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Assessing critical thinking skills in vocational school students during hybrid learning

Asrowi, Iwan Maulana, Mochamad Kamil Budiarto, Taufiq Subhanul Qodr
Doctoral Program in Educational Science, Faculty of Teacher Training and Education, Sebelas Maret University, Surakarta, Indonesia

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ABSTRACT

In the current educational landscape, the development of critical thinking abilities is becoming increasingly important, especially considering the prevalence of hybrid learning methods. This investigation aimed to evaluate the proficiency of critical thinking skills in students who are immersed in hybrid learning. A descriptive quantitative research approach was employed, utilizing observation, documentation, and critical thinking assessments to collect data from a sample of 60 students from vocational high schools. The findings highlight two main results: firstly, the majority of students demonstrate a low level of critical thinking skills within the hybrid learning context, indicating the need for improvement; secondly, various factors that influence these skills were identified. These outcomes emphasize the challenges associated with acquiring 21st-century skills and emphasize the necessity for collaborative efforts. Both educators and students must enhance their commitment to effective learning preparation, with a particular emphasis on motivation to foster improved critical thinking abilities. This research provides valuable insights for educators and policymakers who are striving to enhance the hybrid learning environment to better cultivate critical thinking skills in students.

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Corresponding Author:

Asrowi
Doctoral Program in Educational Science, Faculty of Teacher Training and Education
Sebelas Maret University
Ir. Sutami Street no. 36 Kentingan, Jebres, Surakarta, Central Java, Indonesia
Email: asrowi@staff.uns.ac.id

1. INTRODUCTION

After the decline of the COVID-19 pandemic, a set of fresh regulations emerged, altering the routines across different spheres of life. This transformation is commonly referred to as the "new normal." The new normal extends beyond the realm of the economy and encompasses the education sector as well. The COVID-19 pandemic's influence has served as a pivotal moment, giving rise to a novel approach to education [1], [2]. The Indonesian government is introducing a novel approach to education despite their lack of prior experience. This innovative method, known as hybrid learning, has been adopted based on circular letter No. 4 of 2020 issued by the Indonesian Ministry of Education and Culture. This circular outlines the guidelines for implementing hybrid learning during the second semester of 2020 [3]. Hybrid learning can also be said as blended learning, which is a mixture of online and face-to-face learning [4]-[6]. With hybrid learning, a modern educational method, it is possible to combine traditional teaching in the classroom with online instruction. According to this advanced form of teaching-learning, one can engage in face-to-face or virtual learning activities [7]. Combining the personal supervision of face-to-face interaction and the flexibility of digital resources into one means that each student has his or her own learning environment [5]. Students access resources over the Internet, join online discussions, and attend classes in person. In this era of

the 21st-century, hybrid learning serves as a development strategy making education more responsive [8], [9]. Learning with a combination model between online and offline aims to obtain effective learning [5], [10]. The researcher said that hybrid learning in improving student learning outcomes is not only a learning model but also needs to involve a variety of teaching methods [11], [12].

The Indonesian government's endeavor to equip students with the necessary skills to thrive and excel in the 21st-century is exemplified through the implementation of this system, thereby facilitating the learning process [13], [14]. Hence, certain perspectives argue that critical thinking skills serve as the foundation for acquiring new knowledge, implying that any subject matter taught in the classroom can incorporate critical thinking skills [15], [16]. Provided that the conditioning of both the environment and the learning process is done well [17]. Moreover, students who actively participate in the subject matter are anticipated to develop essential skills in critical thinking [16], [18]. The absence of explicit implementation of learning by enhancing students' critical thinking implies that there is a need to foster the development of critical thinking skills through educational programs [14], [19]. Multiple studies indicate that students possess limited critical thinking skills and require further development in the learning process. This can be achieved through the implementation of effective learning strategies, utilization of technology-based learning tools, or through various other initiatives [20]-[22].

