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CRITICAL THINKING AND LITERACY SKILLS IN STUDENT SCIENTIFIC WRITING: EVIDENCE FROM UNIVERSITAS TERBUKA

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Abstract

Teaching scientific writing has been compulsory in many Indonesian universities. It is usually the main indicator for completing an undergraduate program. Despite this fact, not only do universities apply similar policies, but training in that particular skill is also an increasingly common trend. The Open University of Indonesia, widely known as Universitas Terbuka, is the biggest and the only university that administers distance learning in the state, to implement this policy. An example is the existence of a scientific writing course, a compulsory course in the English Education Department of the Faculty of Teacher Training and Education, where the course is taught to all students as a requirement to graduate from the university. This research was established by selecting seven participants who were enrolled in the course. The objective is to assess the appearance of critical thinking and literacy among students who have been trained in the subject. Seven academic papers representing these seven students were analyzed to identify traces of both necessary skills for conducting research: critical thinking and literacy. The qualitative method was chosen to determine whether students write using critical thinking and literacy. After analyzing the data, the researcher concluded positive findings on the use of both skills, although not all students performed well. However, one particular student showed a unique pattern in applying these skills. In terms of critical thinking, the researcher identified three sequences, while pairing techniques were employed in critical literacy to accommodate this skill's presence.
Keywords: *Critical Literacy, Critical Thinking, Distance Learning, Scientific Writing.*

Introduction

In the Indonesian context, students pursuing a bachelor's degree in English education need to submit research-based writing to graduate from their program.

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Although it is not compulsory for certain universities and educational programs, the demand for undergraduate students to be able to compose reasonable academic papers seems to be an inevitable trend that must be fulfilled. However, relying solely on writing skills is not sufficient to produce a good, acceptable research paper. Students also need to acquire critical thinking and literacy skills to construct an academic paper effectively.

The existence of critical thinking is undoubtedly crucial for students. Despite the concept appearing elusive, it is believed to be instrumental, especially in today's era of disruptive and overwhelming streams of information. Critical thinking is the ability to use *data and evidence* to decide what to trust and what actions to take, reflecting analytic inference and evaluation across multiple sources (Walsh et al., 2019). Teaching critical thinking is important as it enables students to become skeptical of false information. Consequently, it is not surprising that Indonesian schools have begun incorporating it into their curriculum.

As observed in the official document, Regulation of the Republic of Indonesia, Number 17 Year 2010 Concerning Educational Management and Administration (JDIH, 2010), critical thinking is listed as an educational aim for all levels of education. According to the document (Article 77, Numbers a and d, respectively), secondary education aims to produce pupils who are (a) faithful to God, morally correct, and noble, (b) knowledgeable, skillful, critical, creative, and innovative, (c) healthy, independent and confident, and (d) tolerant, socially sensitive, democratic and responsible. The appendix of the paper clarifies that "critical" refers to critical thinking. However, integrating critical thinking into English foreign language teaching is not an easy task due to the existence of a language barrier, and as Gustine (2018) claims, one challenge is that students' knowledge of critical thinking is often incomplete and inaccurate.

In addition to the importance of critical thinking, critical literacy is also essential in academic writing. Critical thinking functions as a cognitive method for analyzing problems, evaluating evidence, and constructing logical arguments, while critical literacy extends these skills into broader social and political contexts. As Appatova et

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al. (2023) note, critical literacy integrates reading, writing, research, and critical thinking as practices that are embedded within real-world conditions. In this sense, critical literacy entails not only extracting essential meaning from texts but also linking those meanings to lived experiences and societal issues (Patria, 2022; Albert, 2022).

Thus, critical literacy builds upon critical thinking by transforming analytical skills into socially engaged practices, showing how academic writing requires both the logical rigor of critical thinking and the contextual awareness of critical literacy. In a nutshell while the ciritical thinking concern on how mental or intelegensia of people in unpacking the problem, critical literacy tries to connect or criticize the existence of literature either in the field of social, economy or science toward the reality of the world. Particularly in academic writing both skills are utilized in order to produce qualified and high standard scientific paper.

