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Validity of Sinergi Learning Model (Science Process Skills Integration with Local Wisdom and Technology)

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Abstrack: *This study aims to validate the SINERGI (Science Process Skills Integration with Local Wisdom and Technology) learning model, which is designed to improve students' Science Process Skills (SPS) through the integration of local wisdom and technology. Validation was carried out by involving five education experts to assess the validity of the content and construct of the model. Content validity covers six main aspects, namely supporting theory, syntax, social system, reaction principle, support system, and model implementation, while construct validity covers seven aspects, including components of the learning model. The validation results show that the SINERGI learning model has a high level of validity with most indicators in the very valid category and reliability above 85% based on the Percentage of the Agreement method. This finding confirms that the SINERGI learning model is feasible to be applied in 21st-century science learning, although minor improvements are needed in the reaction principle aspect.*
Keyword: *Science process skills; local wisdom; technology; validity; 21st century learning*

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PENDAHULUAN

21st-century education demands innovative learning to prepare students for increasingly complex global challenges. In this context, the integration of science process skills (SPS), local wisdom, and technology is an important element that supports the development of critical, creative, collaborative, and communicative skills (4C) (Lubis, 2023; Nengsih, 2022; Rosfiani, 2023). These skills not only serve for academic success, but they also serve as an important foundation in everyday life and future careers (Nugraha, 2024; Safitri, 2022).

Science process skills (SPS) are basic abilities that include observation, formulating hypotheses, conducting experiments, and analyzing and concluding data (Indah, 2023; Septiani & Susanti, 2021). By integrating SPS in learning, students not only understand the theory but are also able to apply it in real-life contexts. This is in line with the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics) that emphasizes an interdisciplinary approach to learning (Safitri, 2022; Syadiah & Hamdu, 2020). The implementation of SPS also provides opportunities for students to develop critical thinking skills and solve problems independently (Asy'ari et al., 2019).

In addition, local wisdom plays a significant role in contextual learning that is relevant to student life. The integration of local wisdom in the curriculum not only strengthens the cultural identity of students but also makes learning more interesting and meaningful (Agmita et al., 2021; Fajri et al., 2024; Sari, 2023). For example, local wisdom can be used as a context for science experiments to explain natural phenomena so that students can more easily understand abstract scientific concepts (Suherman, 2023). Thus, the integration of local wisdom not only increases the relevance of learning but also helps students appreciate and preserve their culture.

Technology is another important component in supporting 21st-century learning. The use of technology, such as digital-based learning applications, e-LKPD, and interactive media, can increase student engagement and create a more effective learning experience (Fitriani & Hunaepi, 2016; Hani, 2024; Rahmawati & Atmojo, 2021; Suryaningsih & Nurlita, 2021). Technology allows teachers to create a dynamic and adaptive learning environment, where students can learn collaboratively and interactively (Laksono, 2023). Training teachers to develop skills in utilizing this technology is very important so that learning can run according to the needs of the times (Marhamah, 2024; Noptario, 2024). However, the conventional learning model that is still dominant in various educational institutions is often considered less relevant to today's competency demands. Learning that focuses on transferring information from teachers to students makes students tends to make students passive and less involved in the learning process (Diamond, 2023). This is contrary to the needs of modern education, which emphasizes critical thinking, creativity, collaboration, and communication skills (Artayasa et al., 2021; Aryani & Nana, 2020; Zahrotin et al., 2021). Research shows that more active learning models, such as guided and project-based inquiry, can significantly improve students' science process skills compared to conventional learning methods (Artayasa et al., 2021; Mahali, 2023).

One of the innovative learning models designed to overcome the weaknesses of conventional methods is the SINERGI learning model. The SINERGI learning model is A learning model that combines science process skills, local wisdom, and technology into science learning. This model aims to create an active and collaborative learning environment where students play the role of researchers and inventors, not just as recipients of information. The inquiry method in this model encourages students to explore and investigate phenomena, from formulating questions, conducting experiments, to analyzing data (Fitriani & Firdaus, 2020; Siswati et al., 2022). With this approach, students can independently build knowledge and develop critical thinking skills.

