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Implementation of the RQA Learning Model Assisted by Electronic Student Worksheets in an Effort to Improve Students' Critical Thinking Skills in the Reproductive System Material

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ABSTRACT

This study aims to test the effectiveness of the implementation of the RQA (Reading, Questioning, and Answering) learning model assisted by interactive E-LKPD in improving students' critical thinking skills in the reproductive system material. The research method used is a quantitative method with a research approach in the form of surveys and observations. The research sample consisted of 2 classes selected using purposive sampling techniques, namely class XI MIPA 4 and XI MIPA 5. The data collection instrument was a critical thinking ability test given before and after treatment. The results of the study proved that the learning activities of students in the experimental class increased with the percentage of learning activities in general reaching 85%, 79%, and 88% at the first, second, and third meetings. In addition, there was a significant difference in critical thinking skills between the experimental class (average N-gain 95%) and the control class (average N-gain 39%), which was supported by the results of the hypothesis test with a significance value of 0.000 (<0.050). Student responses to the implementation of the RQA learning model also showed positive results, where most students (79%) gave positive responses. Thus, it can be concluded that the RQA learning model assisted by interactive E-LKPD is effective in improving students' critical thinking skills.

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1. INTRODUCTION

Learning is a process that takes place within a person that changes their behavior, both behavior in the process of thinking, behaving and doing. While learning is a process of transferring knowledge that involves a system in the world of education, namely the presence of teachers (educators), students, materials, goals and learning tools. In planned learning must be effective and efficient, so that learning objectives are achieved and well received by students and the achievement of national goals of educators (Syafrin, et. al., 2023).

Every student must be able to think critically to be ready to face the inevitable shifts due to the high rate of global modernization, the goal of teaching critical thinking is to strengthen students' basic skills. This can be achieved by involving students in learning activities using various teaching styles and considering relevant aspects. Individual opinions will be easier to make by students who have critical thinking skills (Hitchcock, 2017; Raj et al., 2022).

Students get the opportunity to utilize their capacity to think critically in the school environment such as categorizing, grouping, generalizing, comparing, evaluating, synthesizing, instructing and forming conclusions which are fundamental intellectual processes in students. Individual opinions will be easier to make by students who have critical thinking skills (Aston, 2024; Darwin et al., 2024; Mulnix, 2012).

The inability of students to develop critical thinking skills during learning can be associated with several factors, one of which is that students prefer to memorize facts and formulas rather than understand a concept. Several indicators such as the ability to provide basic clarification, explain the reasons for a decision, draw conclusions, provide further clarification, make assumptions and integrate new knowledge to design and select learning models can help students to think critically and find creative solutions in solving problems (Patel, et al., 2024; Saritepeci & Yildiz Durak, 2024).

Based on initial observations stated by teachers at MA Khas Kempek school, students are still unable to think critically, which causes students to rarely ask questions related to material that is not yet understood, less precise in answering high-level questions. And students are not yet able to think critically in arguing, reasoning and responding to questions from the other person. Therefore, efforts are needed to overcome these problems, one of which is by implementing an appropriate and effective learning model (Misqa et al., 2024; Sok & Heng, 2024). The learning model that is considered appropriate and effective to overcome these problems is the RQA (Reading, Questioning and Answering) learning model.

The RQA learning model has a syntax that requires students to read (Reading) the material that has been given first, then create questions (Questioning) that can encourage students to think more deeply. Students are also encouraged to answer questions (Answering) that have been prepared correctly, so that students are able to think critically. Therefore, the RQA learning model has a better influence compared to conventional learning (Imakulata et al., 2024; Safitri, et. al., 2024).

One of the successes of the RQA model is that it can improve student learning outcomes. This is because in the application of the RQA model there are stages of reading, making questions (questioning) and answering questions (answering). This allows students to process knowledge and integrate their knowledge (Choirunisa' et al., 2024; Hikamah & Maghfiroh, 2024; Leasa et al., 2024).

Based on Nasrudin & Azizah (2019), the RQA model can improve critical thinking skills, because there are stages of asking questions that can train students' critical thinking. Research conducted by Tendrita et al. (2022) also provides research results showing that classes that apply the RQA learning model have a positive impact on students' critical thinking

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skills compared to classes that do not apply the RQA learning model. The advantages of the RQA model are that it makes students read more, are able to reason and argument.

