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Implementing Guided Inquiry-Based Biology Learning Tools to Enhance Students' Critical Thinking Skills

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Abstract: The implementation of biology learning in high school focuses more on mastering concepts and minimal processes. This can be seen from the tendency of teachers to use more teacher-oriented learning. This condition also occurs in SMA Negeri 4 Palu, causing low students' critical thinking skills. This study aims to implement guided inquiry-based biology learning tools to improve students' critical thinking skills on the respiratory system material. This research is a quantitative descriptive research with one group pretest-posttest design. This research involved *30 students of class XI* SMA Negeri 4 Palu. The learning tools implemented in this study are lesson plans, student worksheets, and learning materials. Test instruments in the form of multiple choices and descriptions are used to measure cognitive learning outcomes and students' critical thinking skills. The implementation of learning and student learning activities were also identified in this study using observation sheets carried out by 2 observers. Data were analyzed descriptively using the n-gain equation. Based on the results of the study it was found that (a) the implementation of learning was good (3.6); (b) The frequency of activities that stand out is that they can improve students' critical thinking skills (c) positive student responses (82); (d) students' critical thinking skills increased (N-gain; 0.76 with high criteria). Based on the results of the study it can be concluded that the guided inquiry learning model can improve the critical thinking skills of class XI students at SMA Negeri 4 Palu.

Keywords: Critical thinking; Guided inquiry; Respiratory system

Introduction

The 2013 curriculum suggests that students must have more productive, creative, innovative and affective abilities, so a learning process that supports creativity is needed (Zubaidah, 2019). learning that prioritizes personal experience through the process of observing, asking, reasoning, and trying (observation based learning) to increase student creativity needs to be done (Sabri et al., 2022), so that you get collaborative learning experiences with colleagues (Muhali, 2019) . Teachers as an important component in education have a great responsibility and are very decisive in achieving curriculum competencies (Ekayanti et al., 2022). Each teacher in an education unit is obliged to develop complete and systematic learning tools so that learning takes place interactively, inspiring, fun, challenging, motivating students to participate actively and independently in accordance with the talents, interests and physical and psychological development of students (Fitriani et al., 2022). In line with these demands, Piaget stated that learning is centered on thought processes or mental processes, not just on the results (Hidayana et al., 2022).

The nature of biology as a part or aspect of science/science subjects can be viewed and understood from the nature of science. Natural Science is a unified product, process and attitude so that the objectives of learning Science on the biological aspect must also refer to these three essential aspects, namely 1) knowledge, in the form of understanding concepts, laws and theories and their application; 2) the ability to carry out the process, namely the process of solving problems through the scientific method which includes preparing hypotheses, designing experiments or trials, evaluating, measuring and drawing conclusions; 3) scientific

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attitude, including scientific tendencies, critical thinking, analytical thinking, responsibility, attention to scientific problems and appreciation for scientific matters (Asy'ari, Fitriani, et al., 2019) . Therefore, learning biology should be carried out with the right approach, which combines the experience of science processes with an understanding of science products in the form of direct experience, both in the form of laboratory activities and field activities (Humayrah et al., 2022; Kurniawati et al., 2022) . A learning model that emphasizes the thought process of seeking and finding answers on your own in solving a problem is the inquiry learning model (Iskandar et al., 2021; Muhali, Asy'ari, et al., 2021; Verawati & Sukaisih, 2021) , which in This research is a guided inquiry.

Inquiry learning is a form of student-oriented learning approach (*student centered approach)*, because students will play a very dominant role in the learning process. Inquiry learning departs from the assumption that since humans are born into the world, humans have the urge to find their own knowledge (Arends, 2012) . Curiosity about the state of nature around him is human nature since birth into the world. Since childhood, humans have a desire to know everything through the senses of taste, hearing, sight and other senses. Until adulthood, human curiosity continues to develop by using the brain and mind, knowledge will be meaningful *when* it is based on curiosity (Muhali et al., 2019) .

Guided inquiry is a way of learning to fulfill many curriculum requirements through engaging, motivating and challenging learning according to the goals of the 21st century in schools to guide students to think and learn through inquiry. Guided inquiry is characterized by problems identified and several questions by the teacher as a research procedure and students are provided with clear and concise student performance objectives for inquiry activities (Biazus & Mahtari, 2022) . The application of guided inquiry-based learning can not only improve students' ability to understand material but can also improve critical thinking skills and science process skills (Hidayat & Evendi, 2022; Huliadi, 2021) . The guided inquiry model offers integrated investigations that are planned and guided by librarians and teachers, enabling students to gain a deeper understanding of curriculum subject matter content and conceptual information. Develop skills and abilities necessary for work and daily life in the 21st century (Cleovoulou & Beach, 2019) . In terms of learning, the inquiry model is a teaching/learning strategy designed for students to answer a question or solution to a problem (Septaria & Rismayanti, 2022) . Guided inquiry learning aims to provide opportunities for students to learn how to find facts, concepts, and principles through direct experience, train students' creative thinking skills in investigating problems or questions. In guided inquiry, learning activities must be managed properly by the teacher and learning outcomes can be predicted from the start. This type of inquiry is well applied in learning about fundamental concepts and principles in certain fields of science (Muliadi et al., 2019; Nisa & Nasrudin, 2022; Ranoptri et al., 2022) .