This aligns with research conducted in different countries, highlighting the significance of critical thinking abilities [23]-[25]. For example, a study carried out in Indonesia sought to improve the critical thinking abilities of students through the implementation of various methodologies and educational models [26], [27]. In different countries, efforts to improve critical thinking skills through educational advancements persist. In Thailand, a study showed that 6,000 students scored an average of 36.5% in analytical and critical thinking skills. Scientists in the country are working hard to introduce a new learning model that benefits students. Results from these trials prove that the PUSCU learning model successfully boosts students' critical thinking skills and academic achievements [25]. In addition to using different teaching methods and strategies, a recent study has shown that instructional media can also help improve critical thinking skills. Studies have found that combining interactive media with problem-based learning can be effective in boosting students' critical thinking abilities [28]-[30]. Various research studies conducted in different countries have consistently demonstrated that numerous factors play a significant role in enhancing students' critical thinking abilities. These factors encompass a wide range of elements, including the utilization of diverse learning media, the implementation of effective learning models, and the adoption of appropriate learning strategies by educators during instructional sessions.

Further research is warranted to explore and delve into the significance of fostering critical thinking abilities among students, particularly those enrolled in vocational high schools. The development of these skills is a direct result of educational endeavors that strive to equip individuals with the necessary competencies to thrive in the ever-evolving industrial landscape [31], [32]. Competencies that are by industry and work requirements are critical thinking skills [33], [34]. Vocational students must possess 21st-century competencies, among which lies the significance of critical thinking to ensure the progression of personal growth and societal interactions [35], [36]. It is not unfounded that the industrial sector is constantly evolving and facing new challenges, necessitating graduates to be adaptable to keep up with these changes.

Looking at various previous studies and research related to critical thinking skills, it appears that it is very important for students to master critical thinking skills, especially vocational school students whose graduates are expected to master the competencies needed by the industrial world. As one of the 21st-century competencies, the ability to think critically is one of the competencies that is mandatory and fundamental to be given to students, so in this case, teachers and instructors are expected to use all their abilities. Therefore, this research aims to analyze published research trends related to the implementation of hybrid learning and its contribution to students' critical thinking abilities. It is hoped that the existing meta-analysis study can provide a comprehensive analysis of the implementation of hybrid learning and its consequences for improving vocational school students' critical thinking abilities.

2. METHOD

This research model uses a quantitative descriptive research model [37]. The definition of quantitative descriptive research is one approach to test the theory objectively by examining the relationship between variables. The relationship between variables is measured by research instruments that produce numerical data so that it can be analyzed using statistical analysis [38].

The research sample was 60 vocational high school students in the Department of Building Modeling and Information Design in the Surakarta area. The sampling technique used purposive sampling technique, this technique was taken based on the researchers' considerations to adjust the characteristics of the study population. Purposive sampling is considered the most effective technique for determining samples that are of

interest or by the criteria of researchers so in this research, a total of 60 students were taken to become research subjects who had criteria for certain majors as mentioned earlier [39].

The literature study in the preparation of this paper was carried out to support the theory and reference in determining the right analysis steps. All literature related to critical thinking skills, hybrid learning systems, and vocational students was searched from the databases: ProQuest, ScienceDirect, and Routledge Taylor and Francis. Critical thinking test instrument. Students' critical thinking skills were analyzed from the test results of critical thinking essay questions with the type of Illinois critical thinking essay test [40] for the subject of road and bridge construction. Includes a scoring rubric adopted from the Illinois critical thinking essay test scoring guidelines developed by [23], [36], [41]. This research instrument adopts from it, which has undergone adjustments to the needs of this research. The score for each answer is 6 levels. Where levels 1-3 show poor critical thinking components and levels 4-6 show good critical thinking skills. Take a look at Table 1, which presents several indicators of critical thinking abilities investigated in this research.