The RQA (Reading, Questioning and Answering) learning model also has shortcomings, one of which is that not many researchers have implemented the RQA learning model with the help of student worksheets, especially interactive electronic student worksheets. And there are not many studies that show success in improving critical thinking skills through the application of the RQA learning model. So with this, the researcher took the innovation to conduct research on the application of the RQA learning model assisted by interactive electronic student worksheets which the researcher hopes can improve students' critical thinking skills.

According to Awe & Ende (2019) in his research explained that electronic student worksheets are worksheets that are able to attract students' attention in completing their assignments because they contain a summary of the material containing images, instructions for use and assignments that refer to learning objectives to help students learn in a directed manner. Interactive electronic student worksheets (e-LKPD) are one of the teaching materials that can be developed by teachers for use in the learning process in order to achieve effective learning.

The RQA (Reading, Questioning and Answering) learning model also has shortcomings, one of which is that not many researchers have implemented the RQA learning model with the help of student worksheets, especially interactive electronic student worksheets. And there have not been many studies that show success in improving critical thinking skills through the application of the RQA learning model. So with this, researchers take innovation to conduct research on the application of the RQA learning model assisted by Interactive electronic student worksheets which researchers hope can improve students' critical thinking skills.

Based on the background of the problem above, the application of the RQA (Reading, Questioning and Answering) learning model assisted by interactive electronic student worksheet is expected by the author to change students to be more active, enthusiastic and able to understand the learning material delivered by their teachers in the classroom, so that it can have an impact on improving students' critical thinking skills.

2. METHODE

2.1 Research Design

This study employed a quantitative research method with a quasi-experimental design using a pretest-posttest control group structure. The research was conducted in February 2025 at MA Khas Kempek, involving grade XI students across five science-stream classes, each consisting of 30 students. Two classes were selected purposively as the sample: XI MIPA 4 (experimental class) and XI MIPA 5 (control class). The experimental class received treatment using the RQA (Reading, Questioning, and Answering) learning model, while the control class underwent conventional learning without the RQA model.

Table 1. Research Design Procedures

Class	Pretest	Treatment	Posttest
Experiment class	O1	X	O2
Control class	O1		O2

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The RQA model was implemented in three stages: Reading, Questioning, and Answering. In the Reading stage, students read and summarized material from the interactive electronic student worksheet (E-LKPD). Each meeting addressed different subtopics: (1) male reproductive system, (2) female reproductive system, and (3) disorders of the reproductive system. In the Questioning stage, students formulated questions based on their readings. Finally, in the Answering stage, students answered the questions they had previously created. These activities aimed to foster deeper engagement with the content and promote critical thinking.

2.2 Data Collection

Data were collected using pre-tests and post-tests administered to both the experimental and control groups. The tests were developed based on validated indicators of critical thinking skills and cognitive understanding of the reproductive system topic. Students were assessed before and after the learning sessions to measure the effectiveness of the RQA model intervention. The tests included a combination of multiple-choice and open-ended questions to evaluate content knowledge and reasoning ability.

Observations were also conducted during the treatment sessions to monitor the implementation of the RQA model and ensure instructional fidelity. Additionally, student engagement and participation were noted qualitatively to complement the quantitative test data.

2.3 Data Analysis

The collected data were analyzed using SPSS version 26. First, assumption tests were conducted, including the normality test using Kolmogorov–Smirnov and Shapiro–Wilk, and the homogeneity test using Levene's Test. After meeting the assumptions, an independent samples t-test was performed to compare the post-test scores of the experimental and control groups. A significance level of $\alpha = 0.05$ was used to determine whether the differences in learning outcomes were statistically significant.

3. RESULT AND DISCUSSION

3.1 Result

The data obtained from observations at the first meeting was 85%, at the second meeting there was a decrease of 79% and an increase again at the third meeting of 88% (Figure 1).