Critical thinking is reasonable and reflective thinking that focuses on deciding what to believe or do (Ennis, 2011) . Another definition states that critical thinking is a mode of thinking about any matter, substance or problem, in which the thinker improves the quality of his thinking by skillfully dealing with the structures inherent in thinking and applying intellectual standards to him (Bilad, Anwar, et al . ., 2022; Bilad, Doyan, et al., 2022) . This definition directs attention to the privilege of critical thinking that the only way to develop one's critical thinking skills is through 'thinking about one's own thinking'. The skills that underlie critical thinking, including the ability to; a) recognize problems, b) find ways to solve those problems, c) collect and compile necessary information, d) recognize assumptions and unstated values, e) understand and use appropriate, clear language, and characteristics, f) analyzing data, g) assessing facts and evaluating statements, h) recognizing that there is a logical relationship between issues, i) drawing conclusions and the necessary parallels, j) testing the conclusions and similarities that are one takes, k) reconstitutes one's belief patterns based on broader experience, and l) makes sound judgments about certain things and qualities (Fisher, 2011) .

Guided inquiry learning motivates students to find answers to problems. While finding answers to problems is a critical thinking skill. Student activities involved in inquiry learning include observing, asking questions, testing hypotheses and proving with experiments, using tools, analyzing and interpreting data, proposing answers, explaining, and predicting and presenting the results (National Research Council, 2012) . These activities are mostly critical thinking skills that are trained in this study, namely the skills of asking questions, formulating hypotheses, giving arguments. This study aims to implement guided inquiry-based biology learning tools to improve students' critical thinking skills at SMA Negeri 4 Palu.

Method

This research is a pre-experimental study (Fraenkel et al., 2012) using a one group pretest-posttest design, because there is treatment, without control and without repetition by applying learning that uses the guided inquiry model consisting of lesson plans, worksheets,

student teaching materials, instrument for assessing student learning outcomes, and an instrument for assessing critical thinking skills. This research was conducted on 30 students of class XI IPA SMA Negeri 4 Palu. The research instruments were in the form of observation sheets on the implementation of learning, worksheets, student teaching materials, instruments for assessing student learning outcomes, and instruments for assessing students' critical thinking skills. The data collection technique in this study was by observation, tests and questionnaires with material on the human respiratory system.

Data analysis techniques in this study used quantitative descriptive. The implementation of the lesson plan was observed by two observers and expressed in the form of an average score, student activity was measured by two observers and expressed in the form of a percentage, student responses were expressed in the form of a percentage, completeness of learning outcomes was measured using the pretest and posttest. Learning was analyzed descriptively qualitatively, students' knowledge before conversion was analyzed by *N-gain* (Hake, 1999) , students' critical thinking skills were measured using pretests (*Pretest)* and posttests (*Posttest)* learning which were analyzed descriptively qualitatively and expressed in percentage form.

Result and Discussion

Implementation of Learning

Based on the analysis of research data conducted at SMA Negeri 4 Palu, the guided inquiry model in the form of learning tools used in this study can be implemented properly. This is indicated by research findings which show that the learning process is going well as illustrated in Figure 1.

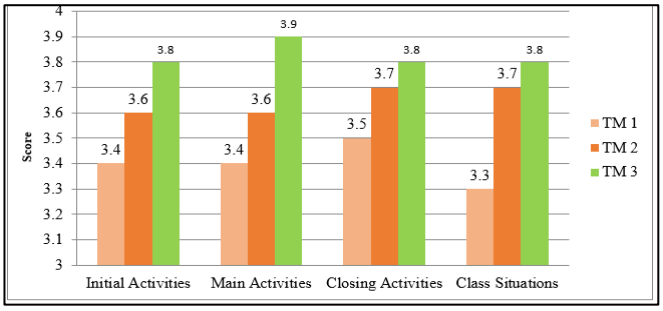

Figure 1. Implementation of Learning Activities

Based on observational data and analysis, the implementation of lesson plans using the guided inquiry model is said to be well implemented, if the learning scenarios designed in lesson plans are carried out routinely and systematically. The results of the analysis show that the management of learning using the guided inquiry learning model for high school students as a whole has been carried out well, in the aspects of preliminary activities, core activities, closing activities and class atmosphere in good criteria. This is because learning activities always refer to lesson plans that have been carefully prepared, neatly arranged and sequential. The reliability of each meeting was 98.6%. In accordance with the provisions of Borich (2016) which states that an instrument is said to be good if it has a reliability coefficient ≥ 0.75 (75%), thus the lesson plan implementation observation sheet shows consistency, meaning that the lesson plan observation sheet instrument used in the study used is reliable.

