



Examining the Validity of Inquiry-Based Biology Learning Tools in Fostering Critical Thinking Ability

Gusti Ketut Alit Suputra^{1*}, Rafika¹, Effendi Dg. Palliwi¹, Nuraini¹, Khairunnisa¹

¹Faculty of Teacher Training and Education, Universitas Tadulako, Palu, Indonesia.

Received: April 10, 2023

Revised: June 21, 2023

Accepted: June 25, 2023

Published: June 30, 2023

Corresponding Author:
Gusti Ketut Alit Suputra
alitsuputra.gusti@gmail.com

DOI: [10.29303/jppipa.v9i6.4538](https://doi.org/10.29303/jppipa.v9i6.4538)

© 2023 The Authors. This open access article is distributed under a (CC-BY License)



Abstract: Critical thinking skills are essential skills of the 21st century which are very important for students to master. Unfortunately, some research results show students' low critical thinking skills. One important component that supports the teaching of critical thinking for students is learning tools. The results of the preliminary study show the lack of learning tools that are oriented towards students' scientific activities so that it is suspected to be the cause of students' low critical thinking skills. This study aims to evaluate the validity of inquiry-based biology learning tools that can explicitly be used to teach critical thinking skills. This research is descriptive-evaluative research because it only evaluates the results of expert judgment on the validity of the developed learning tools. Two validators with professor qualifications were involved in this study to evaluate the validity of the product using the validation sheet instrument. The results showed that the learning tools developed in the form of lesson plans, learning materials, student worksheets, and critical thinking ability tests were generally stated to be valid (score = 3.65) and reliable (score = 0.93) used to teach students' critical thinking skills in system teaching materials Respiratory. Further research related to the practicality test and the effectiveness of the resulting device needs to be carried out in further research.

Keywords: Critical thinking; Inquiry learning model; Learning tools; Respiratory system

Introduction

The human respiratory system is one of the materials contained in the 2013 curriculum in the even semester of class XI (Puspridayanti et al., 2018). The competency standard contained in the 2013 curriculum is understanding the human respiratory system. The basic competency expected in the material on the human respiratory system is to analyze the relationship between the tissue structures that make up the organs in the respiratory system and relate it to its bioprocess so that it can explain the mechanism of blood circulation and functional disturbances that may occur in the human respiratory system through literature studies, observations, experiments and simulations. (Ministry of Education and Culture, 2014; Minister of Education and Culture, 2022). Material on the human respiratory system is material related to aspects of life, there are many difficult concepts in this material, so students are expected to be able to solve problems based on their knowledge (Anidityas et al., 2012). Material on the

human respiratory system is logical when taught using the guided inquiry learning model, because in it many problems can improve students' critical thinking skills and understand concepts in solving problems (Widyaningrum & Wijayanti, 2019).

Unfortunately, teachers mostly use the lecture method on the grounds that it saves time and all material can be provided. Face-to-face for practicum activities is also very minimal, usually carried out only once in one semester. The rest of the learning is done by lectures, even though a lot of material in biology requires experimentation and observation (Santana & Samsuri, 2022). The method as described does not provide opportunities for students to improve students' critical thinking skills (Musahidin et al., 2022). Students' academic skills will not develop in students when the learning process does not accommodate scientific activities through experimental activities so as to develop students' critical thinking skills (Asy'ari & Fitriani, 2017).

How to Cite:

Suputra, G.K.A., Rafika, R., Palliwi, E.D., Nuraini, N., & Khairunnisa, K. (2023). Examining the Validity of Inquiry-Based Biology Learning Tools in Fostering Critical Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, 9(6), 4863–4868. <https://doi.org/10.29303/jppipa.v9i6.4538>

Based on this description, there is a need for appropriate learning tools to be made by teachers in implementing learning models that involve students in learning activities directly while at the same time training students' academic skills and social skills, namely the guided inquiry learning model designed with scientific learning will stimulate students to grow scientific attitude through scientific activities (Arends, 2012). Students are involved in inquiry activities which is an effective way to help students improve critical thinking skills. This study aims to develop valid guided inquiry model-based biology learning tools to improve students' critical thinking skills. It is hoped that the results of this study can be used as empirical information regarding learning alternatives and supporting tools that can enable students to improve critical thinking skills using guided inquiry models on the subject of the human respiratory system.

