

Analysis of Creative Thinking Skill Profiles and Learning Recommendations Through E-Book

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Abstract. Creative thinking skills (CTS) involve sensitivity to problems, consideration of new information, and the generation of unusual ideas, as well as making connections to solve environmental issues. Several studies have shown that students' CTS in Indonesia are still relatively low. Therefore, this study aims to describe the characteristics of student's CTS in biology lessons, particularly in respiratory system material related to smoking habits, and to analyze the application of e-books in improving CTS. This research method is descriptive-quantitative with the research subject 37 high school students in Gresik Regency. The instrument used was a CTS test based on indicators of fluency, flexibility, originality, and elaboration and a questionnaire of students' responses. The analysis technique used was descriptive quantitative. Data from the CTS test results were obtained based on the score rubric and then categorized based on the percentage of CTS of fluency, flexibility, originality, and elaboration indicators. Meanwhile, students' questionnaire data were obtained based on a Likert scale and then categorized based on the percentage of questionnaire results. Research data shows that students' CTS in biology lessons are still low. Fluency and flexibility indicators scored less, the originality indicator was moderate, and the elaboration indicator was not creative. This research confirms that efforts to improve students' CTS can be achieved by implementing interactive learning media, such as e-books, in biology education.

Keywords: Creative thinking, respiratory system, dangers of smoking, e-book

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Introduction

Education in the 21st century is required to develop a learning process and a set of skills in individuals consisting of the 4C are *critical thinking, communication, collaboration, and creativity* (Joy nes et al., 2019). Creativity in education is shown by the ability of students to generate new ideas, develop original concepts, and find new solutions to problems faced in their environment (Muliardi, 2023) because individuals who have completed their studies will need skills to overcome various conditions in real life by thinking creative (Kaeophanuek and Chookerd, 2021).

Creative thinking skills (CTS) is a normal activity related to sensitivity to a problem, considering new information, unusual ideas with an open mind, and making connections in solving problems (Santi 2020). According to Torrance, CTS have four indicators. Fluency is the ability to generate many relevant ideas or answers and a smooth flow of thought. Flexibility is the ability to generate diverse ideas and be able to change ways or approaches, and different directions of thought. Originality is the ability to generate distinctive and rarely considered responses that distinctly differ from conventional thinking. Elaboration involves systematically developing, enhancing, and expanding an initial concept by incorporating nuanced details and comprehensive perspectives (Munandar, 2014).

On the other hand, the results of the PISA 2022 assessment show that Indonesia is among the 14 countries with the lowest CTS. A total of 4.8% of Indonesian students are at level 5 or 6, and 68.8% of Indonesian students are at level 2 and below (OECD, 2024). Several studies support the finding that students' CTS in biology subjects in Indonesia are categorized as low. Sari et al., (2023) found that students' CTS are still underdeveloped and classified as low. Similarly, Aryanti et al. (2021) also found that CTS remain low and struggle to generate ideas. Nasution et al. (2023) further confirmed that Indonesian students are still unable to think divergently. In addition, Nurjamilah et al. (2020) reported that CTS in respiratory system material are categorized as low. The studies above have identified the low level of student's CTS in biology subjects, highlighting the need for efforts to enhance these skills.

Biology learning can emphasize CTS (Handayani et al., 2021) in schools by presenting real-world problems (Widia et al., 2020). One such issue is smoking, which can be related to respiratory system material. WHO (2020) indicates that approximately 225,700 people in Indonesia die each year due to smoking or other tobacco-related diseases. Additionally, in 2019, four out of ten diseases with the highest number of cases per 100,000 people in Indonesia were respiratory diseases (Kemenkes, 2023). However, the Global Adult Tobacco Survey found that 33.5% of Indonesians still smoke conventional cigarettes, while 3% use electronic cigarettes in 2021 (GATS, 2021). Integrating discussions on the dangers of smoking into respiratory system lessons can enhance student engagement and foster creative thinking by encouraging curiosity, linking material to real-life contexts (Kristiyan et al., 2023), and developing solutions to address these issues (Aryanti et al., 2021).

One of the innovations in learning aimed at improving CTS is the use of e-books. Several studies indicate that e-books can enhance CTS. Research by Sedayu et al. (2024) shows that e-books fall into the category of Open Educational Resources, which can foster students' CTS. E-books serve as tutors in the creative thinking process (Tang et al., 2022) and support the development of CTS (Nada & Sari, 2022). As a digital learning medium, e-books integrate text, animation, audio, and video (Siregar et al., 2021) which can enhance conceptual understanding and CTS (Alshehri 2024).

Research by Saripudin et al. (2022) also confirms that e-books can improve CTS. Generation Z tends to prefer e-book-based learning with audio, animation, and infographics for more effective learning. Additionally, e-books offer flexible access allowing students to study using various internet-connected electronic devices (Awaly et al., 2023) without time and space limitations. The use of e-book features and elements also increases attention and learning motivation, strengthens conceptual understanding by linking material to real-world problems, and supports the enhancement CTS (Hasbiyati et al., 2019). However, research on e-books as learning media remains limited, particularly on an international scale, despite their potential to enhance 21st-century skills (Dawana & Setiani 2022) especially in biology education. While previous studies suggest that e-books can improve CTS, they have not specifically examined their impact on biology learning. Therefore, further research is needed to provide recommendations on the use of e-books for enhancing CTS in biology education.

