

Mapping Research on Syawir-Based Physics Learning and Scientific Argumentation: A Systematic Literature Review

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Abstract

This systematic literature review aimed to map research trends, study characteristics, empirical findings, implementation challenges, and research gaps relevant to the development of a Syawir-based physics learning model incorporating scientific argumentation to support high school students' conceptual understanding. The study employed a Systematic Literature Review (SLR) following the PRISMA framework. Literature was searched through OpenAlex using combinations of keywords related to physics learning, Syawir, scientific argumentation, and conceptual understanding. A total of 216 records were identified; after removing 25 duplicates and excluding 166 records during title and abstract screening, 25 articles were retained for full-text analysis. The included studies were published between 2018 and 2026 and were predominantly conducted in Indonesia, with quasi-experimental, experimental, research and development, and Fuzzy Delphi designs. The synthesis indicates that argumentation-oriented learning, inquiry, Argument-Driven Inquiry (ADI), classroom discussion, and Problem-Based Learning (PBL) provide relevant evidence concerning improvements in scientific argumentation, scientific reasoning, and conceptual understanding. However, direct empirical evidence on the formal implementation of Syawir in high school physics remains limited. The findings therefore suggest a conceptual alignment between the dialogic characteristics of Syawir and argumentation-oriented learning, but they do not establish the effectiveness of an integrated Syawir model. This review provides an empirical and conceptual foundation for future research to develop, validate, and empirically test a Syawir-based physics learning model.

Keywords: *Syawir, Scientific Argumentation, Conceptual Understanding, Physics Learning, Systematic Literature Review.*



A. INTRODUCTION

Conceptual understanding is one of the fundamental foundations of physics education, as students are expected not only to master mathematical equations but also to understand principles, relationships among concepts, and explanations of phenomena. Meaningful physics learning therefore requires activities that encourage students to articulate their reasoning, examine ideas, use evidence, and revise their understanding through interactions within the learning environment. The literature analyzed in this review indicates that various argumentative and dialogic learning approaches have been employed to support these processes.

Scientific argumentation plays an important role in science education because it encourages students to connect claims with evidence and reasoning. Several studies included in this review reported improvements in argumentation skills through inquiry-based learning, Argument-Driven Inquiry (ADI), classroom discussions,

contextual learning, and argumentation-based teaching materials (Erlina et al., 2018; Sari et al., 2019; Dulim & Madlazim, 2022; Rahma & Suliyanah, 2025). These findings indicate that dialogic and argumentative activities can constitute an important component of physics learning oriented toward knowledge construction.

In the context of Islamic boarding school education, *Syawir* can be understood as a dialogic practice that involves the exchange of opinions, the presentation of reasoning, the examination of viewpoints, and the pursuit of agreement as integral components of discussion. Conceptually, these characteristics overlap with argumentation-based learning, particularly in terms of dialogue, the exchange of perspectives, and the justification of ideas. However, conceptual alignment does not, in itself, demonstrate that *Syawir* has been proven effective as a physics learning model. This relationship needs to be established through a synthesis of available evidence and subsequently examined through empirical research. The studies analyzed in this review demonstrate various approaches that are conceptually or methodologically relevant to the development of *Syawir*-based learning. SSIBPS, ADI, inquiry-based learning, classroom discussions, problem-based learning, teaching materials, and argumentation assessment provide evidence of ways to create learning environments that encourage students to formulate claims, use evidence, evaluate explanations, and interact with their peers. For example, the classroom discussion model examined by Rahma and Suliyanah (2025) reportedly achieved a normalized gain (*n-gain*) of 0.735 in scientific argumentation, whereas Dulim and Madlazim (2022) reported an *n-gain* of 0.49 for the ADI group. These findings constitute evidence regarding the approaches investigated in the respective studies, rather than direct evidence of the effectiveness of *Syawir*.

Although research on scientific argumentation in physics education continues to develop, direct evidence regarding the formal integration of *Syawir* and scientific argumentation in senior high school physics education remains limited within the collection of studies analyzed. There is insufficient evidence to claim that all 25 reviewed studies investigated the *Syawir* learning model. Instead, most studies focused on other learning strategies or models characterized by dialogic, argumentative, inquiry-based, or collaborative activities. This situation represents a research gap and provides a rationale for positioning the SLR as a foundation for developing a *Syawir*-based learning model, rather than as evidence that the model has already been fully developed or proven effective.