Guided inquiry is used in this study as a learning approach to meet various curriculum requirements by engaging, motivating, and challenging students in line with the 21st-century educational goals. Guided inquiry involves the identification of problems and the formulation of research questions by the teacher, and students are provided with clear and concise performance objectives for their investigative activities (Wenning, 2011). The implementation of guided inquiry-based learning not only enhances students' understanding of the subject matter but also improves their skills in scientific processes and scientific work (Andini et al., 2018; Iskandar et al., 2021; Kusumawati et al., 2022).

The guided inquiry model offers integrated inquiry that is planned and guided by librarians and teachers, allowing students to gain a deeper understanding of the curriculum content and conceptual information. It develops the skills and abilities necessary for work and everyday life in the 21st century (Anderman et al., 2012; Gonzalez-DeHass, 2016). From a learning perspective, the inquiry model is a teaching/learning strategy designed for students to answer questions or solve problems (Fitriani et al., 2022).

Based on the understanding of educational experts and these characteristics, the guided inquiry learning model focuses on the thinking process that constructs experiences through students' active involvement in learning. Students learn by constructing their own understanding based on experiences and what they already know through inquiry activities guided by the teacher.

Method

This study employed a descriptive-evaluative research design (Asy'ari et al., 2018). The evaluation of

the produced products included learning tools such as lesson plans, student worksheets, student teaching materials, and assessment instruments for students' critical thinking skills based on the guided inquiry learning model, specifically focusing on the respiratory system topic. The validation of the products involved two components: content validity and construct validity (Nieveen, 1999). Content validity ensured that all components of the learning model were based on the state-of-the-art knowledge. Construct validity ensured consistency among the model's components. The validation of the tools was conducted by two validators with the aim of obtaining feedback and notes on the developed tools to ensure their suitability for instructional purposes.

The data obtained from the validation of the guided inquiry model were qualitatively analyzed using a descriptive approach by calculating the average scores given by the validators. The assessment of the validity of the learning model employed a 5-point rating scale, where the scores ranged from very inadequate (1), less valid (2), sufficiently valid (3), valid (4), to highly valid (5). The scores obtained from the expert assessment were then converted into qualitative data on a 5-point scale (Ratumanan & Laurens, 2011), as presented in Table 1.

Table 1. Validity Levels of Learning Tools

Interval	Category
0.0 ≤ score ≤ 1.0	Invalid
1.0 < score ≤ 2.0	Less valid
2.0 < score ≤ 3.0	Enough
3.0 < score ≤ 4.0	Valid
4.0 < score ≤ 5.0	Very Valid

The average values of validity and reliability for the learning tools were determined based on the ratings provided by the validators. The reliability of the learning tools was calculated using the percentage agreement equation proposed by Emmer and Millett (Borich, 2016). An instrument was considered reliable if it had a percentage agreement of ≥ 75%, which means that 75% of the average scores from the validator team fell into the valid category.

$$Percentage\ Agreement = 100(1 - \frac{A-B}{A+B}) \tag{1}$$

With A is the frequency of observed behavioral aspects by the observer was determined by recording high-frequency occurrences; while B is the frequency of observed behavioral aspects by another observer was determined by recording low-frequency occurrences.

Result and Discussion

The results of the validation of the biology learning tools based on the guided inquiry model developed

were declared valid to train students' critical thinking skills. The validator provides an assessment with an average score of 3.6 (valid) with a reliability of 91.4% (reliable) for lesson plans; 3.5 (valid) with a reliability of 93% (reliable) for student textbooks; 3.7 (valid) with a reliability of 92.1% (reliable) for student worksheets; 3.8 (valid) with 97% reliability for critical thinking instruments. The results of the validation of biology learning tools based on the guided inquiry model are briefly presented in Table 1.

Table 1. Validity of Biology learning tools based on guided inquiry models

Device Type	Score	Category	Reliability
Lesson Plans	3.6	Valid	0.91
Teaching Materials	3.5	Valid	0.93
Students worksheet	3.7	Valid	0.92
Test Instruments	3.8	Valid	0.97
Sensitivity test	0.61	sensitive	
Average	3.65	Valid	0.93 (Reliable)

Based on the data in Table 3, it is known that the average lesson plan validation score which includes construction validity, content validity, learning activities, learning resources and tools is in the valid category. This shows that the lesson plan developed is valid to use. Table 3 also shows that overall the validator's assessment of the teaching materials developed was stated to be valid and reliable. The results of this validation indicate that the teaching materials developed can/are suitable for use at the implementation/research stage. MFI eligibility which includes terms, content feasibility, and questions are in the valid category. This shows that the developed LKM is valid to use. Furthermore, the critical thinking ability test instrument is also valid which indicates that the test developed can be used to measure students' critical thinking skills in the material on the respiratory system.