The teaching of critical literacy with English as the medium of instruction is common in many English-speaking countries, such as the United Kingdom, the United States of America, and Australia. However, it is rarely practiced in developing countries. In Indonesia, the teaching of English as a foreign language still predominantly focuses on grammar or language structure as the main foundation, with literature being underutilized in promoting student learning. This situation is unfortunate, particularly when considering the teaching of advanced writing, which should emphasize composing research papers or academic journals.

For example, the *Karya Ilmiah/Karil* (Scientific Writing) course at Universitas Terbuka is one such course that aims to train students in writing advanced academic papers. There are various types of scientific work (Karil), with Scientific Articles being the focus of this course. These articles are written forms containing systematic writings or reports on study results or research findings presented following the conventions or rules of scientific writing. Participants of the Scientific Work (Karil) course are Diploma IV or Bachelor's program students who register for the course in the same semester or package semester where Professional Skill Enhancement (PKP) courses or Final Project Program (TAP) courses are offered.

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The ability to extract information and not only critically process it but also connect it with real life is the primary foundation of good research. Traditional research is built on a long connection of previous research, serving as contextual evidence. A novice researcher needs to be trained to understand that their work is not a single project; rather, it is a piece of information that may contribute to the broader puzzle that humanity must solve to address its problems.

With the description above, teaching writing, particularly scientific writing courses, is inherently complex and challenging. Not only does it require students to have a command of English, but also critical thinking and literacy skills to compose an acceptable research paper. Universitas Terbuka, as an open university, mandates its students to enroll in such courses. However, teaching scientific writing at Universitas Terbuka differs significantly from conventional universities because students must integrate critical thinking and literacy in a distance learning context. Despite the growing body of literature on writing pedagogy in higher education, there is still limited research that specifically addresses how distance learning students develop and apply critical literacy skills in scientific writing. This gap highlights the need to explore how critical thinking and literacy intersect in the unique setting of open and distance learning.

At least two main reasons are contributing to this disparity. Firstly, the method of instruction varies. Although the course consists of fourteen sessions similar to those in conventional university classes, students primarily interact with their tutors synchronously through online platforms for up to four meetings. Secondly, there is an underlying assumption that teaching critical writing is not feasible for non-native English speakers.

According to Atkinson (2012), non-native English speakers find it challenging to embrace the ideas of critical thinking (CT) because they often think differently from native English speakers. This condition poses a unique challenge for teaching the course at the university level. Despite its distinctiveness, assessment is a compulsory process that lecturers must undertake for students enrolled in the course. This research serves as an assessment report conducted by a lecturer to observe and

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identify whether students applied critical thinking or literacy in their research project or what traces of critical and literacy thinking can be found in a class of undergraduate students learning to create scientific papers.

Writing is one of the four skills characterized by the ability to articulate a sequence of words in relation to a specific context. There are various types of writing, and when discussing writing, a tangible product serves as the indicator of whether someone has mastered the skill or not. Therefore, Boyle, et.al (2019) define writing as the act of expressing what the writer thinks or feels in written form, reflecting the writer's thoughts. Assessing a successful writing class involves checking students' writing product or their performance. In a scientific writing class, the written paper is the primary focus of assessment.

Brown in Fatimah and Yusuf (2018) categorize types of writing performance into four categories: imitative, intensive, responsive, and extensive. Among these, extensive writing represents the scientific writing course, as students' extensive writing indicates successful management of all writing processes and strategies for various purposes, culminating in the length of an essay, a term paper, a major research project report, or even a thesis. However, unlike other writing classes, scientific writing dose not primarily focus on writing skills or related features. Instead, it prioritizes the students' ability to produce a well-structured scientific paper. Therefore, in this research, the focus is not on analyzing students' grammar or other linguistic elements, but on investigating something rarely assessed in the class: critical thinking.

The integration of critical thinking education (particularly in higher education) originated from the theories of critical thinking developed by philosophers such as Ennis, Facione, and McPeck (in Davies and Barnett (2015); Hitchcock (2018). However, critical thinking remains an abstract that is difficult for many people to comprehend, even though its teaching can be initiated as early as possible. According to O'Reilly, et al. (2024), critical thinking skills can be introduced effectively to children as young as 3–6 years old. Since critical thinking is not easy to grasp, its assessment is even more challenging. However, Tahira and Haider (2019) elaborates that

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successful academic writing requires skills such as recognizing key relationships, drawing inferences, evaluating evidence, and synthesizing data into coherent arguments. This implies that theoretically, assessing whether students write critically, which encompasses critical thinking in the process, involves observing the presence of at least four actions within the writing, such as summarizing, identifying and establishing connections and synthesizing large amounts of data to create global themes or principles.