This study aims to describe the characteristics of high school students' CTS in biology, particularly in the respiratory system material, and to analyze the implementation

of e-books to enhance these skills. By examining students' profiles, this research is expected to provide in-depth information regarding the indicators of CTS that need improvement and serve as a guide for practitioners in implementing e-book-assisted learning as an effort to enhance CTS in biology. The novelty of this research lies in integrating respiratory system material with perspectives on the dangers of smoking to assess CTS and generate recommendations for e-book-assisted biology learning. The findings of this study are expected to offer insights into the use of technology to foster CTS and develop learning strategies that are creative, adaptive, and effective in meeting students' needs.

Methods

This research is quantitative because the data is in the form of numbers and analyzed using statistics (Sugiyono 2015), and descriptive methods because it systematically shows the facts or characteristics of a population (Abdullah et al., 2022). The population of this study was 37 class students who had studied respiratory system material at one of the high schools in Gresik Regency. The instruments used in this study were 8 CTS test questions in the form of essays that refer to indicators of fluency, flexibility, originality, and elaboration on respiratory system material.

The analysis technique used was descriptive quantitative. Each question was assessed based on a scoring rubric with a range of 0 to 3, and each indicator consisted of 2 questions. The data from the CTS test were analyzed using the scoring method adapted from Riduwan (2015) dividing the score obtained by students with the maximum test score, then multiplied by 100.

$$\text{Score students} = \frac{\text{Score obtained}}{\text{Maximum Score}} \times 100\% \quad (1)$$

To determine each indicator's level of creative thinking ability, the researcher calculates the total score per indicator (from 2 questions) by dividing it by the maximum score of the test per indicator and converting it into a percentage by multiplying it by 100%. The percentage results are categorized based on the CTS category adapted from Riduwan (2015) on Tabel 1.

$$\text{Score per indicator} = \frac{\text{Score obtained per indicator}}{\text{Maximum score per indicator}} \times 100\% \quad (2)$$

Tabel 1. Categories of CTS

Value Range (%)	Creative Thinking Category
0 - 20	Not Creative
21 - 40	Less Creative
41 - 60	Quite Creative
61 - 80	Creative
81 - 100	Very Creative

(Source: Riduwan 2015)

The distribution of questionnaires to students was also carried out to strengthen and deepen of students' CTS with 10 closed answer statements. The questionnaire answer criteria are 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). This questionnaire aims to determine students' responses after doing the test questions and knowing the biology learning at school.

Results and Discussion

The Results of CTS of High School Students

This research was conducted by giving a CTS test on respiratory system material and a questionnaire for high school students in Gresik Regency. 37 students took the CTS test on respiratory system material with 8 questions. The first and second questions include fluency indicators, the third and fourth questions include flexibility indicators, the fifth and sixth questions include originality indicators, and the seventh and eighth questions include elaboration indicators. Each indicator consists of two questions with a score range of 0-3 (very low - very high) per question. The following is the score per question obtained by students.

Tabel 2. Learner Score Acquisition per CTS Tes Question

Indicator	Number	Number of Learners with Score Acquisition			
		0	1	2	3
Fluency	1	11	23	3	0
	2	12	19	5	1
Flexibility	3	20	19	5	1
	4	25	11	1	0
Originality	5	2	21	14	0
	6	5	6	9	17
Elaboration	7	34	2	1	0
	8	15	10	7	5

Based on the scores per question in Table 2, students exhibit weaknesses in the flexibility and elaboration indicators, particularly in questions 4 and 7, where the majority scored 0. Meanwhile, the originality indicator showed better results, especially in question 6, with some participants achieving high scores. This indicates that although learners have potential in original thinking, they still face challenges viewing problems from multiple perspectives and developing in-depth responses. Overall, learners obtained CTS test scores ranging from 0 to 54.16, with an average score of 40.54. The CTS score for each indicator is calculated based on the percentage score, which is then interpreted according to the designated category, as presented in the following Table 3.

Tabel 3. Categories of Student's CTS

Indicator	Value Rande (%)	Category
Fluency	27.48	Less Creative
Flexibility	21.62	Less Creative
Originality	55.85	Quite Creative
Elaboration	19.37	Not Creative

Based on the data in Table 3, there are variations in the percentage of CTS test scores across each indicator. The elaboration indicator shows the lowest score, indicating that learners struggle to develop and explain ideas in detail. Meanwhile, the originality indicator has the highest score, categorized as fairly creative, suggesting that while some learners can generate ideas, their creativity is not yet fully optimized. The following is an analysis of students' CTS for each indicator.

Fluency is the first indicator of CTS. There are two questions in the fluency category, where students are asked to generate multiple responses to a given statement. Questions 1 and 2 are designed to encourage students to produce numerous relevant ideas and demonstrate a smooth flow of thought (Munandar, 2014). The following is an analysis of the fluency indicator based on students' responses.

kita menghirup oleh udara yang tercemar debu, asap kendaraan dan rokok, serta mikroorganisme lainnya. Bagaimana cara organ sistem pernapasan melindungi diri ketika kita menghirup udara yang terpapar tersebut?

di. Saring, di bagian dalam hidung terdapat bulu-bulu halus
yang bertujuan untuk menangkap udara yang kita hirup /
menghalangi zat-zat asing / benda asing untuk masuk, ketika
terpapar benda asing itu ketika memberi sinyal ke otak dan
kita akan bersin untuk mengeluarkan / mengeluarkan benda
asing tersebut