Table 1. Indicators of critical thinking ability

No.	Aspects	Critical Thinking Indicators
1	Focus (ability to express opinions)	The process of identifying and formulating answers appropriately Addressing discrepancies between statements and facts
2	Supporting reasons (basis for making a decision)	Able to show evidence for his answer Can answer according to prior knowledge Provide decisions and answers according to the situation and conditions
3	Reasoning (ability to present evidence, arguments, and alternative solutions)	Formulate conclusions based on facts and accompanied by corroborating evidence Can critically accept opinions and reject opinions from other people's conclusions.
4	Organization (ability to construct sentences and answers)	Able to define terms and consider definitions correctly
5	Conventions (language useability)	Persuasively determine rhetorical strategies. It is also useful for us to be aware of the rhetorical strategies of others so that we are not easily fooled.
6	Integration (ability to answer correctly according to the question)	Understand the content and check the quality of their thinking

The analysis of the data gathered from participants will be utilized to derive conclusions. These conclusions are, naturally, established on various criteria employed to interpret the significance of critical thinking abilities. Consequently, the interpretation of the data acquired from participants will genuinely be founded and can be justified. The criteria for interpreting the value of critical thinking skills can be seen in Table 2.

Table 2. Data analysis [41], [42]

Value range	Criteria
41-50	Very high
31-40	High
21-30	Medium
11-20	Low
0-10	Very low

3. RESULTS AND DISCUSSION

3.1. Results

The 10-item Illinois critical thinking essay test encompasses the various elements of critical thinking ability. These components were thoroughly examined in terms of their reliability, validity, difficulty level, and differentiability. According to Cronbach's Alpha formula, the item analysis results in a reliability value of $\alpha = 0.90$, signifying a substantial level of consistency. Furthermore, each item exhibits a validity value of rxy>0.6, affirming their capability to precisely assess the intended construct. Consequently, the instruments employed in this research can undoubtedly be considered valid. The detailed calculation results are presented in Table 3. According to the computation outcomes presented in Table 3, the question's reliability is determined to be 0.90. With a reliability value of $\alpha = 0.90$, it can be inferred that the question falls within the high-reliability category. It is crucial to interpret the obtained reliability score to draw conclusions and

proceed with the subsequent steps [38]. It is crucial to emphasize the significance of the reliability value, as items with high reliability indicate that the question can effectively serve as a measuring tool for the intended target. The high-reliability value plays a vital role in upholding the instrument's validity as a measuring tool [43]. The results of the measurement of the validity of the questions are shown in Table 4. Furthermore, the results of the calculation of the level of difficulty and differentiation of questions are presented in the following Table 5. It is important to note that the testing of differential power and level of measurement is a common practice to ensure the validity of instrument items.

Table 3. Calculation of question item reliability

Calculations	Question number									
	1	2	3	4	5	6	7	8	8	10
Total score of all students	191	246	240	228	234	214	201	227	197	229
Total score of the upper group	32	44	48	36	41	38	40	39	37	40
Lower group total score	22	44	35	26	37	27	26	27	29	25
Average score of all students	1.3	1.2	1.1	1	1.4	1.2	1.1	1.1	1	1
Average upper group score (X)	2.46	3.38	3.69	2.77	3.15	2.92	3.08	3.00	2.85	3.08
Average lower group score (Y)	0.88	1.76	1.40	1.04	1.48	1.08	1.04	1.08	1.16	1.00
X-Y	1.58	1.62	2.29	1.73	1.67	1.84	2.04	1.92	1.69	2.08
Max score of each question item	5	5	5	5	5	5	5	5	5	5
Variance (Si2)	1.12	0.72	0.88	0.87	0.91	0.98	0.89	0.96	1.20	0.99
Total variance (St2)	49.69									
Number of questions	10									
Level of difficulty (P)	0.26	0.24	0.22	0.20	0.28	0.24	0.22	0.22	0.20	0.20
Distinguishing power (D)	0.32	0.32	0.46	0.35	0.33	0.37	0.41	0.38	0.34	0.42
Reliability	0.90									

Table 4. Question item validity measurement results

Aspect	Question number	r_{count}	r_{table}	Description
Focus	4	0.68	≥0.40	Valid
	2	0.75	≥0.40	Valid
Supporting reasons	1	0.73	≥0.40	Valid
	3	0.77	≥0.40	Valid
	8	0.8	≥0.40	Valid
Reasoning	5	0.71	≥0.40	Valid
	6	0.69	≥0.40	Valid
Organization	7	0.76	≥0.40	Valid