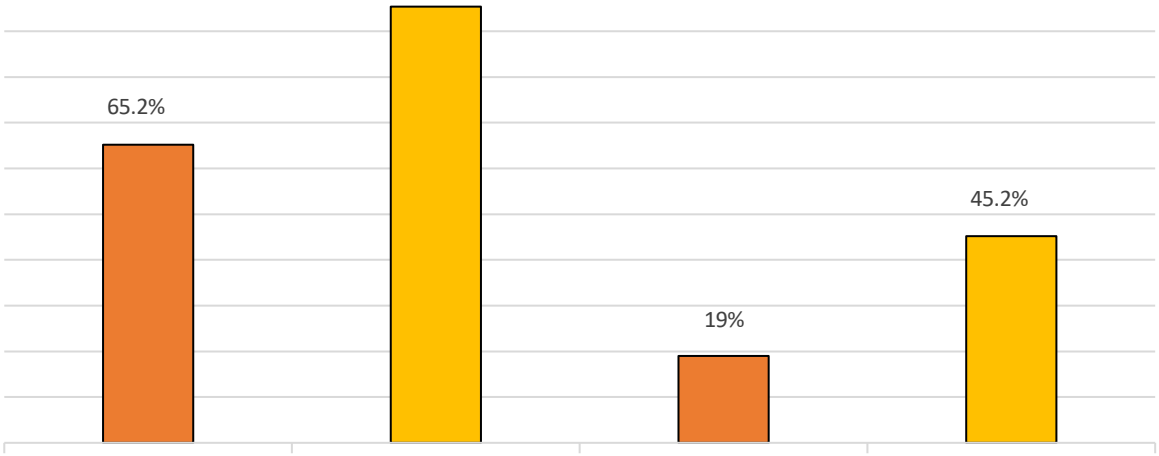

Figure 1. Graph of Student Activity During Three Meetings

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Based on Figure 1, student activities using the RQA learning model assisted by interactive electronic student worksheets in the experimental class showed an increase in student activity that was seen from the first meeting to the third meeting. This makes teachers not the only source of learning, but students can use other media as learning resources.

The average pretest-posttest value of Critical Thinking Skills (KBK) between the experimental class and the control class, there was a difference in the pretest value of 46.2 and the posttest of 50.2. The average pretest results of the experimental class were higher than those of the control class (Figure 2).

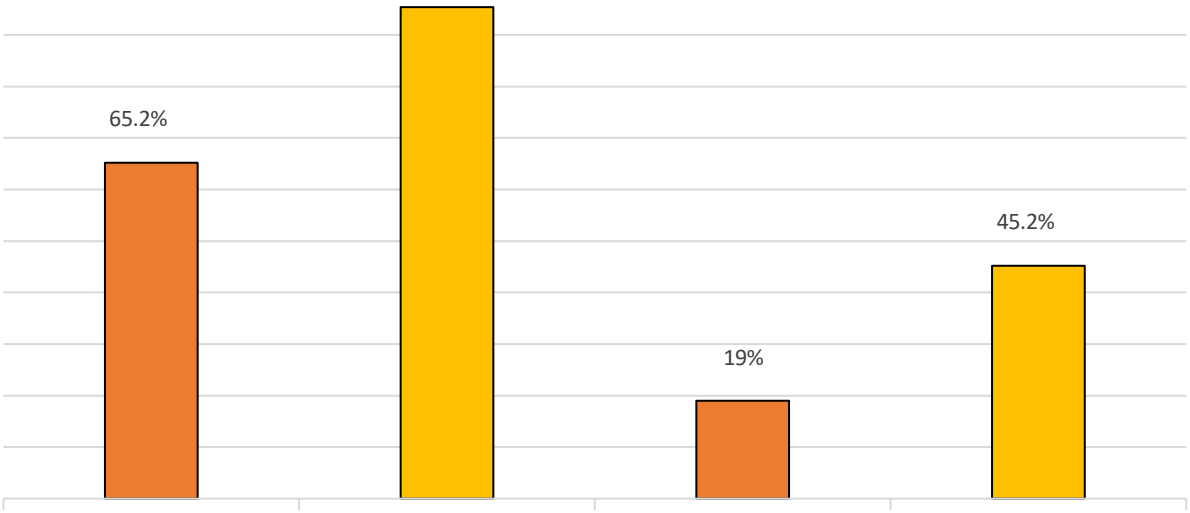

Figure 2. Graph of Average Pretest-Posttest Scores of Experimental and Control Class

Based on Figure 2, the data on the average pretest-posttest value of critical thinking skills (KBK) of the experimental class and the control class both experienced an increase in critical thinking skills, but the increase in critical thinking skills in the experimental class increased more significantly compared to the control class. The average pretest and posttest value of the experimental class was 30.2 while the control class was 26.2.

