

The Effect of the RANGKA Learning Model on Students' Critical Thinking Skills in Cell Biology

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ABSTRACT

This study was designed to investigate the impact of implementing the RANGKA learning model on students' critical thinking skills. A quantitative approach was used with a quasi-experimental research design, applying a pretest-posttest design with a control group. The research population included all 11th grade science students at SMAN 1 Wonomulyo, while the sample selection was conducted using purposive sampling, where the 11th grade science class 2 was designated as the control group and 11th grade science class 3 as the experimental group. The data collection instrument was an essay test, and data analysis was conducted using descriptive and inferential statistics. The results showed that the average critical thinking score of students in the control group was 51.83, while the experimental group was 65.50. Inferential analysis produced a significance value of 0.000, which is lower than the threshold of $\alpha = 0.05$, so the null hypothesis was rejected and the alternative hypothesis was accepted. These findings confirm that the RANGKA learning model has a significant effect on the development of critical thinking skills among 11th grade students at SMAN 1 Wonomulyo.

ABTRAK: Penelitian ini dirancang untuk menginvestigasi dampak penerapan model pembelajaran RANGKA terhadap kemampuan berpikir kritis siswa. Pendekatan yang digunakan bersifat kuantitatif dengan jenis penelitian eksperimen semu, menerapkan desain pretest-posttest dengan kelompok kontrol. Populasi penelitian meliputi seluruh siswa kelas XI IPA SMAN 1 Wonomulyo, sedangkan pemilihan sampel dilakukan menggunakan teknik purposive sampling, di mana kelas XI IPA 2 ditunjuk sebagai kelompok kontrol dan XI IPA 3 sebagai kelompok eksperimen. Instrumen pengumpulan data berupa tes uraian, dan analisis data dilakukan melalui metode deskriptif serta inferensial. Hasil penelitian menunjukkan bahwa rata-rata skor kemampuan berpikir kritis siswa pada kelompok kontrol sebesar 51,83, sedangkan pada kelompok eksperimen mencapai 65,50. Analisis inferensial menghasilkan nilai signifikansi 0,000, yang berada di bawah ambang $\alpha = 0,05$, sehingga hipotesis nol (H_0) ditolak dan hipotesis alternatif (H_1) diterima. Temuan ini menegaskan adanya pengaruh signifikan model pembelajaran RANGKA terhadap pengembangan keterampilan berpikir kritis siswa kelas XI IPA SMAN 1 Wonomulyo.

Keywords: cell material, critical thinking skills, RANGKA learning model, students.

INTRODUCTION

Education is a key driver of national progress and remains a major issue frequently associated with various challenges (Vito, Krisnani, & Resnawaty, 2015). Twenty-first-century education has entered the knowledge era, presenting Indonesia with increasingly complex challenges. Accordingly, education in this era places greater emphasis on preparing students to use technology effectively and to develop essential learning and innovation skills (Wijaya, Sudjimat, & Nyoto, 2016). Education also plays a strategic role in

advancing science and technology. Individuals are therefore expected to acquire relevant knowledge, skills, and attitudes as essential preparation for life and as adaptive capacities for addressing increasingly complex problems (Afandi, Tulus, & Rachmi, 2016).

Efforts to support the learning process involve providing students with appropriate stimuli, guidance, direction, and encouragement to facilitate the achievement of the three principal domains of learning outcomes: cognitive, affective, and psychomotor development (Pane & Dasopang, 2017). However, students' critical and systematic thinking skills do not automatically lead to the effective development of science learning, particularly when instructional strategies designed to foster thinking processes are not optimally implemented across learning activities (Rasyid & Mansur, 2016).

Critical thinking occupies a central position as one of the essential competencies receiving considerable attention in twenty-first-century educational practice. This ability encompasses the capacity to access, examine, and synthesize diverse information and can be systematically learned, developed, and mastered. Furthermore, critical thinking reflects a range of related competencies, including effective communication and the ability to examine, interpret, analyze, and critically evaluate various forms of evidence (Septikasari & Frasandy, 2018).

Based on findings obtained through classroom observations and interviews conducted at SMAN 1 Wonomulyo on Thursday, February 11, 2021, with Irfan Kurniawan Usman, M.Pd., a biology teacher, several students, and university students undertaking teaching internships at the school, it was found that the learning process did not incorporate questions or tasks designed to optimize students' critical-thinking skills. This condition was largely attributed to the COVID-19 pandemic, during which School From Home (SFH) learning was dominated by assignments delivered through WhatsApp groups. Consequently, students experienced considerable pressure due to the accumulation of tasks that had to be completed each day. The questions provided were still predominantly categorized as lower-order thinking skills (LOTS), particularly at the C1 and C2 cognitive levels. As a result, the learning materials presented by the teacher tended to be memorized rather than meaningfully understood by the students.

