and concept checks. However, multimedia approaches such as TikTok videos or PowerPoint-based modules are promising if implemented with adequate technological support.

CONCLUSION

The articles used in this literature review include publications from 2014 to 2024, taken from Google Scholar and GARUDA, with 14 articles selected according to certain criteria. The articles cover various physics materials and school levels, such as static fluids, work and energy, temperature and heat, thermodynamics, momentum and impulse, free fall, and equilibrium and torque. These studies show that using formative assessment, either through technology-based e-formative assessment such as Google Forms, TikTok videos, and multimedia modules, or web-assisted assessment systems, has proven effective in improving students' conceptual understanding and motivation. This approach allows for fast, accurate feedback, identifies misconceptions, and supports students' scientific argumentation skills. Overall, formative assessment and technology integration in physics learning are important in deepening conceptual understanding.

REFERENCES

Akhsan, H., Wiyono, K., Ariska, M., & Melvany, N. E. (2020). Development of HOTS (higher order thinking skills) test instruments for the concept of fluid and harmonic vibrations for high schools. *Journal of Physics: Conference Series*, *1480*(1). https://doi.org/10.1088/1742-6596/1480/1/012071

Aksari, V., Budhi, W., & Hasanah, D. (2021). Pengembangan E-LKPD fisika berbasis inkuiri terbimbing pada materi gerak lurus untuk peserta didik Kelas X SMA. *Jurnal Riset Dan Kajian Pendidikan Fisika*, *8*(1), 43. https://doi.org/10.12928/jrkpf.v8i1.20210

Amaliah, N. U., & Purwaningsih, E. (2021). Analisis pemahaman konsep, multirepresentasi, dan kosistensi jawaban siswa sma pada konsep

hukum iii newton. *Jurnal Pendidikan Sains Indonesia*, *9*(4). https://doi.org/10.24815/jpsi.v9i4.21223

Amiroh, D., Kusairi, S., & Sugiyanto, S. (2020). Pengembangangan sistem penilaian formatif berbantuan web (Electronic assessment tool) untuk menunjang pembelajaran fisika. *Briliant: Jurnal Riset Dan Konseptual*, *5*(3). https://doi.org/10.28926/briliant.v5i3.493

Andersson, C., & Palm, T. (2017). Characteristics of improved formative assessment practice. *Education Inquiry*, *8*(2), 104–122. https://doi.org/10.1080/20004508.2016.1275185

Ariska, M., Akhsan, H., Muslim, M., & Azizah, S. N. (2021). Pemahaman konsep awal mahasiswa pendidikan fisika terhadap materi benda-benda langit dalam perkuliahan astrofisika. *Jurnal Ilmiah Pendidikan Fisika*, *5*(3). https://doi.org/10.20527/jipf.v5i3.3523

Arrafii, M. A., & Sumarni, B. (2018). Teachers' understanding of formative assessment. *Lingua Cultura*, *12*(1), 45. https://doi.org/10.21512/lc.v12i1.2113

Asamoah, D., Shahrill, M., & Latif, S. N. A. (2022). A Review of formative assessment techniques in higher education during covid-19. In *Qualitative Report*, 27(2). https://doi.org/10.46743/2160-3715/2022.5145

Azizah, H. N., Efendi, R., & Karim, S. (2020). Efektivitas integrasi asesmen formatif concept checks pada pembelajaran fisika dalam meningkatkan kemampuan kognitif siswa SMA. *Jurnal Riset Dan Kajian Pendidikan Fisika*, *7*(2). https://doi.org/10.12928/jrkpf.v7i2.17284

Bell, B., & Cowie, B. (2001). The characteristics of formative assessment in science education. *Science Education*, *85*(5). https://doi.org/10.1002/sce.1022

Bulunuz, N., & Bulunuz, M. (2017). Effect of formative assessment-based instruction on high school students' conceptual understanding of balance and torque. *Journal of Inquiry Based Activities (JIBA)*, *7*(1).