Figure 1. Student answers to question number 1 fluency indicator

Figure 1 presents question 1 along with a response from one of the students. In this question, students stated air pollution is caused by dust, vehicle fumes, cigarette smoke, and other microorganisms. They are then asked to describe how the organs of the respiratory system protect themselves when inhaling polluted air. Based on the answer analysis, 11 students did not respond to the question and received a score of 0. Meanwhile, 23 students received a score of 1 because they only mentioned one organ of the respiratory system and correctly explained its protective function. Only three students received a score of 2 for describing two organs with the correct explanations. The majority of students understood the question and provided appropriate answers; however, most of them only mentioned one organ and its function. This indicates that CTS in the fluency indicator are still limited, although some participants were able to describe more than one organ. Nevertheless, the variety of ideas and responses generated remains constrained.

2. Sistem pernapasan terdiri atas berbagai organ dan struktur yang berfungsi untuk pertukaran gas. Jelaskan sebanyak mungkin organ sistem pernapasan beserta fungsinya!

► Hidung : sebagai tempat masuknya udara / O_2 . Di dalam hidung terdapat bulu-bulu halus yang berfungsi menyaring udara dan berbagai debu atau mikroorganisme.
► Trakea : merupakan jalan / jalur bagi udara dari hidung menuju ke paru-paru.
► Bronkus : merupakan percabangan dari trakea / tenggorokan.
► Bronkolus : merupakan percabangan dari bronkus.
► Paru-paru : tempat bertukarnya oksigen dengan karbondioksida yang tepatnya berlangsung di dalam gelembung-gelembung alveoli.

Figure 2. Student answers to question number 2 fluency indicator

Figure 2 presents question number 2 and one student's answer. In this question, students are asked to name as many respiratory system organs as possible and describe their functions. Based on the answer analysis, 12 students did not answer the question and scored 0. Meanwhile, 19 students scored 1 because they only mentioned one organ of the respiratory system and its function, while 5 students scored 2 because they were able to describe two organs correctly. Only 1 student scored 3 for explaining multiple organs and their functions correctly. The more organs mentioned and explained accurately, the higher the student's level of fluency in thinking. However, the majority of students only described 1–3 respiratory system organs and their functions. This indicates that their CTS, particularly in fluency, are not yet optimal.

Based on the results of the CTS test, the fluency indicator falls into the "less creative" category. This is evident from the fact that most students provided correct but limited responses. This condition contradicts the characteristics of fluency, which involve generating multiple answers to a question (Setyawan, 2019). These findings align with Sari et al., (2023) who reported that low fluency indicates students struggle to produce diverse and appropriate responses. Similarly, Ning et al., (2020) found that students with low fluency tend to provide limited and less relevant answers. One possible cause of this issue is the lack of practice in solving text-based, visual, narrative, or contextual problems.

To improve fluency, group learning can be implemented, as supported by Komalasari et al., (2024) whose research shows that collaborative learning CTS, particularly fluency. Wilis et al., (2023) also found that group discussions encourage students to express ideas, answers, and solutions to problems, allowing them to access and process information more effectively (Ernawati & Sari 2022). Additionally, open-ended problem exercises help students develop arguments (Pham 2021), which in turn enhances fluency (Sawu et al., 2023). Another effective method is the use of interactive multimedia, which improves fluency by presenting information in various formats, stimulating multiple cognitive connections (Zhao & Mayer 2023). Research by Rosyidah & Rahayu (2022) found that interactive learning media with visual elements help students comprehend problems and generate solutions. Similarly, Hikmaturosyidah & Racmadiarti (2022) demonstrated that interactive video-based learning media guide students to think more fluidly, improving their understanding and enabling them to generate more ideas. By applying these strategies, students can enhance their fluency in creative thinking, especially in biology learning.

Flexibility refers to an individual's ability to provide various answers, solutions, and alternatives to questions or problems while maintaining conceptual accuracy (Nada & Sari, 2022). In the flexibility category, there are two questions designed to encourage students to interpret images, stories, or problems from multiple perspectives. This allows them to generate diverse ideas, adapt their approaches, and shift their thinking in different directions (Munandar 2014). The following is an analysis of the flexibility indicator based on students' responses.