The development of students' critical thinking skills can be optimized through the implementation of the RANGKA learning model, which systematically promotes analytical and reflective thinking as well as in-depth reasoning throughout the learning process. This model was developed from the contextual REACT learning model (Ihsani, Langitasari, & Affifah, 2020), with greater emphasis on student collaboration and communication during

classroom activities, while the teacher primarily serves as a facilitator. By emphasizing discussion and collaborative learning, the RANGKA model is expected to enhance students' critical thinking skills (Suryawati, Syafii, & Afza, 2012). Students are guided to understand the subject matter by connecting concepts to everyday life and their surrounding environment. This approach encourages students to actively explore, elaborate on, and construct information, thereby enabling them to engage in authentic learning experiences grounded in real-world contexts (Jawad, 2017).

This study was designed to examine the extent to which students at SMAN 1 Wonomulyo demonstrate critical thinking skills when learning cell-related concepts through conventional instruction without the implementation of the RANGKA learning model. It also investigated the development of students' critical thinking skills following the implementation of the model. Furthermore, the study systematically evaluated the extent to which the implementation of the RANGKA learning model enhanced students' ability to construct critical reasoning in understanding concepts and subject matter related to cells at SMAN 1 Wonomulyo.

RESEARCH METHOD

This study employed a quasi-experimental design because its implementation did not fully meet the requirements of a true experiment, which involves standardized procedures and strict control over extraneous variables. A nonequivalent control group design was used to examine the causal relationship between the intervention and the outcomes observed in the experimental and control groups (Sanjaya, 2015).

The population of this study comprised all Grade 11 science students at SMAN 1 Wonomulyo, distributed across five classes with a total of 167 students. For the purposes of the study, Grade 11 Science Class 2 was selected as the control group, consisting of 24 students, while Grade 11 Science Class 3 was designated as the experimental group with an equal number of participants. The samples were selected using a simple purposive sampling technique, in which participants were chosen according to systematically established criteria (Danuri & Maisaroh, 2015). In this study, the criteria required both groups to exhibit heterogeneous characteristics while maintaining a relatively balanced level of cognitive ability among their members.

The research instrument consisted of an essay-type test developed based on indicators representing critical thinking skills. The collected data were analyzed using both descriptive and inferential statistical approaches. A series of prerequisite assumption tests

was conducted prior to hypothesis testing. All statistical analyses were performed using IBM SPSS Statistics version 23.

RESULTS AND DISCUSSION

The analysis of the research data obtained from Class XI Science 2, which served as the control group, yielded the following empirical findings:

Table 1. Descriptive Analysis of Critical Thinking Skills among Grade XI Science 2 Students

Parameter	Pretest	Posttest
Maksimum	40	73
Minimum	13	47
Mean	27,50	51,83
Standar Deviation	7,96	7,52
Variance	63,39	63,39

Based on the data presented in Table 1, the descriptive statistics for the control group's pretest scores showed a maximum score of 40, a minimum score of 13, and a mean score of 27.50. The pretest scores had a standard deviation of 7.96 and a variance of 63.39. Meanwhile, the control group's posttest scores ranged from a minimum of 47 to a maximum of 73, with a standard deviation of 7.52 and a variance of 63.39.

Table 2. Pretest Critical Thinking Skill Categories among Grade 11 Science Students

Score Range	Frekuensi	Category
81 – 100	0	Excellent
61 – 80	0	Good
41 – 60	0	Moderate
21 – 40	18	Poor
0 – 20	6	Very Poor

As shown in Table 2, the critical thinking ability profile of students in the control group can be examined based on the observed frequency distribution. Specifically, six students were classified as having a very low level of critical thinking ability, while the remaining eighteen students were categorized as having a low level.

Table 3. Categorization of Grade 11 Science Students' Posttest Critical Thinking Skills

Score Range	Frekuensi	Category
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81 – 100	0	Very Good
61 – 80	3	Good
41 – 60	21	Moderate
21 – 40	0	Poor
0 – 20	0	Very Poor

As shown in Table 3, 21 students obtained scores within the 41–60 range, indicating a moderate level of critical thinking skills. In contrast, only three students achieved scores within the 61–80 range and were therefore classified as having a good level of critical thinking skills.

Table 4. Descriptive Analysis of Critical Thinking Skills in the Experimental Group of Grade XI Science Class 3

Parameter	Pretest	Posttest
Maksimum	43	83
Minimum	13	47
Mean	28,17	65,50
Standard Deviation	8,71	11,90
Variance	75,80	141,65

Based on the results presented in Table 4, students in Class XI Science 3 obtained a mean pretest score of 28.17, with scores ranging from 13 to 43. The distribution of the pretest scores was indicated by a standard deviation of 8.71 and a variance of 75.80. The mean posttest score increased markedly to 65.50, with scores ranging from 47 to 83, accompanied by a standard deviation of 11.90 and a variance of 141.65.