In the preliminary activities in the lesson plan scenario it was well implemented which can be seen from the way the teacher opened the learning activities by directing students to formulate problems based on students' prior knowledge according to the guided inquiry learning model. This is in accordance with Bruner's discovery learning theory suggesting that students should learn through active participation with concepts and principles, so that they gain experience, and carry out experiments that allow them to discover their own principles (Sani et al., 2022) . It was further explained that, in inquiry learning the teacher must provide confusing situations to trigger curiosity and motivate investigation (Arends, 2012; Muhali et al., 2021).

After the preliminary activities, it is also very important to look at the core activities, in general the students dominate this core activity. This is based on the theory of Constructivism Theory is a theory of building self-understanding from new experiences coupled with initial experiences, the same goes with Musahidin et al. (2022) that learning that is characterized by guided discovery tries to help students learn how to learn effectively and efficiently. This stage directs students to practice critical thinking skills by making inferences (logical conclusions) based on observations. This helps students understand the concept well. The application of *guided inquiry* learning models can improve students' ability to understand material/concepts and can improve their scientific process skills and scientific work (Asy'ari, Fitriani, et al., 2019) .

In the closing activity the teacher and students evaluate by comparing the findings of each group of students in carrying out the observations, thus forming an appropriate conclusion based on the observation activities. (Critical thinking skills: *self-regulation).* Also at this stage, the teacher gives awards to groups of students who are active in learning. Furthermore, the management of class time and atmosphere was carried out in a good category. This indicates that there has been a significant increase in the aspect of managing time and classroom atmosphere during learning in accordance

with the lesson plans that have been used. This was reinforced from the results of direct observation of students during the implementation of learning that students were happy because they felt they could be more active in obtaining meaningful concepts when studying biology with practicum activities. Kuhlthau describes learning as an active individual process , not something done for someone but rather something that is done by someone and considers that experience and inquiry (investigation) are very important in meaningful learning (Muhali et al., 2019) .

Student Activity

Observation of student activity was carried out during the learning process by two observers. Figure 2 shows that the observer only found a few students who exhibited irrelevant behavior in learning. This shows that the enthusiasm of students to take part in learning is very high and is also due to learning activities that are different from before, namely learning activities carried out during this study using a guided inquiry model that is in accordance with Pieget's theory, namely the theory of cognitive development which emphasizes the active role of students in building their own understanding of reality, as suggested by Asy'ari et al. (2019) , which states that from a learning perspective, the inquiry model helps students develop their ability to actively solve problems.

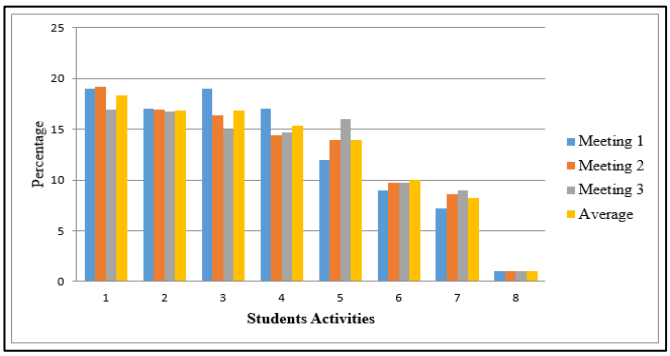

Figure 2. Percentage of student activity

Student response

The results of the study (Figure 3) show the student response questionnaire at points 1 to 7. It can be said that the student's response to all the stated components is good. Students tend to give a positive response to learning with the guided inquiry model. This condition makes students enthusiastic in participating in learning activities and students are more enthusiastic about learning and easily understand the respiratory system material being taught, because basically student learning activities are influenced by student learning motivations which can be seen from the responses of students who stated that they were very interested, very new , very easy, very interested and agreed. This is what shows this guided inquiry model helps students in developing their ability to actively solve problems. allows students to learn actively , is more courageous in expressing the opinions that are in his mind, in accordance with the opinion of Nur (2011) , that one of the main goals of going to school is to improve students' ability to think critically, in order to be able to make rational decisions about what to do or what to believe .