The validity carried out contains two elements of validity, namely *content validity* and *construct validity* (Asy'ari et al., 2018). *The content validity* in question is all the components that compose it learning tools developed must be based on the needs and level of knowledge (Nieveen, 1999) which are based on the results of curriculum analysis, student analysis and concept analysis that have been carried out on the respiratory system material. *Construct validity* means that all components must be consistently related to one another (Nieveen, 1999). Element of validity The contents and constructs that are validated from the learning tools developed include the components that make up the learning device itself are: the competencies (behaviors) that students will have after learning takes place, the components regarding the methods taken to master the competencies (learning activities), the

assessment components to determine student achievement regarding the competencies being taught, and the supporting components (allocation of time and learning resources).

Tools as teaching guidelines in managing learning, have several aspects including aspects related to competence (what you want to achieve), aspects related to the method taken to master competence (learning activities), aspects related to assessment to determine student achievement regarding the competencies taught, and supporting specs (allocation of time and learning resources) (Permendikbudristek, 2022). Learning tools are guidelines or guidelines for teachers in carrying out learning activities, both in class, laboratory, and learning carried out in the field for each basic competency (Devi et al., 2021).

Components for evaluating the validity of learning tools include the competencies (behaviors) that students will have after learning takes place, components regarding the methods taken to master competencies (learning activities), assessment components to determine student achievement regarding the competencies taught, and supporting components (allocation time and learning resources) were declared valid by the validator after going through the review and revision stages. The components of competence (behavior) that students will have after learning takes place include competency standards, basic competencies, indicators, and learning materials. Competency standard/SK is a student's ability qualification that describes students' mastery of knowledge, attitudes, and skills after the learning process takes place. Basic competence/KD is the minimum ability that must be owned by students to support SK mastery. Indicators are markers of achieving KD. Indicators are formulated clearly, using operational verbs, and include behaviors/competencies to be achieved, measured (assessed) and learning materials, so that indicators can be stated as markers for achieving KD, can function to determine learning materials to be taught to students. This is in accordance with Jayanti's statement (2017), that the role or function of indicators in learning includes helping educators clarify learning objectives, selecting materials, designing learning activities, guidelines in developing teaching materials, and guidelines in designing/implementing learning outcome assessments.

The component regarding the method taken to master competence (learning activities) aims to provide experience to students according to achieving indicators, and or basic competencies. The planned learning activities are student-centered, in accordance with the learning model used, namely the guided inquiry learning model. Student-centered learning activities are a form of learning activities that provide opportunities

for students to develop science process skills (inquiry skills) to acquire knowledge, and develop their critical thinking skills (Arsal, 2017). The preparation of learning tools with student-centered learning activities is supported by the statement that learning tools with learning-centered activities are learning tools that focus on giving directions/guidance to students to understand the material being studied, and to help students become effective individuals (Fitriani et al., 2022). It was further explained that student-centered learning is not only centered on acquiring/building knowledge, but also for developing effective learning strategies (Dwikoranto et al., 2020; Sambudi et al., 2023).

Assessment is one of the techniques used to determine the level of student achievement. Assessment can be carried out, if there are available assessment instruments/tools, either using instruments in the form of tests, or in the form of observation sheets. The assessment carried out in this study used written instruments, or assessment techniques used written strategies in the form of descriptive questions to determine critical thinking skills. The description questions used consist of 6 question items that must be answered by students based on the allotted time. The scoring of each response or answer given by students refers to a critical thinking assessment sheet with 6 indicators, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2020).

Instruments that have been prepared before can be used according to their function, namely measuring students' critical thinking skills, first conducted a validity test. Based on the validation results, the instruments that have been developed can/are valid for use at the research stage, or valid for use to measure students' critical thinking skills. This validity is due to the process/procedure for preparing critical thinking skills instruments that meet the requirements of substance, construction, and language, and have evidence of empirical validity. Apart from being validated, the critical thinking skills instrument was also tested for the sensitivity of the items which in general based on Table 1, it was found that the items on the critical thinking skills instrument were declared sensitive (score = 0.61) (Borich, 2016).

The results of the validation of the assessment components include the strategies and forms of assessment instruments that have been described and used to measure the achievement of student competencies. As the statement states that the role/function of the indicators above, the determination of the assessment instrument, both the strategy and the form used, can be stated as good or valid, if it is in accordance with what is to be achieved (indicators), and the material being taught (Muhali et al., 2019).