Accordingly, this study is necessary to systematically map the available evidence, identify patterns in the findings, understand implementation challenges, and determine unresolved research questions. This synthesis is important for addressing the following conceptual question: which learning characteristics have empirical support for promoting scientific argumentation and conceptual understanding, and to what extent can these characteristics inform the design of a *Syawir*-based physics learning model? This review also distinguishes direct evidence concerning *Syawir* from indirect evidence that is conceptually or methodologically relevant.

B. METHOD

This study employed a Systematic Literature Review (SLR) design, with the selection process guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The SLR was conducted to map and synthesize relevant research evidence, rather than to develop or validate a new learning model. The literature search was conducted through OpenAlex, which was used as an indexing source to identify publications based on the research keywords. Journal accreditation information in the initial manuscript was verified using ISSNs through the SINTA directory and Scopus listings. This verification served to describe publication characteristics rather than as a primary criterion for determining research effectiveness. The search strategy employed the following Boolean search strings: ("physics learning model" AND "syawir" AND "scientific argumentation" AND "conceptual understanding"), ("physics education" AND "scientific argumentation" AND "conceptual understanding" AND "high school students"), ("syawir-based learning" AND "physics" AND "argumentation"), and ("conceptual understanding" AND "scientific argumentation" AND "high school physics"). [TO BE COMPLETED: the exact search dates and, where available, details of the procedures used to export or store the search results should be provided to improve reproducibility.]

Inclusion and exclusion criteria were applied to maintain topical relevance and ensure that the selection process could be traced. The analyzed publications consisted of peer-reviewed journal articles or conference proceedings available in full text, written in Indonesian or English, relevant to physics education, scientific argumentation, conceptual understanding, or learning characteristics relevant to Syawir, and involving senior high school students or equivalent educational levels. Duplicate publications, non-peer-reviewed documents, and studies unrelated to the context of physics education were excluded. The publication period specified in the eligibility criteria was 2017–2026, whereas the final articles included in the analysis were published between 2018 and 2026. This difference should be explicitly reported as an outcome of the selection process rather than as a change in the data.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication Year	Articles published between 2017 and 2026.	Articles published outside the 2017–2026 period.
Document Type	Peer-reviewed journal articles or conference proceedings.	Books, book chapters, theses, dissertations, non-peer-reviewed papers, blogs, news articles, or opinion pieces.
Article Language	Articles written in English or Indonesian.	Articles written in languages other than English or Indonesian.
Full-Text Availability	Full-text articles are available.	Full-text articles are unavailable.
Topic Relevance	Topics relevant to Syawir-based physics learning, scientific argumentation, and conceptual understanding.	Topics unrelated to physics learning, Syawir, scientific argumentation, or conceptual understanding.

Study Participants	Studies involving senior high school students or equivalent educational levels.	Studies involving participants outside the senior high school level or unrelated to physics education.
Duplication	Original research articles.	Duplicate articles or previously published literature reviews.

The selection process began with 216 records retrieved from OpenAlex. After 25 duplicates were removed, 191 records remained. Title and abstract screening excluded 166 records because they did not meet the relevance or document-type criteria. The remaining 25 articles were assessed at the full-text stage, and all were included in the synthesis. This process resulted in a final sample of 25 articles. [TO BE COMPLETED: where available, the reasons for exclusion during screening should be categorized to improve the transparency and auditability of the PRISMA process.

The quality of the articles was assessed using five criteria applied in the initial manuscript: topic relevance, clarity of research methods, clarity of data and sample characteristics, clarity of findings, and contribution to the field. Each criterion was assigned a score ranging from 1 to 3. The initial manuscript reported a mean score of 2.9 out of 3. However, because individual appraisal scores were not presented in a table, this mean score alone is insufficient to demonstrate how each study met the quality threshold. Therefore, [TO BE COMPLETED: an article-by-article appraisal table and the criteria used to determine the quality cut-off should be provided]. In addition, the assessment procedures and methods for resolving disagreements should be described if more than one reviewer conducted the appraisal.