Table 5. Categorization of Critical Thinking Skills Based on Pretest Scores in Grade 11 Science Class 3

Score Range	Frekuensi	Category
81 – 100	0	Very Good
61 – 80	0	Good
41 – 60	2	Fair
21 – 40	18	Poor
0 – 20	4	Very Poor

As shown in Table 5, the distribution of critical thinking skills in the experimental group was evaluated using a frequency-based categorical analysis. The results indicated that four

students were classified in the very low category, 18 students in the low category, and two students in the moderate category.

Table 6. Categorization of Posttest Critical Thinking Skills in Class XI Science 3

Score Range	Frekuensi	Category
81 – 100	1	Excellent
61 – 80	15	Good
41 – 60	8	Moderate
21 – 40	0	Poor
0 – 20	0	Very Poor

Based on the data analysis presented in Table 6, the distribution of students' abilities in the experimental group showed notable variation across the performance categories. Eight students were classified in the "moderate" category, fifteen in the "good" category, and one student in the "very good" category.

Table 7. Results of the Normality Test

Variabel	p-value	α	Interpretation
Eksperimen	0,200	0,05	Normally Distributed
Control	0,130	0,05	Normally Distributed

Based on Table 7, the normality test results showed significance values of 0.200 for the experimental group and 0.130 for the control group. Both values exceeded the significance level of $\alpha = 0.05$. Therefore, the critical thinking skills data for students in both the experimental and control groups were normally distributed. Accordingly, the data satisfied one of the prerequisite assumptions for subsequent inferential statistical analysis.

Table 8. Homogeneity Test Results

Test Homogeneity of Variance			
Levene Statistics	df1	df2	Sig.
0,032	1	46	0,859

As presented in Table 8, the homogeneity test yielded a Levene's statistic of 0.032 with a significance value of 0.859. Since the significance value exceeded the predetermined significance level of $\alpha = 0.05$, the variances in students' critical thinking skills between the experimental and control groups were considered homogeneous. Therefore, the data

satisfied the prerequisite assumption for subsequent hypothesis testing to determine the effect of implementing the RANGKA learning model on students' critical thinking skills.

Table 9. Hypothesis Testing for Critical Thinking Skills

Independent Sample Test										
Levene's Test for Equality of Variances						t-test for Equality of Means				
						Sig. (2- tailed)	Mean Differenc e	Std. Error Differenc e	95% Confidence Interval of the Difference	
									Lower	Upper
Keterampilan Berpikir Kritis	Equal variances assumed	6.037	.018	-4.755	46	.000	-13.677	2.874	19.452	-7.882
	Equal variances not assumed			-4.755	38.846	.000	-13.677	2.874	19.481	-7.853

Based on Table 9, the independent-samples *t*-test showed that the significance value of Levene's test was 0.018, which was below the 0.05 threshold. Therefore, the interpretation of the *t*-test results was based on the *equal variances not assumed* row. The analysis yielded a *t*-value of -4.755 with 38.846 degrees of freedom and a two-tailed significance value of $p < 0.001$. Since the significance value was lower than 0.05, the null hypothesis (H_0) was rejected, whereas the alternative hypothesis (H_1) was accepted. These findings indicate that the implementation of the RANGKA learning model had a significant effect on the critical-thinking skills of Grade 11 science students studying cell biology at SMAN 1 Wonomulyo.

The findings of the present study are consistent with those reported by Suryawati, Syafii, and Afza (2012), who developed character education-based contextual RANGKA learning as a strategy for fostering scientific attitudes and critical-thinking skills among senior high school students in biology education. Using the ADDIE instructional design model, their study confirmed a significant improvement in students' critical-thinking skills. Empirically, the mean critical-thinking score increased from 63.85 before the intervention to 74.10 after its

implementation. These findings further demonstrate that the contextual RANGKA learning approach is effective in enhancing students' competencies in biology learning.

The difference in the level of mastery between the control and experimental groups was influenced by various interacting factors that made substantive contributions, particularly those related to the complexity of the learning material and the instructional approaches employed. Cell biology is often perceived by both teachers and students as a difficult and abstract topic. Students' mastery of this subject generally remains oriented toward memorizing cellular structures and their respective functions. Such reliance on memorization in cell biology instruction limits students' ability to establish relationships among concepts, retain information, respond to questions requiring higher-order thinking, and integrate new concepts with prior knowledge to construct the mental representations necessary for understanding abstract concepts (Adrianto, 2020).