To assess the presence of critical literacy in writing, several relevant theories can be used as the framework. Pennycook (2021) suggests that a critical agenda addressing social, economic, and political concerns should be incorporated. Another theory, proposed by Auerbach (1999), asserts that writing with critical literacy serves as a means for examining societal issues and advocating for social change. Based on these theories, we can identify several indicators to demonstrate the presence of critical literacy within' students' writing. These indicators include connection with social issues and efforts to promote social change, the integration of literature reading, the use of students' own words, and consideration of the contextual life surrounding them.

Method

The researcher has opted for a qualitative method for this study. According to Creswell (2023), qualitative research is an approach used to explore and understand the meaning that individuals or groups ascribe to a social or human problem. Given that the purpose of this research is to observe the traces of critical thinking and literacy among students, particularly their attitudes toward the situations surrounding them and whether they demonstrate sufficient criticality, the qualitative method appears to be the most suitable option.

In qualitative research, the researcher's skills are crucial in the process and require a significant amount of interpretation and judgment. As Creswell (2023) asserts in his publication that the researchers themselves serve as key instrument in research. Therefore, the researcher's role is paramount in guiding the research. However, the researcher will be guided by a theoretical framework that can be translated into specific indicators. Using this theory, the researcher creates an

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operational definition that serves as an indicator to assess whether critical thinking and literacy are evident in students' writing tasks. Each of the table within the chart was representing the process and element that identify the existence of critical thinking. By marking their presence one by one researcher knew the occurance of critical thinking. Similar approach is also done for identiying the critical literacy.

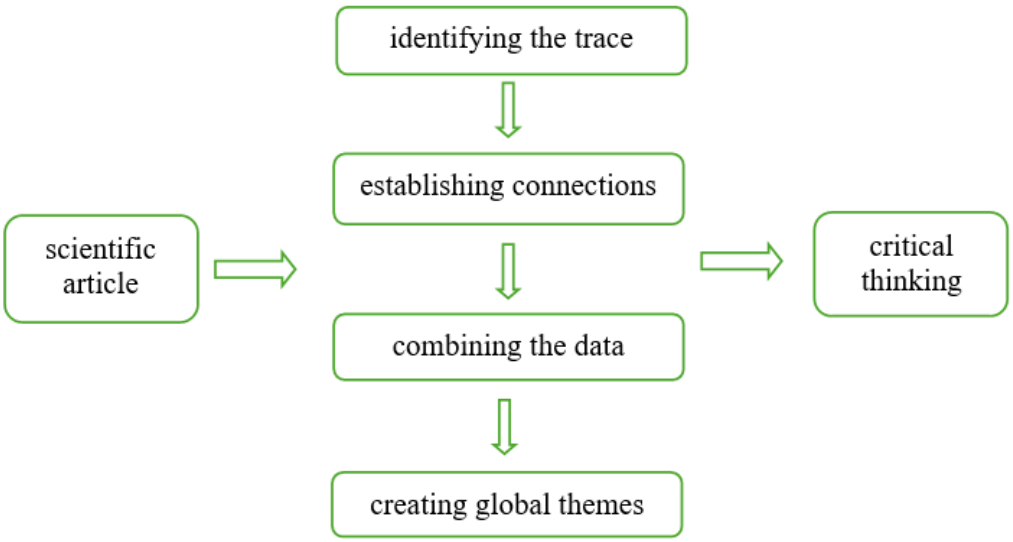

Chart 1. Operational definition of critical thinking assessment in writing

Meanwhile, chart 2 will serve as the operational definition for critical literacy assessment. This approach will ensure a comprehensive evaluation of critical literacy within students' writing tasks**.** As the theory underlined 4 key elements for the existence of critical thinking, each of the table within the chart was representing the element. By marking their presence one by one researcher knew the occurance of critical thinking. Similar approach is also done for identiying the critical literacy.