The SINERGI model holistically integrates scientific values, such as responsibility, cooperation, and scientific ethics, to form a positive attitude of students toward science (Aryani & Nana, 2020; Hadiya, 2019). In addition, the main component of this model, namely experimental and research activities, provides opportunities for students to apply scientific concepts in real contexts. This approach not only improves conceptual understanding but also hones their science process skills (Rini, 2022; Tuada et al., 2017). Furthermore, this model emphasizes the importance of generating new ideas and encouraging students to come up with innovative solutions to various problems.

By combining science process skills, local wisdom, and technology into science learning, the SINERGI learning model offers a holistic and integrated approach. This model is not only relevant for the development of students' science process skills, but it also helps prepare them to face future global challenges. The advantage of this model lies in the ability to integrate SPS, local wisdom, and technology in meaningful and relevant learning. Therefore, the SINERGI learning model is a potential solution to overcome the weaknesses of conventional methods and meet the demands of 21st-century education.

In the process of validating the SINERGI learning model, specific indicators were assessed, including supporting theory, syntax, social system, reaction principle, support system, model implementation, and key components of the learning model. This study aims to validate the SINERGI learning model (Science Process Skills Integration with Local Wisdom and Technology), which is designed to improve students' Science Process Skills (SPS) through the integration of local wisdom and technology in 21st-century learning. Model validation was carried out to measure the validity of the content, which includes six main aspects, such as supporting theory, syntax, social system, reaction principle, supporting system, and model implementation, as well as the validity of the construct which includes seven aspects, including components of the SINERGI learning model. This study also aims to determine the level of reliability of validation instruments using the Percentage of Agreement (Borich, 1994) to ensure consistency between validators.

METHOD

This study uses a development design approach that only focuses on the validation stage of the SINERGI learning model. The validation process was carried out by five experts, who are specialists in the field of biology education and have research experience related to the development of learning models. Their academic backgrounds and scientific contributions reflect a strong foundation in instructional design and biology pedagogy, ensuring the relevance and rigor of the validation process.

The validity of the SINERGI learning model includes two main dimensions, namely content validity and construct validity. Content validity assesses the extent to which the learning model can cover content domains that are relevant to the learning objectives. The validity of the content was reviewed from six main aspects, namely supporting theory, syntax, social system, reaction principle, supporting system, and the implementation of the SINERGI learning model. Construct validity, on the other hand, measures the extent to which the operationalization of a construct in a model fits the underlying theory. The assessment of construct validity includes seven aspects, namely the components of the SINERGI learning model, supporting theories, syntax, social systems, reaction principles, supporting systems, and the implementation of the SINERGI learning model.

The model is considered valid in terms of content if it contains elements of novelty (state of the art) and the relevance of the needs (need), and structurally valid if it shows consistency between parts of the model and conformity with the theory underlying it (Makhrus, 2018; Nieveen, 1999; Sireci & Faulkner-Bond, 2014). The instrument used to measure the validity of the model is a validation sheet, which is filled out by five validators during the validation process. The assessment was carried out using the Likert scale 1-4, where a score of 1 indicates "strongly inappropriate," a score of 2 indicates "inappropriate," a score of 3 indicates "appropriate" and a score of 4 indicates "very appropriate." Validity data was analyzed using the average score of each aspect, which was then categorized based on the following criteria:

Table 1. Learning model validation assessment criteria

Score Interval	Assessment Criteria	Information
$3.25 < P \leq 4.00$	Highly valid	Can be used without revision
$2.50 < P \leq 3.25$	Valid	Can be used with slight revisions
$1.75 < P \leq 2.50$	Less valid	Can be used with multiple revisions
$1.00 \leq P \leq 1.75$	Invalid	Not yet usable and still requires consultation

