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Unlocking Critical Thinking in Learners: RQA and Concept Maps Working Together

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Abstract: Critical thinking plays a vital role in the learning process, as it supports knowledge development and involves evaluating topics, content, and challenges. This research sought to assess the impact of Reading, Questioning, Answering (RQA)-Integrated Concept Maps (RQA-Integrated CM) on improving students' critical thinking abilities. Using a quasi-experimental with a purpose sampling pretest-posttest one group design, 30 biology students from Patompo University in Makassar, South Sulawesi, Indonesia were sampled for the study. The data were collected through essay tests focused on Human Anatomy and Physiology, designed around critical thinking criteria such as basic clarification, bases for a decision, inference, advanced clarification, supposition and integration, strategies and tactics. The tests consisted of 12 valid and reliable questions. The data were analyzed using Wilcoxon test at a 5% significance level. The findings demonstrated that RQA-Integrated CM positively influenced students' critical thinking. Based on these results, it is recommended that educators utilize RQA-Integrated CM to enhance critical thinking in the classroom.

Keywords: Biology Student; Concept Maps; Critical Thinking Skills; RQA

Introduction

The fast-paced changes and vast influx of information in the 21st century require universities to equip their graduates with essential skills. Critical thinking is a multifaceted process that demands advanced reasoning skills to achieve the intended outcome (Wechsler et al., 2018). A primary aim of higher education is to nurture students' critical thinking abilities, which are highly sought after by employers in today's workforce (Thompson, 2011). As centers of learning, universities need to emphasize critical thinking as a core competency for students to successfully manage personal, social, and professional demands (Fong et al., 2017). Consequently, the focus of education should be on developing students' ability to think critically and effectively, rather than relying solely on memorizing facts.

Critical thinking is essential for scrutinizing and evaluating assumptions, as well as confirming conclusions (Li et al., 2022). Key elements of critical thinking include evaluation, analysis, and the ability to analyze and synthesize arguments; engage in both individual and collaborative reasoning; and apply self-regulation (Odebiyi & Odebiyi, 2021; Bandyopadhyay & Szostek, 2019). The Common Core State Standards (CCSS) emphasize several critical thinking examples (Greenstein, 2012), such as applying different reasoning types (inductive, deductive, etc.) depending on the situation, addressing various tasks, objectives, and fields, developing sound and well-considered arguments, and drawing evidence from literature or textual information to support analysis, reflection, and research.

Although critical thinking is crucial in education, many studies show that students' skills in this area are still lacking (Rusmansyah et al., 2019). Scholars emphasize its importance, yet empirical data indicates that college students continue to struggle with critical thinking development (Edwards, 2023). Research by TïMuçïN & ÇïMer (2022) shows that many students rely heavily on rote memorization rather than engaging in deeper analytical thinking to grasp the subject matter. Aligned with findings from prior research, they struggle

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to analyze, evaluate, and interconnect various biological concepts, which hampers the growth of their critical thinking skills (Andariana et al., 2019; Rosba et al., 2021; Hïdayati et al., 2022; Saleh et al., 2023). These challenges emphasize the need for more dynamic and creative teaching strategies that engage students actively in the learning process. Such approaches are crucial for enhancing cognitive growth and developing stronger analytical skills.

An innovative approach to achieve this goal is the Reading, Questioning, Answering (RQA) learning model, which promotes active engagement and deeper understanding through critical analysis and inquiry-based interaction. This model actively engages students by fostering a deeper learning process, where they critically read the material, craft thoughtful, relevant questions, and utilize their acquired knowledge to provide comprehensive answers (Thalib et al., 2017; Hariyadi et al., 2018). This method not only encourages independent thinking (Asmara et al., 2023), but also strengthens their ability to analyze and synthesize information (Amin et al., 2019), leading to a more enriched understanding of the subject matter.

A wealth of research underscores the substantial benefits of the RQA model in enhancing the learning process. Each step in this approach fosters active participation ((Nainggolan & Sirait, 2022), promotes critical thinking (Leasa et al., 2023), and deepens students' understanding of complex topics (Hariyanto et al., 2023). For example, the questioning phase plays a pivotal role, as it helps students to uncover the underlying sources of problems during the pre-learning process. This critical step enhances their engagement with the material and sets the foundation for deeper exploration and understanding (Sumampouw et al., 2016; Hariyadi et al., 2018). As a result, it significantly improves academic outcomes and increases student engagement during learning activities.