The findings indicate that the conventional learning model implemented in the control group was relatively limited in its effectiveness in stimulating students' critical thinking skills. This limitation may have resulted from the dominant role of the teacher during the learning process, which created predominantly one-way interactions and reduced the active participation of most students. Throughout the learning activities, only a small proportion of students were able to provide accurate responses or raise relevant questions (Kasmawati, Jamilah, & Taufiq, 2020). Moreover, the high level of learning fatigue or boredom experienced by students may be associated with the implementation of an ineffective instructional model (Ali, 2013).

The N-gain analysis revealed a notable difference in the improvement achieved by the two groups of students. The control group, which received conventional instruction through a direct instruction approach, obtained an N-gain score of 0.32. This score was classified within the moderate category, although it remained close to the threshold of the low category. By contrast, the experimental group taught using the RANGKA learning model achieved an N-gain score of 0.51. Although this score was also classified within the moderate category, it was substantially higher than that of the control group and showed greater progress toward the high category. Thus, despite both groups being classified within the same category, the magnitude and quality of their improvements demonstrated substantively different tendencies.

The findings further demonstrate that the implementation of the RANGKA learning model increased students' attention and encouraged more active participation throughout the learning process. The development of critical thinking skills was consistently observed

across each phase of the RANGKA learning model. During the *Rumuskan* (Formulate) stage, students were guided to identify the problems presented in the worksheet and subsequently conduct collaborative analyses to develop appropriate alternative solutions (Nurrohmi, 2017). This process contributed substantially to the development of critical thinking skills, particularly those related to problem formulation and the application of deductive reasoning.

During the **Observe (*Amati*) phase**, students are guided to identify and collect data and information directly relevant to the problem under investigation. Such information may be obtained through direct observation of the surrounding environment. During this phase, students proactively engage in perceptual processes by utilizing their sensory abilities, particularly auditory and visual channels, enabling them to transform stimuli into meaningful information that supports the formulation of solutions to the problem being examined (Nurrohmi, 2017). The critical thinking skills that may be developed during this phase include inductive reasoning, information evaluation, decision-making, and the ability to take action based on logical considerations.

During the Statement phase (*Pernyataan*), students transform the collected data into a more communicative and meaningful form. In the context of this study, the data were recorded in students' assignment books as written responses and subsequently incorporated into the worksheets. This phase is closely associated with data processing, which involves transforming raw data into systematically organized information that can subsequently be presented in a report format (Hartati et al., 2020). The critical thinking skill that may be strengthened at this stage is the ability to provide elaboration or further explanation.

During the Combine phase (*Gabungkan*), students discuss the information they have obtained and subsequently evaluate the outcomes of their problem-solving process. They reconsider the answers generated from the tasks they have completed. To integrate their prior conceptions with newly acquired concepts, students exchange ideas with other group members in order to construct a coherent and comprehensive understanding (Alfi et al., 2016).

During the Communicate phase (*Komunikasikan*), students appointed as group representatives present the results of the analysis and problem-solving activities developed through the worksheets. This phase provides an opportunity for students to practice communicating their findings verbally while strengthening their academic communication skills. Consequently, their observational experiences can contribute to the development of

critical thinking by establishing connections between theoretical concepts and empirical practices. Students' critical thinking is particularly evident in their open-mindedness toward various forms of feedback. This openness is demonstrated during presentations when students compare findings, consider alternative perspectives, and identify the most credible information (Nafia & Prasetyo, 2015).

During the Apply phase (*Amalkan*) , students integrate and reflect on the learning experiences they have completed. They are encouraged to apply the knowledge they have acquired, after which their learning outcomes are evaluated. Students use their existing knowledge to solve problems presented in new contexts. A student may be considered a critical thinker when they are able to transfer and implement their knowledge in real-life situations (Suryawati, Syafii, & Afza, 2012).

The sequence of activities incorporated into the RANGKA learning model facilitates the development of students' thinking skills because it is grounded in the principles of constructivist theory. From a constructivist perspective, learning is not understood merely as the transmission of information from teachers to students but rather as a process through which students independently construct knowledge from experience and active engagement. Students are encouraged to identify and analyze problems, explore relevant issues, and critically reconstruct information (Sugrah, 2019). Furthermore, constructivist theory provides opportunities for students to express their ideas explicitly in their own words, exchange ideas with peers, and provide reflective explanations of the concepts they have constructed (Novita, 2020).

CONCLUSION

Based on the overall empirical findings and the analyses conducted, the following conclusions were drawn: (1) the critical thinking skills of students who received conventional instruction without the integration of the RANGKA model in the topic of cells in Grade XI Science at SMAN 1 Wonomulyo were classified as moderate; (2) students who participated in learning through the implementation of the RANGKA instructional model demonstrated structured engagement and learning experiences consistent with the characteristics of the model and likewise exhibited a moderate level of critical thinking skills; and (3) the implementation of the RANGKA learning model made a significant contribution to improving students' critical thinking skills in constructing and understanding cell-related concepts in Grade XI Science at SMAN 1 Wonomulyo.

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