Conclusion

Based on the findings in this study, it can be concluded that the resulting learning tools are valid (score = 3.65) and reliable (score = 0.93) used to teach students' critical thinking skills in respiratory system teaching materials. Further research related to the practicality test and the effectiveness of the resulting device needs to be carried out in further research.

Acknowledgement

The research would like to thank the teachers and students of SD Inpres Baru who were involved during the research process.

Author Contributions

Conceptualization, methodology, formal analysis, writing – review and editing by Gusti Ketut Alit Suputra; investigation, writing – original draft preparation by Rafiqa and Effendi Dg. Palliwi; writing – review and editing by Nuraini, writing – original draft preparation by Khairunnisa

Funding

No specific grant or funding was given to this educational research from any private institution, public or ganization or nonprofit corporation.

Conflict of Interest

The researchers declare no conflict of interests

References

- Anderman, E. M., Sinatra, G. M., & Gray, D. L. (2012). The challenges of teaching and learning about science in the twenty-first century: Exploring the abilities and constraints of adolescent learners. *Studies in Science Education*, 48(1), Article 1. <https://doi.org/10.1080/03057267.2012.655038>
- Andini, T. E., Hidayat, S., & Fadillah, E. N. (2018). Scientific process skills: Preliminary study towards senior high school student in Palembang. *Jurnal Pendidikan Biologi Indonesia*, 4(3), Article 3. <https://doi.org/10.22219/jpbi.v4i3.6784>
- Anidityas, N. A., Utami, N. R., & Widiyaningrum, P. (2012). Penggunaan Alat Peraga Sistem Pernapasan Manusia Pada Kualitas Belajar Siswa Smp Kelas VIII. *Unnes Science Education Journal*, 1(2), Article 2. <https://doi.org/10.15294/usej.v1i2.865>
- Arends, R. (2012). *Learning to teach* (9th ed). McGraw-Hill.
- Arsal, Z. (2017). The impact of inquiry-based learning on the critical thinking dispositions of pre-service science teachers. *International Journal of Science Education*, 39(10), Article 10. <https://doi.org/10.1080/09500693.2017.1329564>