The average N-gain value of critical thinking skills of students in the experimental class is included in the high criteria (90) while the control class is included in the medium criteria (39). From both data, it is known that the average value of the experimental class is higher than the control class (Figure 3).

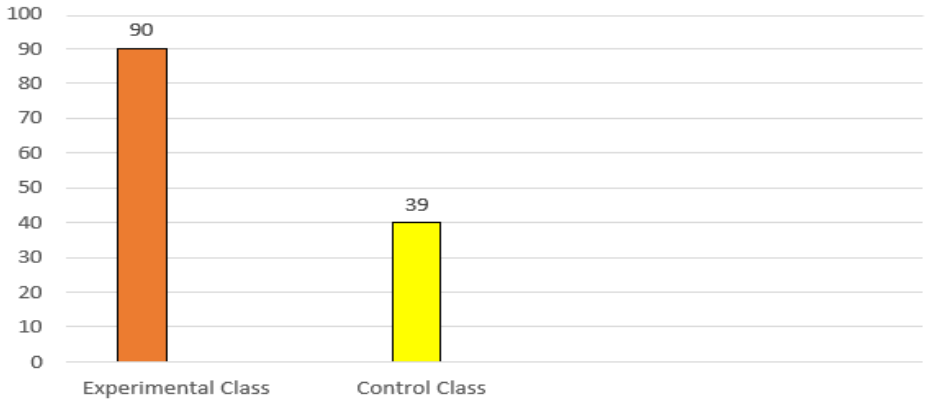

Figure 3. Average N-gain Value Graph of Critical Thinking Skills of Experimental and Control

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p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

Based on Figure 3, the results of the N-gain value data on the increase in critical thinking skills in general from both classes in the experimental class showed high criteria while the control class showed moderate criteria. This shows that the increase in critical thinking skills of students in the experimental class is higher than that of students in the control class. The difference in the increase in critical thinking is because students are free to understand the readings themselves related to the material to be studied, try to make analytical questions from the reading results and answer questions.

The results of the comparison of N-gain that has been achieved from each class on each indicator of critical thinking skills (KBK) experimental class N-gain that is interpreted high is KBK-1 of 0.92 and the low interpreted is KBK-4. While the control class N-gain that is interpreted high is KBK-3 of 0.31 and the low interpreted is KBK-5 (Figure 4).