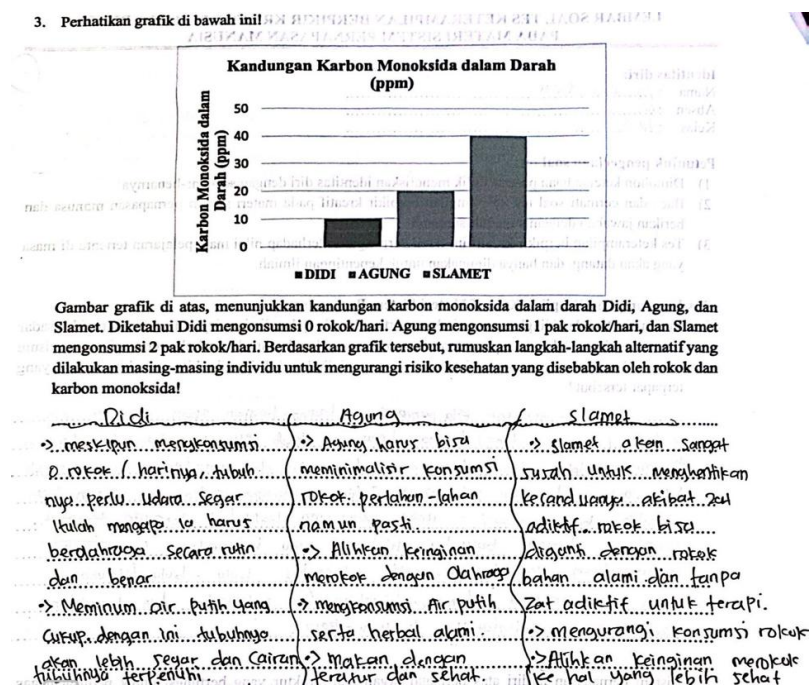


Figure 3. Student answers to question number 3 flexibility indicator

Figure 3 presents question number 3 along with one student's response. In this question, a graph depicting different carbon monoxide levels in the bodies of three individuals is provided. The individuals consist of two active smokers with varying levels of cigarette consumption and one passive smoker. Students are then asked to formulate steps or strategies to reduce the risk of respiratory system disorders caused by carbon monoxide exposure in these individuals. Based on the answer analysis, 20 students scored 0 because they did not respond to the question. 19 students scored 1 for formulating a strategy for only one individual. Meanwhile, 5 students scored 2 for addressing two individuals, and 1 student received the highest score for formulating strategies for all three individuals. The majority of students struggled to interpret the graph and understand the given question, resulting in either a lack of response or an incorrect answer. However, some students successfully analyzed the graph and considered the problem from multiple perspectives, specifically by assessing the carbon monoxide levels in both active and passive smokers. These variations in conditions led to different approaches for minimizing the risk of respiratory disorders, demonstrating flexibility in adapting responses based on diverse situations and viewpoints.

4. Doni seorang pelajar sekaligus atlet basket. Ia selalu melakukan jogging di pagi hari. Sebelum berlari, Doni mengukur frekuensi pernapasannya sebanyak 17/menit. Setelah berlari, Doni mengukur frekuensi pernapasannya sebanyak 26/menit. Jelaskan berbagai faktor yang mempengaruhi hingga frekuensi pernapasan Doni meningkat?
- Beberapa faktor yang mempengaruhi frekuensi pernapasan adalah:
- Intensitas kegiatan yang dilakukan. Dalam keadaan tubuh sedang rileks (sebelum berlari), frekuensi pernapasan cenderung normal karena tubuh sedang tidak melakukan kegiatan yang memiliki intensitas tinggi. Setelah berlari, tubuh telah melakukan kegiatan berintensitas tinggi sehingga mempengaruhi frekuensi pernapasan (meningkat).

Figure 4. Student Answers to Question Number 4 Flexibility Indicator

Figure 4 presents question number 4 along with one student's response. In this question, a short story is provided regarding the increase in breathing frequency during exercise. Students are asked to identify and explain the factors that influence changes in breathing frequency. Based on the answer analysis, 25 students received a score of 0 because they did not respond to the question. A total of 11 students received a score of 1 for identifying one factor, while 1 student received a score of 2 for identifying and explaining three factors. These factors demonstrate students' ability to analyze a problem from different perspectives, as each factor represents distinct conditions, causes, and effects. This question assesses students' ability to approach problems from multiple perspectives; however, many students provided answers based on a single point of view without considering other factors. Although one student successfully identified and explained three factors affecting breathing frequency during exercise, the majority struggled to present diverse perspectives.

Based on the results of the CTS, the flexibility indicator falls into the "less creative" category. This is evident from the fact that most students did not provide diverse answers from different perspectives and struggled to interpret the graphical images presented. This contradicts the expected flexibility behavior, which involves analyzing a problem from multiple perspectives and generating various interpretations of an image, story, or scenario (Setyawan, 2019). As a result, students should be able to produce varied ideas and consider problems from multiple viewpoints. This finding aligns with research by Sari et al., (2023) which indicates that low flexibility reflects students' limited ability to examine and evaluate issues from diverse perspectives. One contributing factor is the lack of

material comprehension, highlighting the need for in-depth learning to enable students to generate diverse yet conceptually sound ideas. Furthermore, research by Ali et al. (2023) suggests that low flexibility is attributed to students' difficulties in adapting to changes or new situations, preventing them from considering multiple possibilities in learning and everyday life.

To enhance CTS in the flexibility indicator, it is essential to implement learning strategies that encourage material exploration and theoretical discovery to deepen students' understanding and problem-solving abilities (Handayani et al., 2021). Additionally, students should be trained to adapt to changes or new situations (Bayley, 2022). One effective approach is exploration-based learning and problem-solving, such as the use of interactive learning media, which has been proven to enhance flexible thinking (Zebua, 2025). Similarly, research by Yolanda et al., (2021) confirms that interactive learning media significantly improve CTS, including flexibility. These media facilitate a deeper understanding of concepts through engaging visualizations, context-based exercises, and immediate feedback (Panda & Principal 2024), allowing students to generate diverse yet conceptually accurate ideas (Suchyadi & Suharyati 2021). Additionally, research by Isaeva et al. (2025) indicates that dynamic learning experiences provided by interactive media help students adapt to various new situations. This is further supported by the findings of Blyznyuk & Kachak (2024) which suggest that adaptability fosters independent thinking and enhances dynamic learning experiences, enabling students to analyze problems from multiple perspectives. Thus, the implementation of interactive learning media not only improves material comprehension but also trains students to think more flexibly, adapt to changes, and approach problems from various perspectives in both learning and real-life contexts.