The chart illustrates the analytical process of deriving critical thinking from students' scientific articles. It shows a sequence of steps through which raw written work is systematically examined to uncover evidence of critical literacy and higher-order thinking skills.

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1. **Scientific Article (Input)**

   The process begins with students' scientific articles as the primary source of data. These texts are the basis for examining how students demonstrate critical engagement with content.

2. **Identifying the Trace**

   At this stage, the researcher looks for initial "traces" or indicators of critical thinking within the article. These may be linguistic cues, argument structures, or references that signal analytical engagement.

3. **Establishing Connections**

   Once traces are identified, the next step is to link ideas together. This involves examining how students connect evidence, arguments, and perspectives, showing their ability to move beyond isolated points toward integrated reasoning.

4. **Combining the Data**

   Here, the identified traces and connections are synthesized. Patterns across the data are grouped, allowing the researcher to see broader relationships that might not be visible at the sentence level.

5. **Creating Global Themes**

   From the synthesized data, the global themes are developed. These themes represent the students' ability to generalize, reflect, and demonstrate critical engagement with broader issues.

6. **Critical Thinking (Outcome)**

   The outcome of this process is an assessment of whether and how students demonstrate critical thinking in their writing. By following the steps, the researcher can systematically trace the progression from specific textual features.

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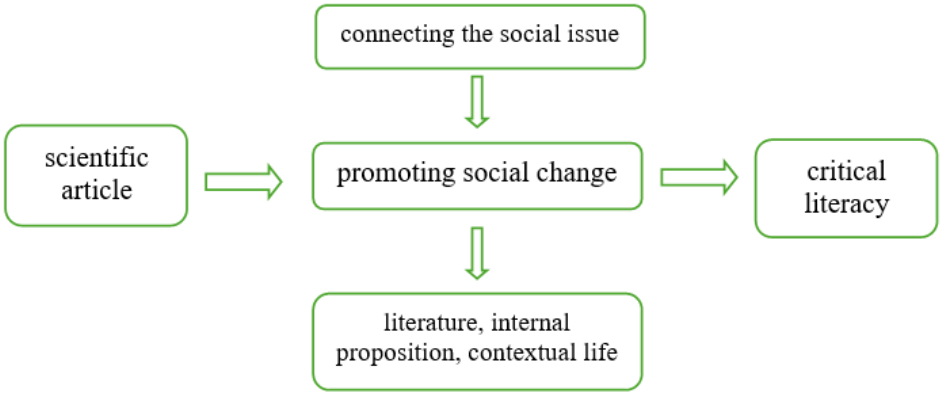

Chart 2. Operational definition of critical literacy assessment in writing

This research was conducted from November 2023 to March 2024. The course itself is scientific writing, one of the compulsory courses that train students in the English Education Department, Faculty of Teacher Training and Education, to be able to compose an inquiry paper. It consists of 8 hybrid sessions divided into 14 learning activities. Students have to access the e-learning website to read the material. They also must attend four Tuweb (tutorial webinar) meetings in a synchronous scheme. The illustration of the session can be seen below:

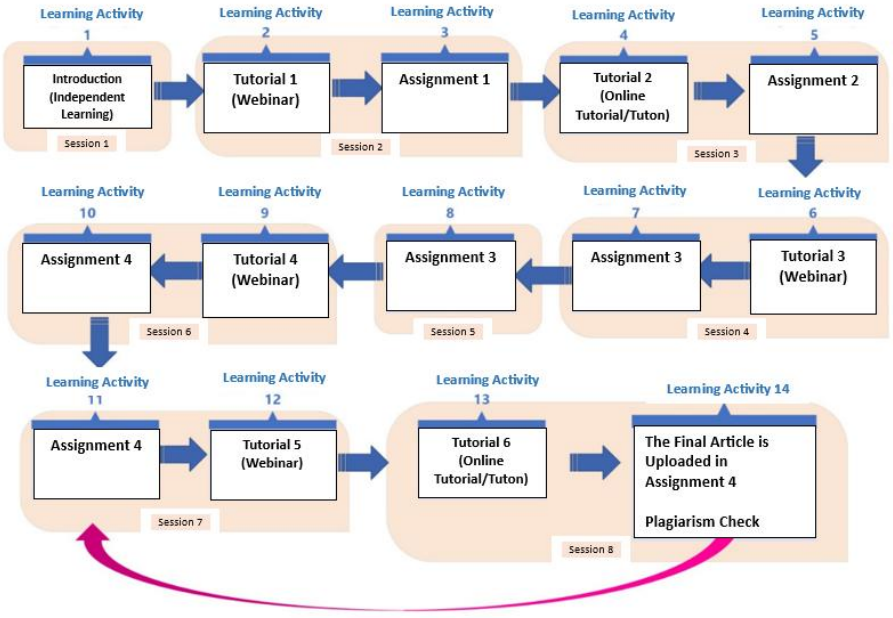

Chart 3. Scientific Writing course learning activities

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This research encompasses all students enrolled in the eight semesters of the English education program. While the students serve as participants in this research, the data collection and analysis processes do not directly involve them. This is because the research relies solely on students writing products, specifically academic research-based paper.

In analyzing the data, the researcher employed two separate processes. The first process is dedicated to critical thinking analysis. Initially, all data is collected and coded using deducative coding. Then, the existence of critical thinking in students' writing is assessed using indicators constructed in chart 1. Finally, conclusions are drawn regarding whether students demonstrate critical thinking in their work. On the other hand, for critical literacy, similar processes are implied. Firstly, the students' assignments were coded using a deductive coding scheme, with categories predefined according to the indicators presented in Chart 2. The coded data were then analyzed systematically based on these indicators. Finally, conclusions were drawn to determine the extent to which evidence of critical literacy appeared in the students' scientific papers.

Results

In investigating students' critical thinking and literacy, the researcher needs to be clear on several points and establish boundaries. For instance, this research focuses solely on students' critical thinking and literacy in writing. This means the researcher will not engage with linguistic measurements or grammatical issues; it is purely about critical thinking and literacy. If, during the analysis, the researcher finds traces of both elements in poorly written sections, the researcher will make note of them.

There are only seven pariticipants out of fifteen in this research whose articles were completed. It is a total number of one scientific writing class that become the participants of this research. All seven articles are analyzed, including quotes that are adopted, both direct and indirect. However, the process of creating the articles involved me as a lecturer and guide. The researcher endeavored to preserve their original ideas and voices, making only minor interventions when necessary. Despite this, the primary focus remains on critical thinking and literacy.

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After analyzing 7 academic articles written by the students, the researcher came to one conclusion: there is evidence of critical thinking and literacy at least in three participants. The traces of two skills are quite visible yet the rest was less viable. Most of the students structured their article into approximately four sections: the introduction, methodology, finding, and conclusion. The majority of the evidence of critical thinking can be found in the introduction part, as it is where students consistently infuse their writing with either critical thinking or literacy.

Students do utilize their critical thinking; however, since they are not advanced researchers, some of them struggle to coherent and cohesive writing. The way they apply critical thinking seems to be more hesitant and exploratory. Grammar, as well as language composition, has flaws here and there. Although it requires more elaboration, they do produce good writing that incorporates critical thinking as well as literacy. Critical thinking and literacy can be observed earlier in their introduction. Most of the students structured their article into approximately four sections: the introduction, methodology, finding, and conclusion. Considering this structure, the majority of the evidence of critical thinking can be found in the introduction part, as it is where students consistently infuse their writing with either critical thinking or literacy.

Discussion

1. Critical thinking and students' way of approaching issues

Based on the finding, the critical thinking does exist. In the work by Participant 1 (P1), titled "Enhance Students' Vocabulary through Animated Movies", there are at least three indicators that the researcher found to demonstrate this. There is a clear identification and establishment of connections, with the combination of abundant data to create global themes or principles, followed by a summary. At the very beginning of her work, she firmly identifies her concern, delineated through at least three sequences. In the introduction, she offers a big picture of language as a means of communication. After that, she transitions to the second part, focusing on promoting one of the language components she wishes to emphasize, namely

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vocabulary. Lastly, she delves into the main issue of teaching vocabulary, recognizing it as the key to overcoming constraints in vocabulary acquisition.

Table 1. Work by Participant

Indicators	Description
1	Our primary means of communication is language.
2	Vocabulary is crucial for linguistic proficiency and learning a foreign.
3	Over the past few decades, a number of academics, researchers, and language instructors have carried out studies to determine which methods are useful for learning vocabulary.