Bulunuz, N., Bulunuz, M., & Peker, H. (2014). Effects of formative assessment probes integrated in extracurricular hands-on science: Middle school students' understanding. *Journal of Baltic Science Education*, *13*(2). https://doi.org/10.33225/jbse/14.13.243

Deke, O., Jewaru, A. A. L., & Kaleka, Y. U. (2022). Engineering design process pada stem melalui authentic pbl dan asesmen formatif : Meninjau desain argumentasi ilmiah siswa terkait termodinamika. *Borneo Journal of Science and Mathematics Education*, *2*(3), 101-124.

Ediyanto, E. (2016). Siklus prapembelajaran model penilaian formatif web-based pada pembelajaran fisika materi suhu dan kalor untuk siswa smk kelas x. *Jurnal Pendidikan Fisika Indonesia*, *12*(2), 126–136.

Elmahdi, I., Al-Hattami, A., & Fawzi, H. (2018). Using technology for formative assessment to improve students' learning. *TOJET: The Turkish Online Journal of Educational Technology*, *17*(2), 182–188.

Evolusi, D. A. N., Dalam, B., & Astrofisika, P. (2012). Konsepsi awal mahasiswa fisika terhadap materi bintang dan evolusi bintang dalam perkuliahan astrofisika. *Jurnal Pendidikan Fisika Indonesia (Indonesian Journal of Physics Education)*, *8*(1).

Festiyed, F. (2015). Studi pendahuluan pengimplementasian kurikulum2013 dalam mengintegrasikan pendekatan saintifik melalui model inkuiri dan authentic assessment dalam pembelajaran ipa di kota padang. *SEMIRATA Universitas Tanjung Pura Pontianak*, 2015 Mai,1-12.

Fukuda, S. T., Lander, B. W., & Pope, C. J. (2022). Formative assessment for learning how to learn: Exploring university student learning experiences. *RELC Journal*, *53*(1). https://doi.org/10.1177/00336882209 25927

Gaylard Baleni, Z. (2015). Online formative assessment in higher education: Its pros and cons. *Electronic Journal of E-Learning*, *13*(4), 228–236.

Geisinger, K. F. (2016). 21st century skills: What are they and how do we assess them?. *Applied measurement in education*, *29*(4), 245-249.

Haug, B. S., & Mork, S. M. (2021). Taking 21st century skills from vision to classroom: What teachers highlight as supportive professional development in the light of new demands from educational reforms. *Teaching and teacher education*, *100*, 103286.

Hindriyani, A., Kusairi, S., & Yuliati, L. (2020). Kemampuan memecahkan masalah rangkaian arus searah pada pembelajaran berbasis masalah disertai penilaian formatif. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(9), 1237. https://doi.org/10.17977/jptpp.v5i9.1 4003

Irma, Z. U. (2022). Efektivitas e-formative assessment untuk meningkatkan penguasaan konsep pada materi fluida statis. *Jurnal Pendidikan*, *23*(2).

Irons, A., & Elkington, S. (2021). Enhancing learning through formative assessment and feedback. In *Enhancing Learning through Formative Assessment and Feedback*. https://doi.org/10.4324/97811386105 14

Kamar, N., Kusairi, S., & Zubaidah, S. (2016). Pengembangan asesmen formatif dan remediasi berbasis komputer pada pokok bahasan suhu dan kalor smp kelas vii. *Lensa: Jurnal Kependidikan Fisika*, *4*(2). https://doi.org/10.33394/j-lkf.v4i2.93

Kusairi, S. (2012). a Computer-assisted analysis of physics formative assessment for senior high schools. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *16*(3), 68–87.

Kusairi, S., Hardiana, H., Swasono, P., Suryadi, A., & Afrieni, Y. (2021). E-formative assessment integration in collaborative inquiry: a strategy to enhance students' conceptual understanding in static fluid concepts. *Jurnal Pendidikan Fisika Indonesia*, *17*(1), 13–21.