Originality is related to novelty, meaning that the ideas expressed are genuinely new or different from most people's (Nada & Sari, 2022). In this study, there are two questions in the originality category, specifically questions 5 and 6. Presented with a story and accompanying questions, students are asked to generate unique and distinct answers compared to their peers. This aligns with Munandar (2014) statement that the originality indicator refers to unusual responses, distinct from others, and rarely given by most people. The following is an analysis of the originality indicator based on students' responses.

5. Didi dan keluarganya sedang makan malam di sebuah cafe & resto. Setelah makan, ayahnya mulai merokok di dalam area cafe & resto tersebut. Didi tidak melihat adanya larangan merokok dan melihat ada asbak yang disediakan di atas meja. Namun ia melihat ada pengunjung lain dalam keadaan hamil sedang makan di meja sebelah keluarga Didi. Jika anda adalah Didi, apa yang anda lakukan untuk mengatasi situasi ini namun tetap menghargai ayah anda yang perokok aktif?
- Saya akan menegur ayah saya untuk mematikan rokoknya dan memberitahukan ayah saya tentang keberadaan ibu hamil tsb. lalu menyuruh ayah saya untuk melupakan aktifitas merokoknya di luar resto saat berada di restoran

Figure 5. Student answers to question number 5 originality indicator

Figure 5 presents question number 5 along with one student's answer. In this question, a short story related to smoking habits in public environments is provided. Students are then asked to propose efforts to maintain health in everyday situations. Based on the answer analysis, 2 students received a score of 0 because they did not respond to the question. A total of 21 students received a score of 1 for proposing only one effort to maintain health. Meanwhile, 14 students received a score of 2 for suggesting two efforts,

and none received a score of 3. For this question, students were given the freedom to answer based on their ideas, allowing them to provide unique responses. However, some students still gave similar answers, failing to demonstrate originality.

6. Budi sedang mendaki gunung bersama empat orang temannya. Di tengah perjalanan menuju puncak, mereka memutuskan untuk beristirahat. Ketika kembali melanjutkan pendakian, salah satu teman tiba-tiba mengalami sesak napas. Berikan sebanyak mungkin tindakan atau upaya yang harus dilakukan Budi dan teman lainnya untuk melakukan pertolongan pertama dan menstabilkan kondisi temannya!
- ↳ Pertama teman yang sesak didudukkan dengan nyaman. jika sesak napas maka segera diberikan tabung oksigen (desika) pada mulut dan hidung temannya agar tidak kehabisan oksigen. Oksika diberikan sampai nafas kembali stabil. Setelah nafas sudah mulai stabil temannya di beri minum dan diberi waktu untuk beristirahat. > ketika didudukkan / dibaringkan jangan diketumahi agar tidak kehabisan oksigen.

Figure 6. Student answers to question number 6 flexibility indicator

Figure 6 presents question number 6 along with one student's answer. In this question, a short story is provided about experiencing shortness of breath while climbing a mountain. Students are then asked to propose efforts to address this respiratory system disorder. Based on the analysis of the responses, 5 students received a score of 0 because they did not answer the question. A total of 6 students scored 1 for formulating only one effort, while 9 students scored 2 for suggesting two efforts. Meanwhile, 17 students received a score of 3 because they formulated three or more efforts to treat the respiratory system disorder. The majority of students were able to understand the given story and respond according to the question's directive, which was to propose initial treatment efforts for individuals experiencing shortness of breath. Most students confidently expressed their ideas, resulting in varied yet conceptually correct answers, which reflects originality. However, some students' responses were still similar.

Based on the results of the CTS test above, the originality indicator falls into the less creative category, despite achieving the highest score range. This is evidenced by the fact that most students provided different responses when faced with a problem. This aligns with the statement of Nada & Sari (2022), which emphasizes that originality requires strong character to generate answers that differ from others. Originality can be assessed based on whether students' responses are distinct and conceptually accurate. The findings of this study demonstrate originality as described by Setyawan (2019) namely the ability to generate new and unconventional answers, as well as to combine elements in unique ways. Research conducted by Ning et al., (2020) also indicates that students fall into the quite creative category for the originality indicator, as they can analyze problems relevant to their surroundings due to their interest in the topic. As a result, they can provide diverse answers.

To enhance students' originality, learning strategies that foster creativity and independent thinking are essential. One effective approach is problem-based learning (PBL). This is supported by the study of Sahada & Febriani (2025) which demonstrates that PBL enhances originality by encouraging students to actively engage in problem-solving and confidently propose unique ideas. Real-world problems stimulates students to generate alternative solutions rather than relying solely on conventional answers. Furthermore, creating a learning environment that supports free expression and values every idea can boost students' confidence in presenting their unique thoughts. The findings of Fitriah et al. (2022) highlight that brainstorming techniques in class discussions help students develop new ideas without fear of making mistakes. Teachers can further strengthen originality by providing open-ended questions that allow for multiple correct

answers, thereby encouraging students to think outside the box when formulating solutions (Monrat et al., 2022). By implementing these strategies, students' originality can be cultivated, ultimately enhancing their creativity in analyzing and solving problems innovatively.