Data extraction covered authors and publication years, countries, research designs, participant characteristics, learning approaches or interventions, and principal findings. The data were then synthesized thematically by grouping recurring findings into several patterns: improvements in conceptual understanding and scientific argumentation, student responses, argumentation quality and implementation challenges, and opportunities for further research. In interpreting the findings, studies that did not directly investigate Syawir were treated as conceptually or methodologically relevant evidence rather than as evidence of the effectiveness of the Syawir model.

Data extraction was conducted systematically and included key information such as research objectives, methodological designs, participant characteristics, learning interventions, and principal findings. Data analysis employed a thematic synthesis approach to identify recurring patterns, themes, and relationships across the findings, thereby providing a comprehensive overview of the development of Syawir-based physics learning through scientific argumentation.

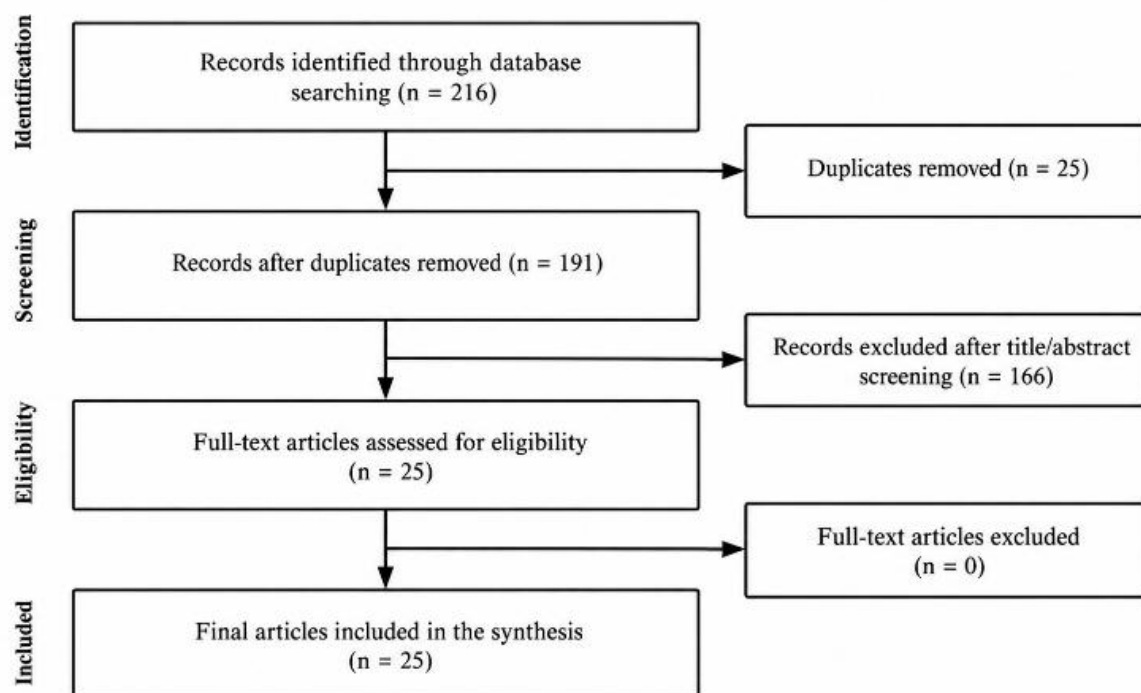


Figure 1. PRISMA Flowchart

C. RESULTS AND DISCUSSION

The selection process followed the PRISMA flow. A total of 216 records were identified through OpenAlex, 25 duplicates were removed, and 191 records remained for screening. During title and abstract screening, 166 records were excluded. Twenty-five articles were assessed at the full-text stage, and all were retained for synthesis. Thus, the final number of articles analyzed was 25, published between 2018 and 2026. The 25 articles were predominantly studies conducted in Indonesia. The most frequently used research designs were quasi-experimental studies, experimental studies, research and development (R&D), and the Fuzzy Delphi method. Research themes included improvements in conceptual understanding and argumentation skills, students' responses and interest, argumentation quality, and implementation challenges. These characteristics indicate that the literature corpus provides more evidence on argumentative and dialogic learning than on Syawir directly.