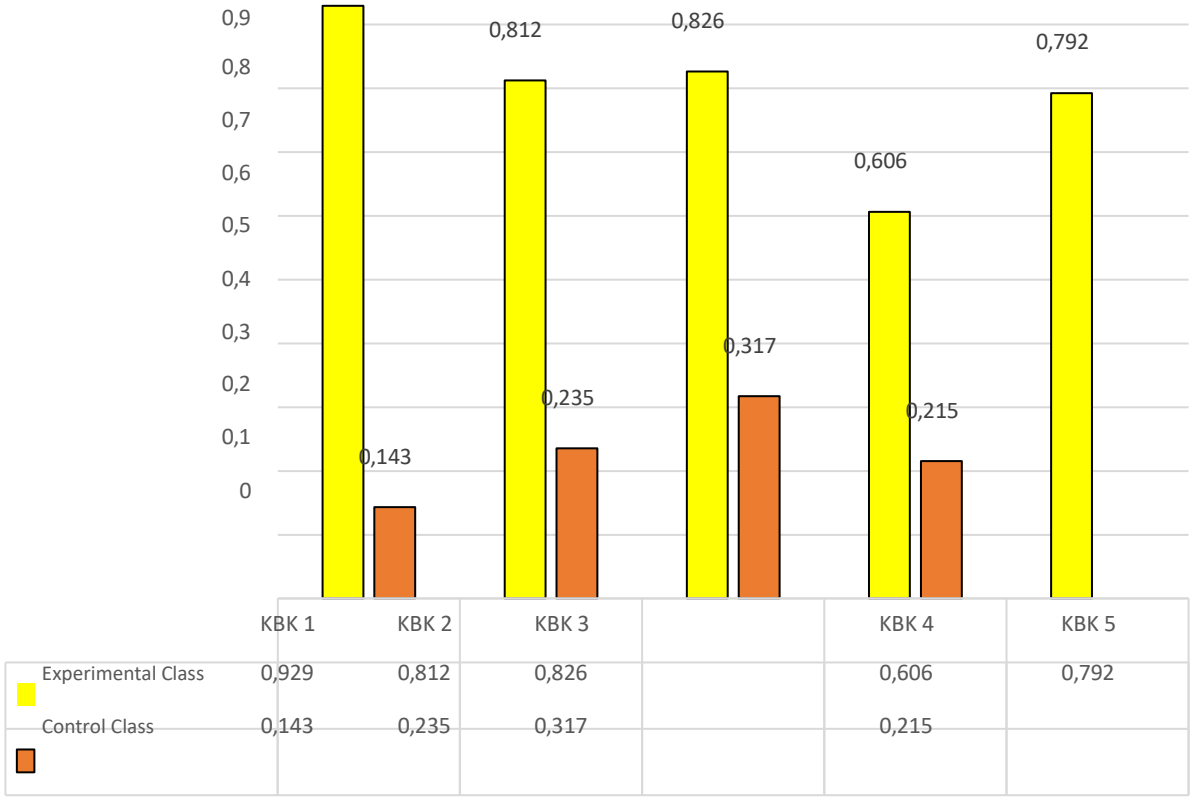

Figure 4. Average Graph of N-Gain Value of Thinking Skills Indikator

Based on Figure 4, the average N-gain value for each indicator of critical thinking ability (CBT) in the experimental class with the largest N-gain value of CBT-1 is about providing a simple explanation, while the smallest N-gain value is in CBT-4 about providing further explanation. Meanwhile, in the control class, the largest N-gain value is in CBT-3 about drawing conclusions and the smallest is in CBT-5 about arranging strategies and tactics.

The results of the N-gain normality and homogeneity test between the experimental class and the control class obtained the same significance value of the experimental class and the control class > 0.05 so that the data of both classes were normally distributed. The sample size was 30 in each class so that seen from the Shapiro Wilk value. The Homogeneity Test on N- gain data generally obtained a significance value of 0.356, it is said that the data that has been analyzed is homogeneously distributed (Table 2).

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Table 2. Results of the Normality and Homogeneity Test in General

Data	Class	Normality Test*Shapiro–Wilk*	Homogeneity Test
N-Gain	Experimental Class	Sig. 0.363 *Normal*	
	Control Class	Sig. 0.160 *Normal*	0.356 *(Homogeneous)*

Based on table 2, the results of the prerequisite test, namely the normality test of the experimental class and the control class, show that the data are normally distributed because the significance value of both is > 0.05. This normality test stage is important for determining the hypothesis test. Solihah et al, (2021) said that if the population is normally distributed, a homogeneity of variance test is then carried out. Based on the hypothesis test, a significance value of 0.000 or <0.05 was obtained, which means that H0 is rejected and Ha is accepted (Table 3).

Table 3. General Hypothesis Test Results

Data	Hypothesis Testing	Significance Value	Information
N-Gain	t-Test	0	H_o rejected

Based on table 3, the results of the hypothesis test using the T-test show a significance value of <0.05, which means that H0 is rejected and Ha is accepted. It can be concluded that there is a significant difference between the experimental class that applies the RQA (Reading, Questioning and Answering) learning model and the control class that does not apply the RQA (Reading, Questioning and Answering) learning model.

The results of the questionnaire calculation showed that most students had a good response to the RQA (Reading, Questioning and Answering) learning model with strong criteria of 18 students and sufficient criteria of 12 students (Table 4).

Table 4. Student Response Table For Learning

Criteria	Number of students	Presentase
Weak	0	-
Enough	12	40%
Strong	18	60%
Very Strong	0	-
Amount	30	100%

The results of the questionnaire respondents showed that 60% of students had a strong response to the implementation of the RQA (Reading, Questioning, and Answering) learning model and 40% gave a sufficient response. Based on these data, it can be concluded that overall RQA (Reading, Questioning, and Answering) learning received a very strong response from students with an average percentage of 80% (Figure 5).