Elaboration is related to the activity of developing ideas in a more detailed form concerning the problem or question given (Nada & Sari, 2022). In this study, there are two elaboration category questions: numbers 7 and 8. A story is presented in the form of a problem, and students are asked to formulate solutions and problem-solving strategies in detail. This aligns with Munandar (2014) statement that the elaboration indicator involves the development, addition, enrichment, detailing, and expansion of an idea. The following is an analysis of elaboration indicators based on students' answers.

7. Ada beberapa kasus kematian yang disebabkan oleh keracunan gas karbon monoksida (CO) yang terhirup. Jelaskan bagaimana karbon monoksida dapat menyebabkan keracunan hingga kematian jika dianalisis dari proses pernapasan dan peredaran darah!

Kalau logika saya, darah kan membawa CO_2 dan O_2 kalau karbon monoksida dibawa oleh darah ^{ke seluruh tubuh} ~~lewat~~ melalui pernapasan bisa menimbulkan ~~beracun~~ ^{keracunan} yang menyebabkan kematian tergantung CO yang dihirup semakin banyak semakin buruk...

Figure 7. Student answers to question number 7 elaboration indicator

Figure 7 shows question number 7 and the answer of one of the students. In question number 7, a problem is presented, and students are directed to describe the relationship between the carbon monoxide content in the blood and the respiratory process. One of the causes of carbon monoxide content in the blood is smoking or inhaling smoke. There are three key answer points: the process of O_2 and CO being inhaled, the binding of O_2 and CO in the blood, and the impact of CO on the body. Based on the answer analysis, 34 students received a score of 0 because they did not answer the question. A total of 2 students received a score of 2 because they could describe one point of the answer in detail and precisely. One student received a score of 2 because they could describe two answer points in detail and precisely. This question emphasizes the development of ideas and theories, so the more detailed the answer, the more it aligns with elaboration behavior. However, the majority of students can provide detailed ideas, even though they are not optimal.

8. Rina adalah teman dekatmu dan didiagnosis menderita asma karena alergi debu. Setiap kali terpapar debu, Rina mengalami batuk, sesak napas, dan dada terasa berat. Hal tersebut dikarenakan dinding saluran pernapasannya mengalami pembengkakan. Sebagai teman yang peduli, buatlah rencana perawatan secara rinci yang membantu Rina mencegah kambuhnya serangan asma tersebut!
- Memberi tahu Rina untuk selalu mengenakan masker yang memfilter debu saat diluar ruangan.
 - Mengingatkan Rina untuk menghindari area berdebu.
 - " " " untuk selalu membawa oksika / inhaler, obat pereda alergi, dan masker cadangan.
 - Mengingatkan untuk sering membersihkan kamarnya agar tidak ada debu yang menumpuk sehingga menimbulkan alerginya kambuh.
 - Mengingatkan untuk selalu menjaga kesehatan baik secara fisik maupun mental agar tidak mudah terserang alerginya.

Figure 8. Student answers to question number 8 elaboration indicator

Figure 8 shows question number 8 and the answer from one of the students. In question number 8, a short story is presented, and students are directed to describe the steps to prevent the recurrence of asthma attacks. Based on the analysis of the answers, 15 students received a score of 0 because they did not answer the question. A total of 10 students received a score of 1 because they were able to describe one preventive step. A total of 7 students received a score of 2 for describing two preventive steps. Five students received a score of 3 for being able to describe three or more preventive steps. This elaboration question emphasizes developing and elaborating on an existing idea. The majority of students have difficulty elaborating answers in depth, although some students can provide detailed and correct answers.

Based on the results of the CTS test above, the elaboration indicator falls into the uncreative category and is the aspect with the lowest score in students' CTS. This is evident from the inability of students to provide the correct answer, develop existing ideas, and explain answers in detail. This condition contradicts the elaboration behavior according to Setyawan (2019) which involves developing or describing an existing idea, adding or specifying details of an object or idea, and improving the quality of the idea. Research conducted by Aryanti et al. (2021) also shows that the elaboration indicator remains underdeveloped, as students have not been able to provide detailed answers and solutions to problems. In addition, difficulty in understanding the material is one of the obstacles that hinder students in solving problems (Sari et al., 2023). Therefore, students need more time to detail the answers or ideas they put forward (Ali et al., 2023).

To improve elaboration in CTS, it is necessary to apply appropriate learning strategies, such as scaffolding and the use of interactive media. Research by Ernawati & Sari (2022) showed that scaffolding can improve CTS, particularly in the elaboration aspect. This strategy provides gradual guidance to students in analyzing and processing information so that it can be constructed into more detailed alternative ideas. Scaffolding also helps students in developing ideas by providing triggering questions, concrete examples, and directions that stimulate deeper thinking (Al Mamun & Lawrie, 2024). In addition, the use of interactive media equipped with images, videos, animations, and simulations can increase students' learning motivation. Research by Awaly et al. (2023) showed that interactive learning media positively contributed to the improvement of CTS. This media received positive responses from students because it supports both online and offline learning and is equipped with attractive visual and audio elements. Learning through this interactive media allows students to explore the material more deeply. With the combination of scaffolding strategies and interactive media, students are encouraged to think more broadly, develop ideas in more detail, and improve their ability to explain and elaborate on an idea.

Results of Students' Response to Biology Learning

Students responded to a biology learning questionnaire at school. The questionnaire included 10 closed-ended statements, with answer criteria ranging from 1 (strongly disagree), 2 (disagree), 3 (agree), to 4 (strongly agree). The following are the students' responses to the biology materials, their CTS, and the biology learning experience at school.