(Makhrus, 2018; Nieveen, 1999; Prahani et al., 2017)

The reliability of the SINERGI learning model was tested using the *Percentage of Agreement* (Borich, 1994), which calculates the agreement rate between validators. The formula used is:

$$Percentage\ of\ Agreement = 100\% \left(1 - \frac{A - B}{A + B}\right)$$

A refers to the highest score, while B is the lowest score given by the validator. A learning model is considered reliable if the percentage of agreement between validators reaches or exceeds 75%. This approach ensures that the validation instruments used have a high degree of consistency in the assessment between validators. The research stage begins with the preparation of a learning model based on a literature review and analysis of learning needs. After that, a validation sheet is developed and given to five validators to be assessed. The assessment results provided by the validator are then analyzed to determine the level of validity and reliability of the model. The findings from this analysis are used as a reference to revise and refine the model before it is applied more widely. The SINERGI Model Structure Diagram can be seen in Figure 1 below.

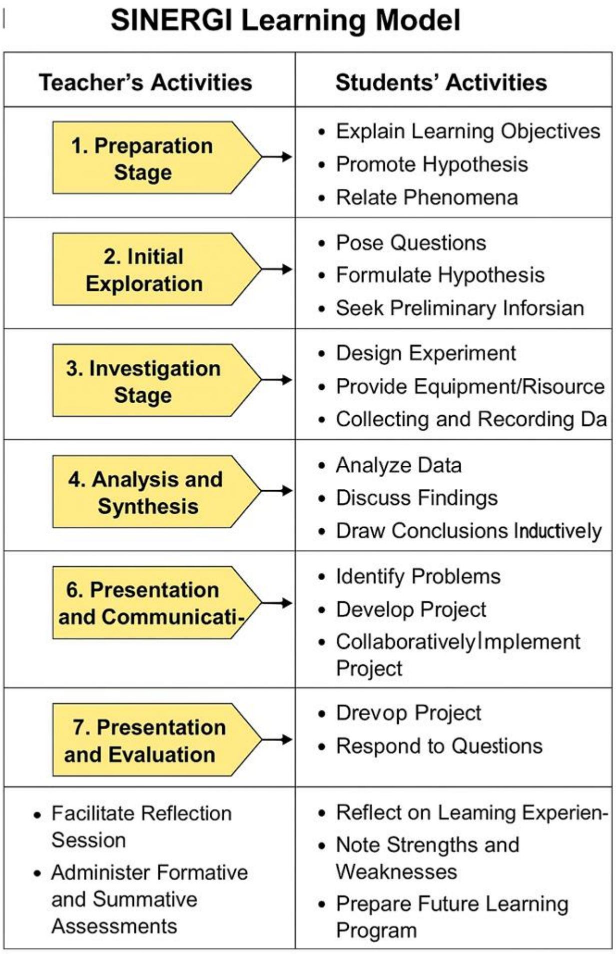

Figure 1. Diagram of the SINERGI Model Structure

RESULTS AND DISCUSSION

The validity of the model is evaluated to ensure that each component in the model has met the scientific aspects and consistency by the theory that underlies it. Validity analysis involves measuring the validity of content and constructs, which includes a variety of key indicators, such as supporting theories, syntax, social systems, and the implementation of learning models. In addition, the reliability of the model is also analyzed using *the Percentage of Agreement method*, which aims to measure the level of agreement between validators. The results of this analysis provide an overview of the extent to which the SINERGI learning model can be trusted and relied on in its implementation in the field. As for the syntax of the SINERGI learning model, the results of content validation and the results of the validation of the SINERGI learning model construct can be seen in Tables 2, 3 and 4 respectively:

Table 2. Syntax of the SINERGI learning model

Activity Stages	Teacher Activities	Student Activities
1. Preparation Stage	a. Explain the learning objectives and their relevance to students' lives. b. Provide an introduction to relevant local phenomena. c. Motivate students to actively participate in learning.	a. Listen to the explanation of learning objectives and connect with the initial knowledge. b. Identify local phenomena introduced by teachers. c. Expressing a willingness to be actively involved in learning.
2. Initial Exploration	a. Ask a spark question that stimulates students' curiosity. b. Encourage students to formulate hypotheses or initial ideas based on observed phenomena. c. Facilitate students in seeking initial information through group discussions or learning resources.	a. Ask questions related to the introduced phenomenon. b. Formulate a hypothesis or initial idea about a phenomenon. c. Gather initial information through discussion and independent exploration.
3. Investigation Phase	a. Guiding students in designing experiments or scientific investigations related to phenomena. b. Provide the necessary tools, materials, or media for investigation activities. c. Supervising and providing technical assistance during the investigation process.	a. Designing experiments or research according to guidelines. b. Conduct experiments or scientific investigations in groups. c. Collect data and record observations.
4. Analysis and Synthesis	a. Guiding students in analyzing the data of the results of the investigation and relating it to theoretical concepts. b. Facilitate group discussions to draw conclusions from the results of the investigation.	a. Analyze data and identify patterns or relationships found. b. Discuss the results of the analysis in groups and draw conclusions.
5. Breakdown Project Problems and Development	a. Directing students to identify relevant real problems and guiding them in the development of project-based solutions. b. Ensure that the project developed integrates local wisdom, technology, and scientific concepts that have been studied.	a. Identify problems and develop creative and applicable projects. b. Execute projects collaboratively and apply the concepts learned to solve problems.

Activity Stages	Teacher Activities	Student Activities
6. Presentation and Communication	a. Guide students to prepare presentations on the results of projects or investigations. b. Provide feedback during the presentation process.	a. Compile a report or presentation of project results. b. Present the results of the project or investigation and answer questions from the audience.
7. Reflection and Evaluation	a. Facilitate reflection sessions to evaluate learning processes and outcomes. b. Provide formative and summative assessments based on clear criteria.	a. Reflect on learning experiences, record strengths and weaknesses, and identify improvements for subsequent learning. b. Receive feedback and strategize to improve skills or understanding in the future.

Furthermore, the SINERGI learning model makes a significant contribution to improving the quality of science education by integrating local wisdom and digital-based learning practices. The local elements in this model provide contextual relevance that strengthens students' cultural understanding and engagement in the learning process. Simultaneously, the integration of digital tools such as simulations, multimedia, and collaborative platforms facilitates active learning, encourages exploration, and supports scientific communication. This dual integration ensures that learning is not only rooted in students' sociocultural environments but is also responsive to the demands of 21st-century digital literacy. Therefore, the SINERGI model can be regarded as an innovative solution that bridges traditional-local values with modern technological competencies in science education.

SINERGI learning model *(Science Process Skills Integration with Local Wisdom and Technology)* is designed to create relevant, contextual, and applicable learning experiences by integrating science process skills (SPS), local wisdom, and technology. This approach is based on various learning theories, such as (Mokalu et al., 2022; Newman & Latifi, 2020)Social learning theory (Siswadi, 2022), *Experiential Learning* (Chen et al., 2022)and problem-based learning (Musfirah, 2023).

Constructivism encourages students to build knowledge through active exploration and social interaction, while social theory emphasizes learning through observation and collaboration. Experiential learning theory supports a learning cycle based on direct experience, reflection, and experimentation. In addition, the problem-based learning (PBL) approach directs students to solve real problems based on local wisdom with the support of technology (Rahmadi, 2019).

In the SINERGI model, technologies such as digital simulations and collaborative platforms facilitate exploration, data analysis, and scientific communication (Syafani & Tressyalina, 2023; Widodo, 2023). SPS includes observation, classification, and inference applied in learning activities, which not only enhances scientific understanding but also encourages critical thinking and innovation (Ningrum, 2018; Sulistiany & Darmawan, 2020).