Table 1. Overview of the 25 Studies Included in the Systematic Literature Review

Aspect	Finding
Final number of articles	25
Publication period	2018–2026
Predominant country	Indonesia
Predominant methods	Quasi-experimental studies, experimental studies, research and development (R&D), and Fuzzy Delphi
Dominant themes	Improvements in conceptual understanding and argumentation skills; positive student responses and interest; argumentation quality and implementation challenges

Based on the available data extraction, there was 1 publication in 2018, 1 in 2019, 2 in 2020, 1 in 2021, 3 in 2022, 3 in 2023, 10 in 2025, and 2 in 2026. This pattern

indicates an increase in the number of publications in the most recent years represented in the analyzed corpus. However, this trend should be interpreted as a trend in research on argumentation and physics learning relevant to this review, rather than as a trend specific to Syawir research.

Table 2. Characteristics and Main Findings of the Included Studies

No.	Author(s) (Year)	Country	Method	Main Findings
1	Alberida et al. (2026)	Indonesia	Quasi-experimental	The implementation of the SSIBPS learning model significantly improved students' scientific argumentation and scientific writing skills, with a moderate effect size.
2	Rahma & Suliyanah (2025)	Indonesia	Experimental	The classroom discussion learning model was implemented very well, substantially improved students' scientific argumentation skills (n-gain = 0.735), and received positive responses from students.
3	Erlina et al. (2018)	Indonesia	Quasi-experimental	EBR effectively improved students' scientific reasoning in inquiry-based physics instruction. Improvements varied from high to low across scientific reasoning components, and students responded positively.
4	Sari et al. (2019)	Indonesia	Quasi-experimental	Students' scientific argumentation skills improved following the implementation of a contextual learning model based on multiple representations, with a shift toward higher argumentation levels.
5	Siswanto et al. (2025)	Indonesia	Fuzzy Delphi	Consensus was reached on the stages of a reading model designed to develop argumentation and critical thinking skills: predicting purpose/content, explaining phenomena, critical-argumentative reading, and evaluating predictions.
6	Dulim & Madlazim (2022)	Indonesia	Experimental	ADI was implemented very well and significantly improved students' scientific argumentation in the experimental group (n-gain = 0.49, moderate) compared with the control group (n-gain = 0.17, low). Student responses also indicated three main factors shaping argumentation patterns.
7	Murdani et al. (2023)	Indonesia	Learning model development and	Following implementation of the PABCSCHL model, the number of students reaching the highest level of conceptual mastery increased to 23 students, while 25 students reached

			implementation	the highest level of argumentation ability.
8	Lentika & Admoko (2022)	Indonesia	Research and development (R&D)	The developed student worksheets were valid (93.75–100%), practical (average student responses of 82–91.5%), and highly effective in improving argumentation skills, with an average n-gain score of 0.7342 (high).
9	Setiati et al. (2025)	Indonesia	Fuzzy Delphi	The resulting teaching materials were valid and appropriate for students' cognitive levels, structured using a validated argumentation model, and demonstrated good readability.
10	Kariani et al. (2025)	Indonesia	Research and development (R&D)	The developed teaching materials were feasible for use (75% and 83.3%), practical (positive responses from teachers at 85% and students at 84.8%), and effective in improving argumentation skills, with an average N-gain of 0.777 (high).
11	Nurita et al. (2023)	Indonesia	Mixed methods	The inquiry learning model successfully developed students' argumentation skills, with high n-gain scores for structured inquiry (0.88), guided inquiry (0.84), and open inquiry (0.74).
12	Mapau et al. (2025)	Indonesia	Research and development (R&D)	The developed Problem-Based Learning (PBL) physics teaching module was valid (Aiken's $V = 0.79$), highly practical (89% teacher response), and reasonably effective (N-gain = 0.62, moderate) in improving students' argumentation skills.
13	Jewaru et al. (2021)	Indonesia	Descriptive case study	Students' scientific argumentation quality in thermodynamics was moderate (46.54), with Level 3 (fairly strong) being dominant. The lowest performance was at Level 2 in the subtopics of work and thermodynamic processes.
14	Paramita et al. (2020)	Indonesia	Quasi-experimental	Guided inquiry learning using a STEM approach affected students' conceptual understanding and argumentation skills. No interaction was found between the learning model/approach and prior ability in relation to conceptual understanding and argumentation skills.
15	Irawan et al. (2025)	Indonesia	Qualitative survey	Students' argumentation skills in static fluids ranged from Levels 1 to 4, with