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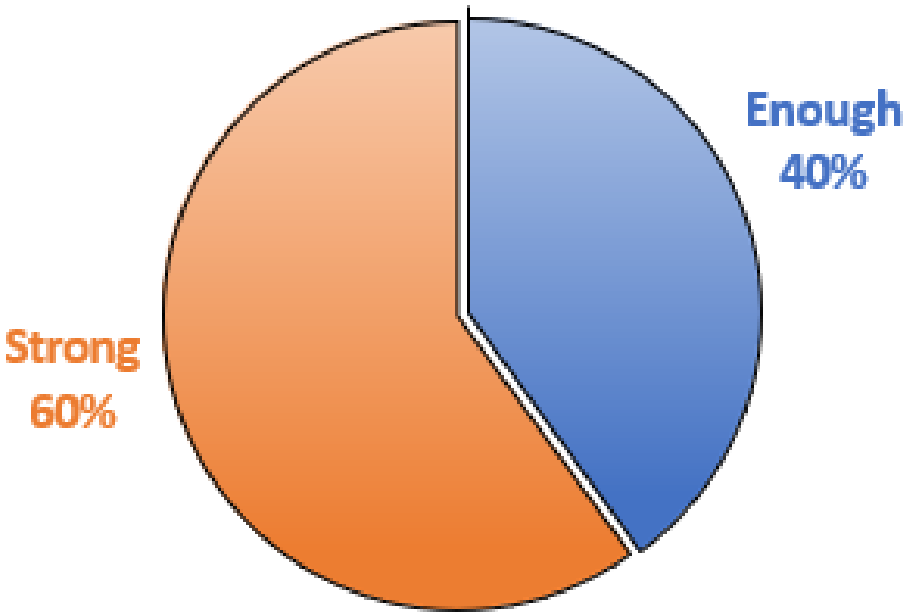

Figure 5. Student Response Questionnaire Recapitulation Graph

Based on Figure 5, it explains the students' responses in using the RQA (Reading, Questioning, and Answering) learning model, the results of the questionnaire filled out by students in the experimental class were 12 students who obtained a percentage of 40% with sufficient criteria and 18 students obtained a percentage of 60% with very strong criteria. This states that the learning provided by the teacher by implementing the RQA model assisted by interactive electronic student worksheets is quite good.

3.2 Discussion

The findings of this study provide compelling evidence that the RQA (Reading, Questioning, and Answering) learning model, when integrated with interactive e-worksheets, substantially enhances students' critical thinking skills in biology learning. The consistent improvement in student activity from the first to the third meeting demonstrates that RQA effectively fosters engagement, participation, and student autonomy. This shift from passive reception toward active knowledge construction aligns with the constructivist paradigm, which emphasizes learner agency and active interaction with instructional materials as key to meaningful learning (Lima, 2017; Manyukhina & Wyse, 2019; Rob & Rob, 2018). The data revealed that students were not merely responding to teacher instruction but actively engaging with content through reading, questioning, and reasoning, reflecting a transition toward inquiry-based learning (Dobber et al., 2017; Schramm et al., 2018).

The RQA model's three-phase structure, reading, questioning, and answering, enabled learners to internalize material, develop analytical questions, and articulate responses, resulting in stronger conceptual retention. This cyclical process parallels the metacognitive model of self-regulated learning, where reflection and self-questioning enhance understanding (Callan et al., 2021; Callan & Cleary, 2019). The increase in critical thinking scores observed in the experimental group compared to the control group substantiates previous findings that dialogic and reflective pedagogies cultivate higher-order cognitive skills (Meng et al., 2020). The experimental group's higher N-gain (classified as high) indicates that the RQA model, supported by digital scaffolding, provides not only cognitive activation but

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also motivational support, leading to sustained learning engagement (Cai et al., 2022; Chen et al., 2023).