Table 3. Validity of the content of the SINERGI *(Science Process Skills Integration with Local Wisdom and Technology) learning model.*

No	Validation indicators	Score	Validity categories	Reliability coefficient (%)	Reliability categories
1	Supporting Theories	3.53	Highly Valid	85.71	Reliable
2	Syntax	3.55	Highly Valid	85.71	Reliable
3	Social System	3.40	Highly Valid	85.71	Reliable

No	Validation indicators	Score	Validity categories	Reliability coefficient (%)	Reliability categories
4	Reaction Principle	3.40	Highly Valid	92.86	Reliable
5	Support System	3.60	Highly Valid	100.00	Reliable
6	Implementation of the SINERGI Learning Model	3.60	Highly Valid	85.71	Reliable

Table 3 presents the results of the validation of the content of the SINERGI *(Science Process Skills Integration with Local Wisdom and Technology)* learning model, which includes six main validation indicators, namely supporting theory, syntax, social system, reaction principle, supporting system, and implementation of the SINERGI learning model. Each indicator is assessed based on the average score, validity category, reliability coefficient, and reliability category. The validation results showed that all indicators had an average score above 3.25, with a very valid category, which indicates that the elements of the SINERGI learning model have been well-designed and relevant to the learning objectives.

The reliability coefficient for almost all indicators is above 85%, with the category of reliability. The support system indicator notes the highest reliability coefficient of 100%, indicating a perfect consensus rate among validators. Other indicators, such as supporting theories, syntax, and the implementation of the SINERGI learning model, have a reliability coefficient of 85.71%, which is also classified as reliable. Meanwhile, the reaction principle indicator has a slightly higher reliability coefficient than the average, which is 92.86%, indicating an excellent level of reliability.

The validation results show that the SINERGI learning model has a high level of validity and reliability, so it is feasible to apply it in various learning contexts. This high validity and reliability reflect that the model is based on a strong and consistent theory of education, as recognized in various educational literature. Research by (Herianto & Marsigit, 2023) emphasized that good educational theory is an important guideline for achieving effective learning goals. Moreover (Ma'ruf et al., 2022) It also shows that curriculum design based on solid educational theories will reflect the quality and relevance of learning practices, which is in line with the SINERGI learning model.

The validity and reliability of the model's syntax are high, indicating that each phase in learning has been designed with good internal linkages. This supports the effectiveness of the implementation of the model in the field, as affirmed by (Wahida et al., 2022), which states that a well-structured learning model can significantly improve student learning outcomes. Research also supports these findings, highlighting that a directed constructivism-based learning model can strengthen students' understanding and motivate them in the learning process.

Although all indicators of the SINERGI learning model have been included in the very valid category, more attention needs to be paid to the indicators of the principle of reaction. This indicator is important to ensure a stronger relationship between educator and student reactions during the learning process. The high-reliability coefficient of this indicator indicates consistency in assessment among validators, in line with the findings (Hidayat, 2023), which emphasizes the importance of interaction between teachers and students in supporting educational success. Small improvements in the design of reaction principles can have a significant impact on the overall effectiveness of the model. This is supported by research (Rahmi & Roza, 2019) which shows that good interaction between teachers and students can not only increase learning motivation but also have a positive impact on learning outcomes. Thus, the SINERGI learning model offers a holistic approach that is relevant and innovative in supporting 21st-century education.