				most at Level 2 (able to provide claims with data and reasoning), indicating that scientific argumentation skills were relatively low.
16	Kurniaty et al. (2025)	Indonesia	Quantitative descriptive-correlational	A strong positive relationship was found between cognitive ability and argumentation skills ($r > 0.6$, $p < 0.05$), indicating that higher cognitive ability was associated with stronger scientific argumentation.
17	Wajdi et al. (2025)	Indonesia	Quasi-experimental	The mini-hydropower plant learning media had a significant effect on students' argumentation skills ($t\text{-count} = 4.23 > t\text{-table} = 1.72$).
18	Hilala et al. (2023)	Indonesia	Survey	The measurement instrument demonstrated good validity and reliability. Student abilities varied, with a tendency toward weak explanations of certain acid-base phenomena.
19	Nurjannah et al. (2025)	Indonesia	Quasi-experimental	The experimental group (ADI + scientific method) achieved greater improvements in cognitive ability ($n\text{-gain} = 0.65$, moderate) and argumentation skills ($n\text{-gain} = 0.76$, high) than the control group (ADI only). A strong positive correlation was also found between cognitive and argumentation gains.
20	Fernando et al. (2024)	Indonesia	Survey	The mean score for students' scientific argumentation skills in static fluids was low (10.60), with many students unable to use sufficient evidence to support their arguments.
21	Aini & Suprpto (2022)	Indonesia	Quantitative survey	Performance Assessment instruments had a positive and significant effect on students' scientific argumentation skills in physics learning, which reached a high/good category. Students also showed positive interest in their implementation.
22	Bukifan et al. (2020)	Indonesia	Experimental	Students' conceptual understanding differed significantly before and after ADI-based STEM education, with $p < 0.001$ and an effect size of 2.39.
23	Tahir et al. (2026)	Indonesia	Quasi-experimental	Students taught using the ADI model achieved argumentation scores significantly above the minimum mastery criterion (KKM), with average $n\text{-gain}$ values across the three classes

				consistently in the high category (0.77, 0.77, and 0.76).
24	Salsabila et al. (2025)	Indonesia	Systematic literature review	ADI consistently improved students' ability to construct data-based arguments, evaluate peers' arguments, and reflect on conceptual understanding. It was also reported to be more effective than conventional learning models or ordinary inquiry.
25	Ashel et al. (2024)	Indonesia	Bibliometric analysis	Research on this topic tended to increase annually, with keywords including senior high school, physics/science education, e-learning, and argumentation skills. Opportunities were identified in higher education, other disciplines, teaching materials/inquiry, assessment, and conceptual understanding. A relationship between argumentation and problem-solving skills was also identified.

The studies in the corpus provide evidence that several learning approaches can support scientific argumentation, scientific reasoning, and conceptual understanding. SSIBPS was reported to improve scientific argumentation and scientific writing skills with a moderate effect size (Alberida et al., 2026). The classroom discussion model reportedly produced a high gain in scientific argumentation, with an n-gain of 0.735 (Rahma & Suliyanah, 2025). ADI also showed improvements in argumentation, with an n-gain of 0.49 in the experimental group compared with 0.17 in the control group in the study by Dulim and Madlazim (2022). Other evidence indicates improvements in argumentation through inquiry, teaching materials, contextual learning, PBL, and technology-based approaches (Erlina et al., 2018; Sari et al., 2019; Lentika & Admoko, 2022; Murdani et al., 2023; Mapau et al., 2025).

The synthesis of 25 articles indicates that argumentative and dialogic learning has a diverse empirical basis in physics education. ADI, inquiry-based learning, classroom discussions, PBL, argumentation-based teaching materials, and collaborative approaches have been reported to support argumentation skills, scientific reasoning, or conceptual understanding in different contexts. These findings provide evidence that learning activities requiring students to formulate claims, use evidence, explain reasoning, and respond to other perspectives are worth considering in the design of physics instruction. From a social constructivist perspective, these findings can be interpreted as supporting the importance of social interaction in knowledge construction. However, this SLR did not test social constructivist theory and therefore cannot claim that the findings extend or prove the theory. A more appropriate interpretation is that the learning characteristics identified in the literature can be understood through a social constructivist perspective because they

position interaction, negotiation of meaning, and reason-giving as part of the learning process.