The existence of identification later followed the establishment of a connection. In this case, she refers to at least two things: previous work and her own experience, and the solution she offers, which is the implementation of teaching vocabulary using movies with subtitles. This demonstrates systematic thinking derived from her critical analysis in writing. It starts with identifying a problem, followed by a solution. Additionally, her various quotes emphasize the use of data, particularly secondary data, to support arguments, which constitutes the third indicator of critical thinking. Finally, her research culminates in a comprehensive summary. Her research is focused on discussing teaching vocabulary, employing a method of teaching with clear subtitles. Moreover, her work is written, reflecting her application of critical thinking. The summary is outlined as follows.

> *P1: The objectives of this research were to ascertain the students' proficiency in vocabulary acquisition both before and after viewing the film, as well as the usefulness of English-language films with subtitles in helping students' vocabulary growth*.

The finding above is endorsing the fact that teaching writiing might enhance stduents critical thinking. A research publish by Quitadamo and Kurtz (2007) has showded a similar sense. Some students who grouped in wiriting class displyed a signifcant imporvement on critical thinking. Despite the fact that the finding was similar we cannot neglect that the setting of their research is United States of America (USA) where critical thinking is a common education foundation unlike Indonesia according to According to Atkinson (2012). The existence of language barrier where

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english is first and second language for USA student while foreign for students that enrolling the scientific writing class is also a great difference. Furthermore this study was conducted with the students in distance learnign class unlike convensional class on Quitadamo and Kurtz's research. All those make this research is not only endorsing the previous finding but established its own merrit.

P1 is indeed one of the clearest examples demonstrating a trace of critical thinking in her academic writing. However, other students also exhibited elements of critical thinking. For instance, a work by Participant 2 (P2), a participant that wrote "The Use of Small Group Discussion Method to Improve English-speaking Ability" also demonstrates a trace of critical thinking even though it does cause some poor performance. While the essay exhibits good identification, the poor connection to the central issue she aims to explore, coupled with a lack of supporting data, weakens the critical thinking evident in this essay. Similarly, another participant's work (P3) follows a somewhat similar pattern but with slightly better improvement. She wrote an article titled "Improving Students' Descriptive Text Writing Skills Using the Problem-Based Learning Model." Despite its promising aspects with good ideas, some areas require improvement. In terms of critical thinking, good identification has been made, as evidenced by statements within her work.

> *P3: the English proficiency, especially the writing skills of VIII SMP students, is still poor.*

She also included quite good statistical data to strengthen her statements and create a connection with a solution to solve the issue. However, what makes her critical thinking seem weak is her hasty conclusion. This can be observed in her first essay where she identifies her main concern. Instead of slowly building her case by clearly stating her main issue or point she wants to tackle, she tends to rush through one point and move on to another argument.

2. Critical literacy on writing

Within research, literature plays an essential role as a starting point. It aids researchers in developing ideas and guides them into specific fields of interest and disciplines. More practically, literature is a starting point to make your research

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meaningful. Practically, literature serves as the foundation for meaningful research, equipping researchers with the necessary tools to identify gaps and establish measurements. However, understanding the importance of literature within research is not always straightforward. Some novice researchers may view it merely as an obligatory component mandated by academic papers or scientific publication formats. Furthermore, the presence of literature in scientific articles is only valuable when followed by the ability of the reader to apply a critical approach. Without critical literacy, literature in academic journals becomes a mere requirement to fulfill formatting standards, lacking significant contributions to disciplines or previous scholarly work.

There are three indicators that the researcher chooses to assess the existence of critical literacy within scientific papers written by students. These indicators relate to social issues, promoting social change, and the connection between literature, internal propositions, and contextual life. Among the seven articles that I analyzed, traces of critical literacy have occurred, yet not all show it. Some students are doing it quite well, while others are still struggling. Among the seven participants, P1, much like in the critical thinking assessment, demonstrated impressive critical literacy skills. She started with the statement that:

> *"Millions of people speak certain languages, whereas only a few thousand speak others. Since English is the most widely used language in the world, its significance cannot be downplayed or overlooked". (Llyosovna, 2020)*

She tried to address that communication is an issue. Particularly, the lack of communication due to the language barrier is one of the sources of problems in our society. Quoting Llyosovna (2020), she tried to underline that English as an international language might be a viable solution. Not only showing the social issue with literature reference as the backup, she also promotes the solution as follows:

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> "Acquiring proficiency in the English language will enable you to interact with individuals' worldwide, simplifying travel and enhancing your understanding of diverse cultures."