Table 4. Validity of the construction of the SINERGI *(Science Process Skills Integration with Local Wisdom and Technology) learning model*

No	Validation indicators	Score	Validity categories	Reliability coefficient (%)	Reliability categories
1	Components of the SINERGI Learning Model	3.40	Highly Valid	87.50	Reliable
2	Supporting Theories	3.80	Highly Valid	100.00	Reliable
3	Syntax	3.70	Highly Valid	87.50	Reliable
4	Social System	3.60	Highly Valid	87.50	Reliable
5	Reaction Principle	3.20	Valid	83.30	Reliable
6	Support System	3.60	Highly Valid	87.50	Reliable
7	Implementation of the SINERGI Learning Model	3.60	Highly Valid	87.50	Reliable

Table 4 illustrates the results of the validation of the construction of the SINERGI *(Science Process Skills Integration with Local Wisdom and Technology) learning model* which is evaluated through seven main indicators, namely the components of the SINERGI learning model, supporting theories, syntax, social systems, reaction principles, supporting systems, and the implementation of the SINERGI learning model. Each indicator is scored based on the average score, validity category, reliability coefficient, and reliability category.

The supporting theory indicator obtained the highest average score of 3.80 with a highly valid category and a reliability coefficient of 100%, which reflects a high level of consistency among validators. This is in line with research (Flake et al., 2017), which emphasizes that construct validation is an important element in the development of educational instruments to ensure that the measuring tools used are trustworthy and relevant. In addition, the syntax indicators, social systems, support systems, and implementation of the SINERGI learning model also received a very valid category with an average score between 3.60 to 3.70 and a reliability coefficient of 87.50%. These findings indicate that these components have been well-designed and have strong consistency, as supported by research (Chang et al., 2021), which shows that a learning model with a clear structure is able to significantly improve student learning outcomes.

The components of the SINERGI learning model have an average score of 3.40 with a very valid category and a reliability coefficient of 87.50%. Although these results are relatively good, it is necessary to strengthen relevant references to further ensure the validity of the findings. On the other hand, the reaction principle obtained an average score of 3.20 with a valid category and a reliability coefficient of 83.30%. Although this indicator shows a fairly good level of reliability, its validity score is lower than other indicators, so it requires further evaluation and improvement, i.e., according to the input of the validator, for example, in the initial phase, using real cases or contextual problems as triggers for discussion or reflection. In the investigation phase, make sure that each student has a clear role in his group, for example, recorders, presenters, and discussion leaders, so that all students can be actively involved in the evaluation and reflection stage ask students to write a short journal to ensure the development of their knowledge as a form of continuous reflection. This follows the findings (Kane, 2013), which emphasizes the importance of continuous evaluation of elements in the SINERGI learning model to ensure their relevance and effectiveness in supporting evolving learning.

Thus, the results of construct validation show that the SINERGI learning model has a high level of validity and reliability, which makes it very feasible to be applied in educational practice. The model is supported by a robust design, consistency between components, and the potential to support effective learning that is relevant to the needs of the 21st century.

CONCLUSION

Based on the results and discussion above, it can be concluded that the SINERGI learning model has a high level of validity and reliability, with an average score of content and construct validity above 3.25 and a reliability coefficient of more than 85%. The model is designed to integrate process science (SPS) skills, local wisdom, and technology in learning, thus providing a relevant and innovative approach to support 21st-century skills development. The results show that the main elements of the model, such as supporting theories, syntax, and social systems, have been designed consistently and according to learning objectives. However, the principal aspect of the reaction requires refinement to improve its relevance to other phases of learning. Thus, the SINERGI learning model is feasible to be used in various educational contexts to improve students' critical, creative, collaborative, and communicative thinking skills.

RECOMENDATION

The suggestions in this study are as follows:

1. The results of this study require further research, especially the implementation of the SINERGI learning model in the classroom learning process. The practicality and effectiveness of the developed model can be evaluated through its application in various learning contexts. Relevant further research can be focused on assessing the practicality and effectiveness of the SINERGI model, to ensure that this model can improve students' science process skills and support holistic learning that is relevant to the needs of the 21st century.
2. The aspect of the reaction principle in the SINERGI learning model needs to be refined to ensure a closer relationship between educators and students, thereby increasing the effectiveness of learning.

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