The indicator-level analysis of critical thinking revealed that students excelled most in "providing simple explanations," while smaller gains were found in "providing further explanations." This suggests that while RQA effectively supports fundamental reasoning, deeper critical synthesis may require extended exposure or more complex stimuli. These findings are consistent with evidence that iterative questioning practices enhance comprehension but may not immediately translate into advanced evaluative reasoning (Wilson & Smetana, 2011). Nevertheless, compared to traditional lecture-based methods, the RQA approach clearly produced stronger analytical development and improved conceptual coherence among learners (Saputri & Corebima, 2020; Tangge & Rede, 2018).

From a theoretical standpoint, this research reinforces the value of constructivist and social-cognitive learning theories in modern biology education. By promoting peer collaboration and self-questioning, the RQA model operationalizes Vygotsky's principle of the Zone of Proximal Development, where learning occurs most effectively through guided discovery and dialogue (Nicholas, 2021). The use of interactive e-worksheets further amplified this dynamic, allowing students to visualize, annotate, and synthesize knowledge independently while receiving indirect guidance from the teacher (Rahmayani & Indriyani, 2024). These tools not only diversified learning resources but also supported multimodal engagement, aligning with 21st-century digital pedagogy frameworks (Johan et al., 2022, Johan et al., 2020).

Practically, the findings carry important implications for biology teachers in secondary and religious-based education contexts. Implementing the RQA model requires teachers to reposition themselves from transmitters of knowledge to facilitators of inquiry, a pedagogical shift that encourages students to take intellectual risks and express reasoning (Leasa et al., 2023). The interactive e-worksheet component, moreover, bridges technological and pedagogical innovation, fostering environments where students can navigate, manipulate, and evaluate information autonomously. Such integration aligns with Indonesia's current Merdeka Curriculum, which emphasizes critical thinking, collaboration, and learner independence as key competencies for 21st-century citizens (Fauzan et al., 2023; Limbong et al., 2024).

However, several limitations must be acknowledged. The sample size was relatively small, restricted to two classes within one institution, which constrains the generalizability of findings. Additionally, because the study was conducted over only three sessions, it may not fully capture long-term cognitive and affective outcomes. Prior familiarity of some students with the RQA method and digital worksheets could also have introduced bias in learning behavior (Saputri & Corebima, 2020). Furthermore, the assessment of critical thinking relied solely on test-based indicators, potentially overlooking qualitative dimensions such as reasoning depth, creativity, and argumentation patterns.

Future research should therefore adopt longitudinal and mixed-methods approaches, examining not only quantitative learning gains but also discourse analysis of student reasoning processes. Comparative studies across different subjects and school types, particularly vocational and Islamic institutions, would provide richer insights into contextual adaptability. Moreover, integrating RQA with emerging digital platforms such as adaptive learning systems or gamified modules could extend its effectiveness in promoting critical and reflective thinking.

In summary, the integration of the RQA learning model with interactive e-worksheets

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offers a powerful pedagogical framework that promotes engagement, critical thinking, and digital literacy in biology learning. The results affirm that systematic questioning and reflective answering cultivate deeper cognitive processing, fostering the intellectual independence envisioned in modern education reform. When implemented consistently and supported by technological tools, RQA has the potential to become a cornerstone of transformative science instruction in Indonesia and beyond.

4. CONCLUSION

This study has demonstrated that the integration of the RQA learning model with interactive electronic student worksheets offers a meaningful contribution to fostering active learning and enhancing students' critical thinking skills in biology education. Through the structured phases of reading, generating questions, and formulating answers, students were not only guided to engage deeply with the subject matter but also encouraged to develop higher-order thinking processes. This pedagogical model promotes autonomy, inquiry, and collaboration, transforming the classroom from a teacher-centered environment into a learner-driven space. The consistent increase in student participation and intellectual engagement throughout the learning sessions indicates that the RQA model, when supported by appropriate digital tools, cultivates a more reflective and dynamic learning atmosphere.

Moreover, the positive student responses toward this model reveal a high degree of acceptance and motivation, suggesting that learners perceive RQA not merely as an instructional strategy, but as a valuable learning experience. Its ability to stimulate curiosity and facilitate understanding of complex biological concepts positions RQA as a promising approach for broader implementation. Despite certain contextual limitations, the outcomes of this study reinforce the potential of inquiry-based models in achieving educational goals aligned with 21st-century competencies. Future applications of this model should consider diverse classroom settings and longitudinal implementation to further explore its long-term impact on students' cognitive development and academic resilience.

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