Lee, H., Chung, H. Q., Zhang, Y., Abedi, J., & Warschauer, M. (2020). The effectiveness and features of formative assessment in us k-12 education: A systematic review. *Applied Measurement in Education*, *33*(2). https://doi.org/10.1080/08957347.20 20.1732383

Leenknecht, M., Wijnia, L., Köhlen, M., Fryer, L., Rikers, R., & Loyens, S. (2021). Formative assessment as practice: the role of students' motivation. *Assessment and Evaluation in Higher Education*, *46*(2). https://doi.org/10.1080/02602938.20 20.1765228

Maknun, J. (2020). Implementation of guided inquiry learning model to improve understanding physics concepts and critical thinking skill of vocational high school students. *International Education Studies*, *13*(6), 117–130.

Maulidyah, R. L., & Zainuddin, A. (2022). Implementasi tes formatif

berbasis multirepresentasi untuk analisis pemahaman konsep siswa. *Jurnal Penelitian Pembelajaran Fisika*, *13*(1). https://doi.org/10.26877/jp2f.v13i1.11317

Mbonyiryivuze, A., Yadav, L. L., & Amadalo, M. M. (2022). Physics students' conceptual understanding of electricity and magnetism in nine years basic education in Rwanda. *European Journal of Educational Research*, *11*(1). https://doi.org/10.12973/EU-JER.11.1.83

Menéndez, I. Y. C., Napa, M. A. C., Moreira, M. L. M., & Zambrano, G. G. V. (2019). The importance of formative assessment in the learning teaching process. *International Journal of Social Sciences and Humanities*, *3*(2), 238–249. https://doi.org/10.29332/ijssh.v3n2.322

Morris, R., Perry, T., & Wardle, L. (2021). Formative assessment and feedback for learning in higher education: A systematic review. *Review of Education*, *9*(3), 1–26. https://doi.org/10.1002/rev3.3292

Mufit, F., & Fauzan, A. (2023). The effect of cognitive conflict-based learning (CCBL) model on remediation of misconceptions. *Journal of Turkish Science Education*, *20*(1).

Nababan, N. P., Nasution, D., & Jayanti, R. D. (2019). The effect of scientific inquiry learning model and scientific argumentation on the students' science process skill. *Journal of Physics: Conference Series*, *1155*(1). https://doi.org/10.1088/1742-6596/1155/1/012064

Niasari, M. (2022). Instrumen penilaian formatif berbasis google form pada materi usaha dan energi. *Diffraction*, *3*(1). https://doi.org/10.37058/diffraction.v3i1.2861

Nuha, S. A., Kusairi, S., & Sujito, S. (2017). Pengaruh implementasi formative feedback berbasis web dengan menggunakan butir isomorfik terhadap penguasaan konsep fisika siswa sma pokok bahasan: usaha dan energi. *Seminar Nasional Fisika Dan Pembelajarannya*, *September*.

Pellegrino, J. W. (2014). Assessment as a positive influence on 21st century teaching and learning: A systems approach to progress. *Psicología Educativa*, *20*(2), 65-77.

Puspitasari, R., Mufit, F., & Asrizal. (2021). Conditions of learning physics and students' understanding of the concept of motion during the covid-19 pandemic. *Journal of Physics: Conference Series*, *1876*(1). https://doi.org/10.1088/1742-6596/1876/1/012045

Rahmawati, S., Kusairi, S., & Sutopo. (2019). Analisis penguasaan konsep siswa yang belajar materi momentum dan implus berbasis scientific approach disertai formative assessment berbantuan web. *Jurnal Pembelajaran Sains*, *3*(1).

Rahmita, F. I., & Wasis, W. (2022). Remediasi miskonsepsi dengan lkpd model guided inquiry learning berbantuan phet simulation pada materi fluida dinamis. *Jurnal Ilmiah Pendidikan Fisika*, *6*(2). https://doi.org/10.20527/jipf.v6i2.5276

Ramadhani, D. P. (2021). Analisis penerapan asesmen formatif dalam pembelajaran ipa dan fisika: literature review. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, 11(2), 110-120.