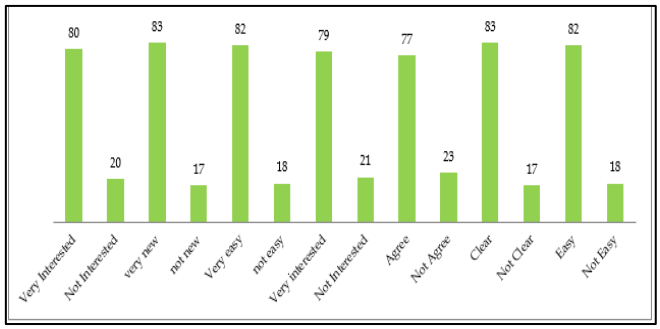

Figure 3. Percentage of Student Responses

Analysis of Learning Outcomes Tests (Knowledge Aspect)

pretest and *posttest* scores of students by calculating *the N-gain* of each student which also supports the increase in student learning outcomes with high criteria (Hake, 1999). . In addition, the sensitivity test of the THB items on the knowledge aspect as presented shows that the mean score of the item sensitivity is declared sensitive (Linn & Gronlund, 2000) . The sensitivity index of an item is a measure of how well the item differentiates students' abilities before and after learning using learning tools (Ratumanan & Laurens, 2011) . With these results indicate learning with the guided inquiry model is effective and has a significant effect on the learning outcomes of students' knowledge aspects. This is in line with the opinion which states that the application of the guided inquiry model provides benefits that can increase students' understanding of processes, concepts and relationships (Wirzal, Halim, et al., 2022; Wirzal, Nordin, et al., 2022) .

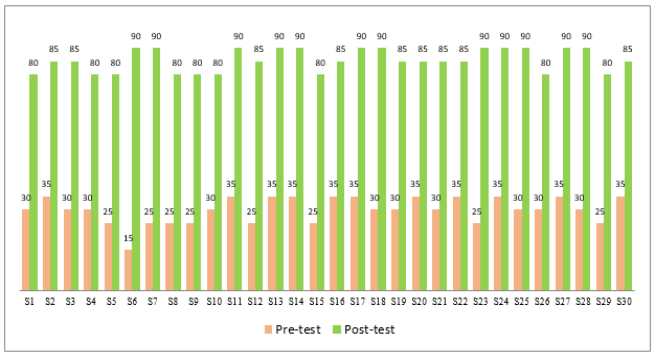

Figure 4. Student Learning Outcomes

Students' Critical Thinking Ability

The increase in students' critical thinking skills in a study of 30 students in class XI IPA showed that there had been a significant increase before learning (*pretest*) with uncritical criteria and after learning (*posttest*) with very critical criteria and the N-gain average acquisition was what supported the increased thinking ability critical students. Students' critical thinking skills assessed in this study are the abilities of interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2020) . Six stages of the test are used to measure students' critical thinking skills, the first stage is in the process of critical thinking, namely *interpretation* is used to measure how students can understand or express the meaning of various kinds of experiences, data situations or examples, the second stage is *analysis* , namely identifying inferential relationships intended and actual among statements, questions, concepts, which are intended to express judgments, experiences, reasons, information or opinions. How to analyze that is by testing data or analyzing arguments. The third stage is *evaluation*, namely assessing the credibility of statements which are reports or descriptions of perceptions, experiences, situations or judgments. The fourth stage is identifying and obtaining the elements needed to make reasonable conclusions. The fifth stage is stating the results and presenting the arguments. The sixth stage is students' thinking skills or processing information (Prayogi & Muhali, 2015) . All tests are given in the form of a written test.

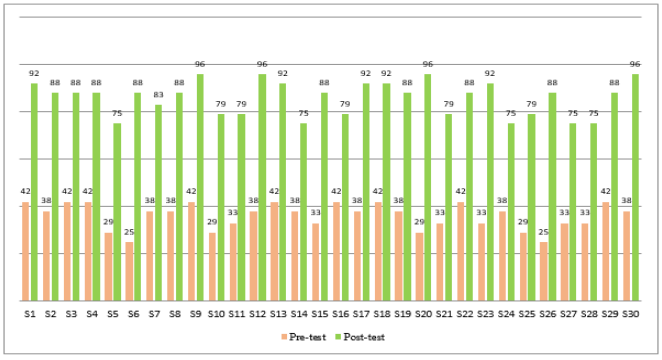

Figure 5. Students' Critical Thinking Ability

Conclusion

Based on the results of the research that has been done, it can be concluded that the application of the guided inquiry learning model with study material on the human respiratory system can improve high school students' critical thinking skills. It is necessary to pay attention to preparation and time management so that learning can be more effective and efficient. For further research, it is recommended that before carrying out learning to provide an explanation of the guided inquiry learning model.

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Author Contributions

Conceptualization, methodology, formal analysis, writing—review and editing by Ali; investigation, writing—original draft preparation by Rafiqa and Effendi Dg. Palliwi; writing—review and editing by Nuraini, writing—original draft preparation by Rahmadiani

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Conflict of Interest

The researchers declare no conflict of interests.

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