Statement 1 "I feel that biology is an interesting subject to learn" received a positive response from all students. Subudi (2023) observations show that biology subjects are interesting material for students, but often students seem less interested in the material being studied. According to Jayawardana & Gita (2020) biology is the study of living things with all the interactions that occur in their environment. Biology learning seems difficult and a lot of memorization, but is interesting, fun, can be practiced, and is useful in everyday life. Biology can be learned textually and contextually with innovations such as the use of technology so that it can increase motivation and interest in learning biology, encourage active students, and make learning more meaningful.

Table 4. Student's Response to Biology Learning and CTS at School

No.	Statement	Student's Response			
		Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
1.	I feel that biology is an interesting subject to learn	0	0	73	27
2.	I feel that respiratory system material is an easy-to-understand	0	5.4	75.6	19
3.	Biology learning activities with practicum make it easier to understand and remember the material learned	0	0	51.3	48.7
4.	I feel that technology-based learning strategies make it easier for me to remember and understand biological material	0	19	62	19
5.	I apply the method with pictures and colors when learning biology material	2.7	16.2	56.8	24.3
6.	I find it difficult to answer questions with more than one answer	2.7	10.8	75.7	10.8
7.	I am able to provide answers to questions that are diverse or varied	0	29.8	67.5	2.7
8.	I am able to interpret the meaning of pictures, stories, and problems	0	21.6	73	5.4
9.	I find it difficult when I give a new answer that is different from the usual one	2.7	29.7	67.6	0
10.	I find it difficult to answer questions in detail	5.4	32.5	51.3	10.8

Statement 2 "I feel that respiratory system material is an easy-to-understand" received a majority of positive responses from students, although some disagreed. This indicates that students experience difficulties in understanding the material. Simangunsong (2021) research shows the level of difficulty in learning biology, especially respiratory system material in high school students, namely explaining the structure and function of respiratory organs (high difficulty), analyzing respiratory mechanisms, capacity, and frequency of breathing (high difficulty), explaining the exchange process of oxygen and carbon dioxide (very high), and analyzing abnormalities and respiratory organs (moderate).

Statement 3 "Biology learning activities with practicum make it easier for me to understand and remember the material learned" received a positive response from all students. According to Nurjamilah et al. (2020) biological material, especially the respiratory system, discusses complex mechanism processes and involves various organs in carrying out their functions, so it is quite difficult to understand and requires learning with other methods besides lectures and discussions. Putri et al. (2020) research shows that practicum provides a deep learning experience and increases understanding of the respiratory system material learned by students. Through practicum, students can apply theory directly which strengthens conceptual understanding and facilitates students to be actively involved during learning

Statement 4 "I feel that technology-based learning strategies make it easier for me to remember and understand biological material" received a majority of positive responses from students. Biology learning can be combined with various technologies and applications

so that learning becomes more interesting, fun, modern, and sophisticated (Jayawardana and Gita 2020). An example of the use of technology in learning is e-books. The results of Romayanti et al., (2020) show that electronic books facilitate the learning process, the material is clear and easy to understand, and the presence of videos is very helpful for independent learning. Students can build understanding, generate many ideas, find many solutions to problems, and detail answers. Thus, it can train CTS.

Statement 5 "I apply the method with pictures and colors when learning biology material" received a positive response from most students. However, some students disagreed. This shows the different learning styles of learners. Research by Ningsih et al., (2022) shows that each student has their learning style in Biology lessons. Students who have a visual learning style will find it easier to understand information through practice questions, assignments, pictures, and videos. Students with an auditorial learning style tend to easily understand information through lectures and discussions. While students with kinesthetic learning styles find it easier to understand information if they are involved in hands-on activities. Most students agree with the application of note-taking methods with pictures and colors when studying biology, this shows that the majority of students have a visual learning style. According to Widiyono (2021) taking notes by combining colors, symbols, shapes, and so on presents a visualization of material that can make it easier for the brain to absorb and remember the information received.

Statement 6 "I find it difficult to answer questions with more than one answer" received a positive response from most students, but there were some students who gave a negative response. This statement leads to fluency in CTS, which represents the ability of students to generate many ideas and answers related to problems and questions in a short time (Sugiyanto et al., 2018), accompanied by reasons and correct (Widiastuti et al., 2021). The majority of students do not find it difficult to provide more than one answer, but there are students who find it difficult and have not been able to provide more than 1 answer or idea. In line with the results of the CTS test in Table 3, the fluency indicator which gets the less creative category, most students only give 1 answer correctly, although there are some students who give more than 3 answers correctly. The results of Widiastuti et al., (2021) show that in the fluency indicator, the higher the fluency skills of students, the answers given will be coherent, accompanied by correct reasons, and provide diverse answers.

Statement 7 "I am able to provide answers to questions that are diverse or varied" shows that the majority of students agree, but there are some students who disagree. This question leads to flexibility in CTS, representing the ability of students to generate many ideas and approaches in answering questions (Sugiyanto et al., 2018). The majority of students felt able to provide diverse or varied answers. The flexibility indicator of students is in the less creative category because most students cannot provide answers based on different and varied points of view. According to Nada & Sari (2022) flexibility is related to fluency. The more ideas, ideas, or alternative answers given to answer the problem, the more likely the answers given are different points of view, and different from the general answer, but still conceptually correct.