Syawir has potential as a pedagogical framework because, conceptually, it emphasizes dialogue, the exchange of viewpoints, and the pursuit of agreement. When these characteristics are combined with scientific argumentation, the learning structure can be designed so that students do not merely express opinions but also connect claims with evidence and reasoning. Nevertheless, this relationship remains conceptual within the present study. There is insufficient evidence to conclude that the integration of Syawir and scientific argumentation has been empirically effective.

The implication is that subsequent development research needs to define operational indicators of Syawir in physics classrooms. These indicators should distinguish Syawir from ordinary discussion, for example through participation structures, mechanisms for proposing and testing ideas, use of evidence, responses to differing viewpoints, and decision-making or consensus-building processes. Such an operational definition is essential to enable the model to be validated and empirically tested.

The available evidence indicates a relevant relationship between argumentative activities and cognitive learning outcomes, although the nature of this relationship varies across studies. Some studies report improved conceptual understanding following argumentative interventions or ADI, whereas others focus on argumentation quality or reasoning. Because the designs and variables differ across studies, the results of this SLR are better used to identify evidence patterns than to calculate a single pooled effect size. Future development of the Syawir model could treat conceptual understanding and argumentation quality as separate but related outcomes.

Recurring challenges across the research corpus include the time required for discussion, teacher readiness, teaching-material quality, and students' ability to use evidence appropriately. These challenges are important for Syawir development because dialogic practices may require more time than transmission-oriented instruction. The model should provide structured procedures, learning tools, argumentation scaffolding, and assessment instruments so that deliberation does not stop at an exchange of opinions without scientific justification.

The main research gap lies in the limited direct empirical evidence concerning a physics learning model based on Syawir that formally integrates Syawir practices with scientific argumentation. The available literature primarily addresses argumentation models, inquiry, discussion, PBL, and the development of teaching materials. Accordingly, the main contribution of this SLR is to provide an evidence map that can inform the selection of components to be tested in a Syawir model, rather than to claim that such a model has already been proven effective.

Based on the synthesis, future research could develop the model through stages involving the formulation of learning syntax, expert validation, development of learning materials and assessments, practicality testing, and effectiveness testing. Such research should directly examine whether the defined characteristics of Syawir

improve students' conceptual understanding and argumentation quality. Longitudinal studies may also be considered to investigate the sustainability of argumentation skills, but this remains a future research agenda rather than a finding of the present SLR.

The contribution of this study lies in systematically mapping evidence relevant to connecting argumentative learning with the potential development of a Syawir-based physics learning model. The 25 studies provide insights into how argumentation, inquiry, discussion, problem-based learning (PBL), teaching materials, and collaborative learning support physics learning, informing model development without directly proving Syawir's effectiveness. The main limitations are reliance on one primary search platform, few studies directly addressing Syawir, heterogeneous research designs, and the absence of an individual article appraisal table. Thus, the findings should be interpreted as an evidence map rather than an estimate of Syawir's effectiveness.

D. CONCLUSION

This Systematic Literature Review of 25 articles identifies various approaches relevant to scientific argumentation in physics education, including ADI, inquiry-based learning, classroom discussions, PBL, teaching-material development, and collaborative learning. Several studies reported improvements in scientific argumentation, scientific reasoning, and conceptual understanding, providing an empirical foundation for developing physics pedagogy. However, the findings do not establish the effectiveness of a Syawir-based physics learning model, as direct empirical evidence remains limited. The main research gap concerns the lack of studies explicitly developing, validating, and testing a Syawir-based model integrated with scientific argumentation.

Future research should formulate and validate the model's learning syntax, operational indicators, learning materials, and assessment instruments, while considering teacher readiness, time allocation, argumentation scaffolding, and assessment. Subsequent empirical and longitudinal studies should examine its effectiveness, conceptual understanding retention, and the sustainability of argumentation skills. Thus, this review provides an evidence map and research agenda rather than a validated learning model. The effectiveness of Syawir in senior high school physics education requires further development and empirical testing. Thus, the contribution of this study is to provide an evidence map and a research agenda, rather than to present a validated learning model. The effectiveness of the Syawir model in senior high school physics education still needs to be examined through subsequent development research and empirical studies.

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