Rosuli, N., Koto, I., & Rohadi, N. (2019). Pembelajaran remedial terpadu dengan menerapkan model pembelajaran generatif untuk mengubah miskonsepsi siswa terhadap konsep usaha dan energi. *Jurnal Kumparan Fisika*, *2*(3), 185–192.

https://doi.org/10.33369/jkf.2.3.185-192

Rosyad, S., Diantoro, M., & Kusairi, S. (2021). Pengaruh scientific approach berbantuan penilaian formatif terhadap motivasi belajar dan hasil belajar fisika siswa kelas xi perempuan pada materi elastisitas. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(10). https://doi.org/10.17977/jptpp.v5i10.14134

Rother, E. T. (2007). Systematic literature review X narrative review. In *ACTA Paulista de Enfermagem*, 20 (2). https://doi.org/10.1590/s0103-21002007000200001

Sari, I. P., Mustikasari, V. R., & Pratiwi, N. (2019). Pengintegrasian penilaian formatif dalam pembelajaran IPA berbasis saintifik terhadap pemahaman konsep peserta didik. *JIPVA (Jurnal Pendidikan IPA Veteran)*, *3*(1), 52. https://doi.org/10.31331/jipva.v3i1.778

Schildkamp, K., van der Kleij, F. M., Heitink, M. C., Kippers, W. B., & Veldkamp, B. P. (2020). Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. *International Journal of Educational Research*, *103*(April), 101602. https://doi.org/10.1016/j.ijer.2020.101602

Soamole, S., Amiroh, D., & Salim, A. (2024). Pengembangan e-formative assessment pada materi suhu dan kalor untuk meningkatkan hasil belajar fisika dengan balikan video tik tok. *SAINTIFIK@: Jurnal Pendidikan MIPA*, *8*(2). https://doi.org/10.33387/saintifik.v8i2.7349

Sudakova, N. E., Savina, T. N., Masalimova, A. R., Mikhaylovsky, M. N., Karandeeva, L. G., & Zhdanov, S. P. (2022). Online formative assessment in higher education: Bibliometric analysis. in *education sciences*, 12(3). https://doi.org/10.3390/educsci12030209

Syahputra, E. (2018). Pembelajaran abad 21 dan penerapannya. *Prosiding Seminar Nasional SINASTEKMAPAN*, *I*(11), 1276–1283.

Taqwa, M. R. A., Febriyanto, M. A., & Misbakhussuduri, A. (2022). Pengembangan modul elektronik berbasis multimedia dengan asesmen formatif pada materi fluida statis. *Jurnal Inovasi Pendidikan Sains Dan Terapan*, *1*(2).

Van Orman, D. S. J., Gotch, C. M., & Carbonneau, K. J. (2024). Preparing teacher candidates to assess for learning: A systematic review. *Review of Educational Research*, *March*. https://doi.org/10.3102/00346543241233015

Winaryati, E. (2018). Penilaian kompetensi siswa abad 21. *Seminar Nasional Edusainstek FMIPA UNISMUS 2018*, *6*(1), 6–19.

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, 39(1). https://doi.org/10.1177/0739456X17723971

Y. Benben, V., & Allein Antoenette C. Bug-os, M. (2022). Physics students' academic achievement and motivation in a gamified formative assessment. *American Journal of Educational Research*, *10*(6). https://doi.org/10.12691/education-10-6-2

Yan, Z., & Pastore, S. (2022). Assessing teachers' strategies in formative assessment: The teacher formative assessment practice scale. *Journal of Psychoeducational Assessment*, *40*(5). https://doi.org/10.1177/07342829221075121

Yin, Y., Tomita, M. K., & Shavelson, R. J. (2014). Using formal embedded formative assessments aligned with a short-term learning progression to promote conceptual change and achievement in science. *International Journal of Science Education*, *36*(4). https://doi.org/10.1080/09500693.20 13.787556

Zamista, A. A. (2022). Online assessment as an alternative learning assessment in the digital era: A systematic literature review. *INSANIA : Jurnal Pemikiran Alternatif Kependidikan*, *27*(2).