In statement 8 "I am able to interpret the meaning of a picture, story, and problems" shows the majority of students agree, but there are some students who disagree. This statement leads to flexibility in CTS, students can provide various interpretations of a picture, story, or problem (Setyawan, 2019). The majority of students feel able to interpret the meaning of existing images, stories, or problems. However, it is not in line with the results of the CTS test in Table 3, in the flexibility indicator students are in the less creative category. In question number 3, only 17 students (46%) were able to understand the meaning of the graphs and statements presented, so they were able to provide answers from various points of view correctly. The test results are not in line with the results of the students' questionnaire. According to Sari et al., (2023) a low flexibility indicator shows the weak skills of students to see and consider things from various points of view.

Statement 9 "I find it difficult when I give a new answer that is different from the usual one" some students gave positive responses, but some gave negative responses. This statement leads to originality in CTS, students can come up with ideas or answers that are new, different from existing ones, and conceptually correct (Nada & Sari, 2022). The majority of students feel that they have no difficulty providing answers that are new and different from the usual ones, in line with the results of the CTS test in Table 3. Most students can provide new answers based on their ideas and ideas, but there are still the same answers found between sitting participants. According to Sugiyanto et al., (2018) originality can be achieved if students are accustomed to practicing thinking with different points of view so that they can produce ideas, answers, or ideas that are new and different from existing ones.

Statement 10 "I find it difficult to answer questions in detail" shows the majority of students agree, but some students disagree. This statement leads to elaboration in CTS, namely developing ideas based on supporting information or references, so as to provide detailed answers (Nada & Sari, 2022). The majority of students did not find it difficult to answer questions in detail, but 37.9% found it difficult. In the elaboration indicator, students are in the uncreative category, because the majority of students cannot provide detailed answers and develop existing ideas. According to Sari et al. (2023) the elaboration indicator is low because the students' understanding is still lacking and have not maximized understanding.

The results of the overall analysis show that students' CTS in learning biology, especially in respiratory system material, still need improvement. Based on the CTS test, the elaboration indicator is categorized as not creative, the flexibility and fluency indicators are categorized as less creative, and the originality indicator is categorized as quite creative. This condition indicates that students struggle to develop ideas, process information flexibly, and elaborate on ideas in depth, especially when faced with a problem. Sari et al. (2023) revealed that CTS are influenced by learning models and student motivation. Therefore, a more innovative learning approach is needed to increase students' engagement and understanding in the learning process.

E-Book Recommendations to Improve CTS

Biology learning can be integrated with technology and the internet to create a more engaging, enjoyable, modern, and innovative learning experience (Jayawardana & Gita 2020). Technological advancements are one of the key success factors in learning, particularly through the use of digital applications and platforms that facilitate communication, material delivery, learning activities, and digital assessment (Rajagukguk & Hasanah 2023). One form of technology application in biology learning is e-books, which serve as digital learning media to enhance students' conceptual understanding and CTS.

An e-book is a type of book in digital format that can be accessed anytime and anywhere through electronic devices (Hendra et al., 2023). Alshehri (2024) literature study indicates that e-books can improve students' CTS and conceptual understanding, as evidenced by the following research findings. Tang et al. (2022) research shows that e-books not only function as learning resources but also enhance students' CTS. Similarly Cahyanti (2021) research confirms that e-books integrated with creative thinking indicators fluency, flexibility, originality, and elaboration contribute to developing and strengthening students' creative thinking abilities. Furthermore, Fadlilah et al. (2023) research revealed that well-designed e-books can train CTS across various indicators. Regarding the fluency and flexibility indicators, students can develop ideas in the form of answers and questions, view a problem from multiple perspectives, and apply different thinking approaches based on videos, stories, or problems presented in the e-book. In terms of originality, learners are encouraged to generate new and innovative ideas due to increased curiosity during the learning process. Meanwhile, in the elaboration indicator, learners can explore new possibilities in greater depth without certain limitations, allowing them to expand and refine their ideas.

E-books are interactive media that support more effective, communicative, and collaborative learning. Research by Saripudin et al. (2022) shows that e-books receive positive feedback from students, particularly Generation Z, who prefer digital-based learning with audio, animation, and infographic features. The use of e-books as part of digital technology enables students to better understand biological concepts and develop reasoning skills for problem-solving. Additionally, e-books can be integrated with virtual labs actively engaging learners and fostering CTS (Rifa'i & Hasanah 2022). Features such as guiding questions, concrete examples, and instructional prompts in e-books (Clinton-Lisell et al., 2023) can help learners analyze, process information, and solve problems (Ernawati & Sari 2022). The elements in e-books can be tailored to fluency, flexibility, originality, and elaboration indicators (Sonia et al., 2024). Therefore, e-books can serve as an innovative solution in technology-based biology learning, optimizing students' intellectual development.

Conclusion

Based on data analysis, it is concluded that students' CTS in Gresik, particularly in biology, specifically in the respiratory system material, remain low. The CTS for the fluency and flexibility indicators are categorized as less creative, the originality indicator as moderately creative, and the elaboration indicator as not creative. The elaboration indicator received the lowest score, while the originality indicator received the highest. This study indicates a positive student response to technology-based biology learning, recommending interactive learning media such as e-books to enhance CTS. Consequently, students can better understand concepts and actively engage in learning activities, such as gathering information, asking and answering questions, considering different perspectives, generating new ideas, or developing existing ones in detail. Future research is expected to involve a larger sample and implement e-books in learning to further improve CTS.

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