However, critical thinking encompasses more than just the ability to pose and respond to questions; it also involves organizing and connecting the concepts being studied (Thompson, 2011). Concept maps play a crucial role as visual tools, aiding students in grasping the relationships among these concepts. During the concept mapping stage, students distill their reading into a well-structured and logical visual representation. These maps enhance critical thinking by helping students organize material from broad themes to specific details, ensuring clarity and focus on the topic (Lee et al., 2013). Concept maps not only facilitate deeper understanding but also promote a structured approach to learning, enabling students to connect ideas cohesively (Torre et al., 2017). This process strengthens critical thinking as they analyze and synthesize information in a more meaningful way, ultimately enhancing their overall learning experience (Dowd et al., 2015).

By integrating concept maps into the RQA learning model, students can enhance their critical thinking by actively organizing and connecting new information with existing knowledge. This approach encourages deeper analysis, allowing learners to see relationships between concepts and fostering a more structured, critical understanding of complex subjects. Instead of merely memorizing facts, students engage in higher-order thinking, evaluating and synthesizing material, which significantly improves their ability to approach problems and make informed decisions. This study aims to investigate the effects of Integrated RQA (Reading, Questioning, Answering) and Concept Map (CM) on students' critical thinking skills. The research hypothesis is formulated as follows: there is an influence on students' critical thinking skills in Integrated RQA and CM learning.

Method

This study employs a quasi-experimental with a Pretest-Posttest One Group Design. The independent variable is the RQA-Integrated CM learning model, and the dependent variable is critical thinking skills. The population includes all Biology Education students at Patompo University. The sample consists of 30 sixth-semester students (2023/2024) selected using purposive sampling. The research utilized an essay test as the primary instrument, consisting of both a pre-test and a post-test. Instruments were validated by experts and include written tests and observation sheets. Instruments were validated by experts and include written tests and observation sheets.

Result and Discussion

The descriptive analysis showed an improvement in critical thinking skill scores after applying the RQA-Integrated CM model, with the highest score being 70.00 and the lowest score at 56.67. The N-gain score of 0.42 suggests that this model is moderately effective for use (Figure 1).

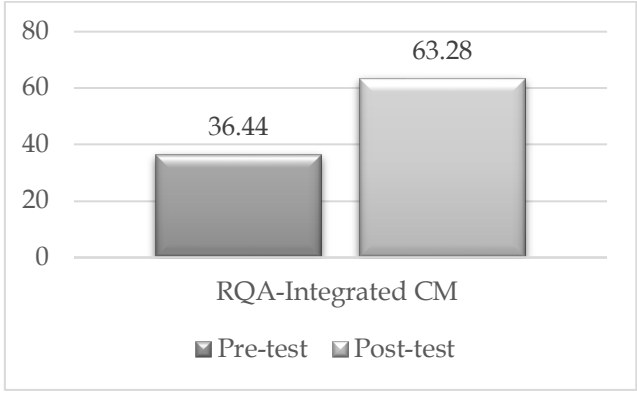

Figure 1. Average Value of Students' Critical Thinking Skill

The students' critical thinking scores were derived from the results of their post-test. Six key aspects of critical thinking were assessed, as illustrated in Figure 2.

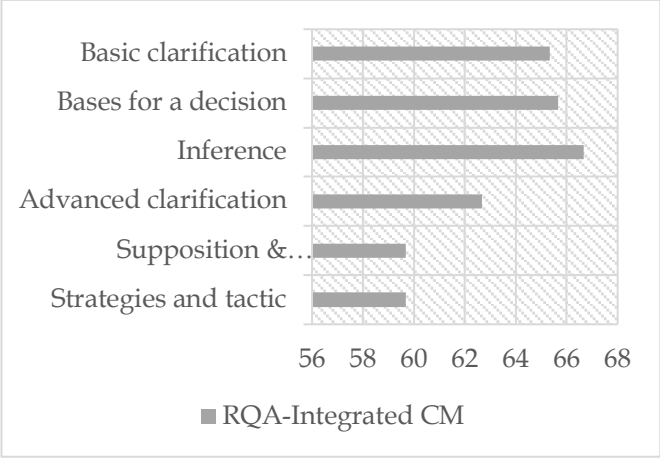

Figure 2. Students' Critical Thinking Skill Scores

Figure 2 suggested that the aspect of critical thinking that ranks first is inference. This finding indicates that students are capable of drawing conclusions or making predictions based on the available evidence or information. The results obtained from the Wilcoxon test were illustrated in Table 1.