She was not only recognized this realization within her own words but also proposed this awareness to others. Utilizing what I term the "pairing technique," she advocated for her thoughts and promptly supported them with relevant literature sources. In this study, the pairing technique is defined as an academic writing strategy in which a writer articulates personal ideas or arguments and immediately links them with supporting evidence from scholarly sources. This technique requires a critical mindset to effectively read and connect the reading material with the contextual issue we are dealing with. Throughout her explanations, she consistently demonstrated this practice, acknowledging that as a research article, personal opinions alone hold limited value without any backup reasoning from experts or previous scholars.

Table 2. Opinion from the Participant

Opinion	Literature
Movies are one type of visual medium that can be used as a solution to the issue	We can utilize animated movies as a way to get kids interested in learning English since their vivid colors and easy-to-pronounce words help kids comprehend and improve their vocabulary and grammar skills Romadhon, et.al (2022).
Accordingly, pupils can directly understand the tale by watching animated films.	Students who watch animated films can learn to form phrases gradually (Ar, 2020).

Despite the fact that critical literacy has been performed quite well by P1, we cannot neglect the fact that she is a newbie researcher. The pairing technique she employs is not always consistent; sometimes, she loads up with too many opinions, while in other paragraphs, it is filled with numerous quotations. However, her awareness of bringing up literature as an endorsement of her thoughts, as well as her ability to critically read relevant literature, demonstrates that critical literacy is one of her strengths in writing. Ultimately, the third indicator of critical literacy is the ability to connect three elements at once: the literature we read, our own thoughts or words,

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and the contextual event. Although P1 may have some flaws in this regard, it is attributed to her lack of experience and training in writing. With more experience and training, she is likely to improve.

P1 might be considered as the only student who shows a strong critical literacy. Another student may show a trace of a work by Participant 4 (P4) with the title: "Improving Vocabulary Mastery", yet if there are very low issues, it does not frequently support social issues that he found with literature that is relevant. The application of literature is more like helping with establishing definitions and mere description. It does not strengthen his opinion or support the solution he promotes. Participant 5 (P5) also performs a similar sightline improvement. However, Participant 6 (P6) in her work entitled "Contextual Teaching and Learning Method to Improve Students' Writing Skills and Activeness" shades an optimism and Participant 7 (P7) with Improving The Speaking Skills, shade an optimism that students actually have that skill, yet they seem to be too hasty in choosing the literature to support their opinion or connect their opinion with the existing reading resource.

Conclusion

Teaching distance learning is a complex process. The constraints that exist create an urgency to apply hybrid learning. One of the courses that is taught is a scientific writing course. It is one among many courses that obligate students to participate synchronously and asynchronously. It means the learning process can be held only and offline accordingly. A scientific writing course is a course that demands students to submit research papers as their final task as well as the compulsory assignment to make them fail or succeed in the class. The fact that they produce a scientific paper which is supposed to be built based on critical thinking and requires critical literacy encourages me to conduct research into whether they apply both skill sets in their writing.

Based on the research findings, it is evident that both critical thinking and critical literacy are present. For critical thinking, the researcher identified good identification of the issue or topic to discuss, followed by a strong establishment of connections to other discussions or reasoning. Additionally, good critical thinking is

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supported by quite a large amount of data and leads to a coherent conclusion. Each of these elements is simultaneously connected to one another as a pointer to how a writer develops a scientific paper and presents their case.

Critical literacy is also observed, demonstrated by one of the participants through a technique that the researcher called "pairing." This method involves integrating the participant's ideas with the contextual situation, guided by literature discussions. However, despite the presence of critical thinking and critical literacy in students' work, not all students excel in these areas. Some perform better than others, while some still struggle. Therefore, it is crucial to conduct further research on how critical thinking is integrated within the scientific writing curriculum. Exploring different methods besides qualitative analysis, which was utilized in this study, might also be used to enrich this field of interest.

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