- Asy'ari, M., & Fitriani, H. (2017). Literatur Reviu Keterampilan Proses Sains sebagai Dasar Pengembangan Keterampilan Berpikir Tingkat Tinggi. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 5(1), Article 1. <https://doi.org/10.33394/j-ps.v5i1.1114>
- Asy'ari, M., Ikhsan, M., & Muhali, M. (2018). Validitas Instrumen Karakterisasi Kemampuan Metakognisi Mahasiswa Calon Guru Fisika. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 6(1), Article 1. <https://doi.org/10.33394/j-ps.v6i1.955>
- Borich, G. D. (2016). *Observation Skills for Effective Teaching: Research-Based Practice* (0 ed.). Routledge. <https://doi.org/10.4324/9781315633206>
- Devi, N. S., Efendi, I., & Samsuri, T. (2021). Model Pembelajaran Kooperatif Tipe Student Teams Achievement Division Berbantuan Media Video Terhadap Motivasi dan Hasil Belajar Kognitif. *Reflection Journal*, 1(1), Article 1. <https://doi.org/10.36312/rj.v1i1.530>
- Dwikoranto, D., Setiani, R., Prahani, B. K., & Mubarok, H. (2020). Mobile Learning to Improve Student Collaborative Skills: An Alternative to Online Learning in the Era of Covid-19 Pandemic. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, 4(3), Article 3. <https://doi.org/10.36312/e-saintika.v4i3.314>
- Facione, P. A. (2020). *Critical Thinking: What It Is and Why It Counts*. Measured Reasons LCC. <https://www.insightassessment.com/wp-content/uploads/ia/pdf/whatwhy.pdf>
- Fitriani, H., Samsuri, T., Rachmadiarti, F., Raharjo, R., & Mantlana, C. D. (2022). Development of Evaluative-Process Learning Tools Integrated with Conceptual-Problem-Based Learning Models: Study of Its Validity and Effectiveness to Train Critical Thinking. *International Journal of Essential Competencies in Education*, 1(1), Article 1. <https://doi.org/10.36312/ijece.v1i1.736>
- Gonzalez-DeHass, A. (2016). Preparing 21st Century Learners: Parent Involvement Strategies for Encouraging Students' Self-Regulated Learning. *Childhood Education*, 92(6), 427-436. <https://doi.org/10.1080/00094056.2016.1251791>
- Iskandar, J., Gummah, S., Prayogi, S., & Asy'ari, M. (2021). Pengaruh Penggunaan Model Pembelajaran Inkuiri Terbimbing terhadap Prestasi Belajar Fisika Siswa SMP. *Empiricism Journal*, 2(1), Article 1. <https://doi.org/10.36312/ej.v2i1.515>
- Jayanti, P. (2017). Validitas dan Efektivitas Lks Berbasis Pembelajaran Aktif dengan Metode Bermain Peran Pada Materi Sistem Imun. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 6(1). <https://ejournal.unesa.ac.id>
- Kemendikbud. (2014). *Permendikbud No.103 Tahun 2014: Tentang Pembelajaran Pada Pendidikan Dasar dan Pendidikan Menengah – KomKat KWI*. Kemendikbud. <https://komkat-kwi.org/2015/08/18/permendikbud-no-103-tahun-2014-tentang-pembelajaran-pada-pendidikan-dasar-dan-pendidikan-menengah/>
- Kusumawati, Y., Umar, U., & Hakim, L. (2022). The Application of Blended Learning Using Edmodo Media to Increase Learning Motivation and Achievement in Learning Physics. *Empiricism Journal*, 3(2), 264-276. <https://doi.org/10.36312/ej.v3i2.1014>
- Muhali, M., Yuanita, L., & Muslimin, L. (2019). The Validity and Effectiveness of the Reflective-Metacognitive Learning Model to Improve Students' Metacognition Ability in Indonesia. *Malaysian Journal of Learning and Instruction*, 16(Number 2), Article Number 2. <https://doi.org/10.32890/mjli2019.16.2.2>
- Musahidin, M., Muhali, M., Asy'ari, M., & Sukaisih, R. (2022). Meningkatkan pemahaman konsep dan kesadaran metakognisi peserta didik pada materi struktur atom melalui pemodelan. *Journal of Authentic Research*, 1(1), Article 1. <https://doi.org/10.36312/jar.v1i1.637>
- Nieveen, N. (1999). Prototyping to Reach Product Quality. In J. van den Akker, R. M. Branch, K. Gustafson, N. Nieveen, & T. Plomp (Eds.), *Design Approaches and Tools in Education and Training* (pp. 125-135). Springer Netherlands. https://doi.org/10.1007/978-94-011-4255-7_10
- Permendikbudristek. (2022). *Permendikbudristek No 16 Tahun 2022 tentang Standar Proses pada Pendidikan Anak Usia Dini, Pendidikan Dasar, dan Jenjang Sekolah Menengah*. Permendikbudristek.
- Puspridayanti, V. S., Wedi, A., & Ulfa, S. (2018). Pengembangan E-Module Mata Pelajaran Biologi Kelas XI Semester II Materi Sistem Pernapasan Manusia Di SMA Negeri 1 Karanganyar Trenggalek. *Jurnal Inovasi Dan Teknologi Pembelajaran*, 4(2), Article 2. <https://doi.org/10.17977/um031v4i22018p056>
- Ratumanan, T. G., & Laurens, T. (2011). *Penilaian Hasil Belajar pada Tingkat Satuan Pendidikan*. Unesa University Press.
- Sambudi, N. S., Jusoh, N., Sapiaa, N. A. H., & Ahmad, S. I. (2023). Integrated Project in Separation Process Class as Innovative Tool to Improve Students' Online Learning Experience. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, 7(1), 18-29. <https://doi.org/10.36312/esaintika.v7i1.1042>
- Santana, R., & Samsuri, T. (2022). Pengembangan lks biologi berbasis poe (predict observe explain) untuk meningkatkan hasil belajar kognitif siswa.

- Journal of Authentic Research*, 1(1), Article 1.
<https://doi.org/10.36312/jar.v1i1.650>
- Wenning, C. J. (2011). The Levels of Inquiry Model of Science Teaching (Shaded sections added January 2012; refer to Wenning (2010) for explications of real-world applications component of the Inquiry Spectrum.). *Journal of Physics Teacher Education Online*, 6(2), Article 2.
- Widyaningrum, D. A., & Wijayanti, T. (2019). Implementasi buku petunjuk praktikum biokimia berbasis inkuiri terbimbing untuk meningkatkan kemampuan kerja ilmiah. *Edubiotik: Jurnal Pendidikan, Biologi Dan Terapan*, 4(02), Article 02.
<https://doi.org/10.33503/ebio.v4i02.437>