Table 1. The results of the Wilcoxon test on students' critical thinking skil

	Average	St dev.
Pre	36.4443	3.95703
Post	63.2777	3.97515
Z hitung		= -4.786
Z tabel		= 1.960
p-value Z		= 0.000

Table 1 shows that the average score for the critical thinking skill variable (pre) was 36.44±3.96, which is lower than the average score for the critical thinking skill variable (post) at 63.28±3.98. There was an increase in the average critical thinking skill score from pre to post. To validate this, a Wilcoxon test was conducted. The Wilcoxon test results showed a calculated Z value smaller than the Z table (-4.786 < -1.960), and the p-value was less than α (0.000 < 0.050). Therefore, the decision to reject H0 was made, indicating a significant difference between pre and post average scores based on the measured critical thinking skill variable. It is evident that there was a significant increase in the average critical thinking skill score from pretest to posttest.

The research results showed that the critical thinking skill ranked first was inference. At the inference stage, students were able to draw logical conclusions based on the evidence and available information. This aspect involved higher-level thinking, including identifying relevant facts, drawing conclusions from them through logical reasoning, understanding relationships between information, and making predictions supported by evidence (Fisher, 2011; Ennis, 2018). This process emphasized students' need to evaluate the credibility of sources and avoid unsupported assumptions.

Meanwhile, the last position was occupied by Supposition and Integration, and Strategies and Tactics. This finding indicates that students cannot support their decisions with appropriate reasoning or judgment based on relevant theories and facts (Hidayati et al., 2022). For example, most students were unable to determine the possible diagnosis of a patient with kidney failure (e.g., changes in urination patterns, back pain, and changes in urine color). This phenomenon occurs because they cannot construct their knowledge based on theories and facts. This inability affects their capacity to develop effective approaches for decision-making, which includes planning, selecting appropriate steps, and adjusting strategies when situations change to achieve desired goals (Eggen & Kauchak, 2012; Fitriani et al., 2024; Zubaidah et al., 2024). In a similar vein, research by Amin & Adiansyah (2023) and Maksum et al., (2022) revealed that students' critical thinking skills generally do not encompass the ability to construct and assess arguments. As a result, their skills in supposition and integration are inadequate, as they tend to neglect other logical reasons to substantiate their decisions (Fatmawati et al., 2023; Ennis, 2018).

The results of the Wilcoxon test (Table 1) indicate that the learning model has a significant effect on students' critical thinking skills. The RQA-integrated CM model provides new experiences for students through various activities such as literature searching, summarizing readings, organizing information into concept maps, proposing solutions, and engaging in group discussions. This aligns with research by Kim et al., (2019), which suggests that learning strategies and methods can enhance student engagement in questioning and expressing opinions, as well as improve higher-order thinking skills. The RQA model enhances students' knowledge and stimulates their curiosity through engaging reading activities and encouraging them to ask questions (Bahri et al., 2019).

In addition, integrating concept mapping with the RQA learning model aids students in structuring information from general to specific. This approach fosters the development of their critical thinking abilities. Concept maps encourage cognitive, organizational, logical, and analytical skills essential for dynamic writing, while also enhancing language proficiency among students (Brown, 2003; Xu & Pang, 2020). By creating concept maps, students can stay focused on the topic and effectively organize the sequence of their written ideas or concepts (Zubaidah et al., 2023).

The improvement of critical thinking skills can be attributed to several factors. Firstly, the questioning and answering process within the RQA model prompts students to engage in deeper cognitive processing of the subject matter, thereby fostering a more critical comprehension. Secondly, the implementation of concept maps enables students to visualize the connections among different concepts, which subsequently aids in the development of a more comprehensive and analytical understanding.

Conclusion

The results of this study indicate that the implementation of the RQA-Integrated CM learning model has a significant impact on improving students' critical thinking skills. Therefore, the RQA-Integrated CM learning model is highly recommended for enhancing students' critical thinking abilities. Further research is needed to obtain more comprehensive results on the impact of the RQA-Integrated CM implementation on a larger research sample with the same variables. Additionally, the RQA-Integrated CM learning model offers opportunities for broader research on various subjects, educational levels, and 21st-century skills.

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Author Contributions
Andi Andariana: Conceptualization, Data curation, Methodology, Project administration, Supervision, Writing; Rezeki Amaliah: Formal analysis, Investigation, Resources, Validation; Depi Triana: Visualization

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Conflicts of Interest
The authors declare no conflict of interest.

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