Table 5. Calculation of question difficulty and question difficulty level

Calculations	Question number									
	1	2	3	4	5	6	7	8	8	10
Total score of all students	191	246	240	228	234	214	201	227	197	229
Total score of the upper group	32	44	48	36	41	38	40	39	37	40
Lower group total score	22	44	35	26	37	27	26	27	29	25
Average score of all students	1.3	1.2	1.1	1	1.4	1.2	1.1	1.1	1	1
Average upper group score (X)	2.46	3.38	3.69	2.77	3.15	2.92	3.08	3.00	2.85	3.08
Average lower group score (Y)	0.88	1.76	1.40	1.04	1.48	1.08	1.04	1.08	1.16	1.00
X-Y	1.58	1.62	2.29	1.73	1.67	1.84	2.04	1.92	1.69	2.08
Max score of each question item	5	5	5	5	5	5	5	5	5	5
Variance (Si2)	1.12	0.72	0.88	0.87	0.91	0.98	0.89	0.96	1.20	0.99
Total variance (St2)	49.69									
Number of questions	10									
Level of difficulty (P)	0.26 difficult	0.24 difficult	0.22 difficult	0.20 difficult	0.28 difficult	0.24 difficult	0.22 difficult	0.22 difficult	0.20 difficult	0.20 difficult
Distinguishing power (D)	0.32 both	0.32 both	0.46 both	0.35 both	0.33 both	0.37 both	0.41 both	0.38 both	0.34 both	0.42 Both

According to the information presented in Table 5, it is evident that the description questions used to assess critical thinking possess a high level of difficulty. This is supported by the fact that the P value for each item is less than 0.30, indicating that these items fall within the difficult category. The difficulty level of these questions aligns with the objective of the study, which is to evaluate critical thinking abilities. Critical thinking skills are considered to be advanced skills [44]. On the other hand, questions that exhibit good differentiation, with a score of D<0.5, are capable of effectively distinguishing between students with low and high levels of critical thinking skills. These well-differentiated items can be utilized to identify students' critical thinking abilities. Questions that fulfill the necessary conditions for item analysis are employed to

assess the critical thinking skills of students, leading to the analysis of data that has been examined and presented in Table 6.

Table 6. Test results of students' critical thinking skills

Value		Focus		Supporting reasons		Reasoning		Organization		Conventions		Integration	
		f	p	f	p	f	p	f	p	f	p	f	p
41-50		4	7%	8	13%	6	10%	5	8%	3	5%	4	7%
31-40		7	12%	9	15%	11	18%	8	13%	13	22%	7	12%
21-30	N=60	10	17%	9	15%	10	17%	7	12%	8	13%	17	28%
11-20		31	52%	28	47%	21	35%	25	42%	25	42%	19	32%
0-10		8	13%	6	10%	12	20%	15	25%	11	18%	13	22%
Average		11.03		11.95		13.44		12.32		12.86		13.17	
Criteria		Low		Low		Low		Low		Low		Low	

Table 6 above illustrates that the majority of students' average acquisition of critical thinking skills falls within the low category. The collected and analyzed data, as depicted in Figure 1, illustrates that within the group of students who obtained scores between 11-20 (low), 31 individuals (52%) demonstrated a strong focus on the subject matter, while 28 individuals (47%) provided supporting reasons. Furthermore, 21 individuals (35%) displayed proficient reasoning skills, 25 individuals (42%) exhibited excellent organizational abilities, 25 individuals (42%) adhered to conventions, and 19 individuals (32%) showcased impressive integration skills. It is worth noting that within the range of 0-10 (very low), the aspect of the organization had the highest number of students scoring very low, specifically 15 individuals (25%) compared to other aspects. Additionally, among those who scored between 21-30 (moderate), the integration aspect had the highest number of individuals, with 17 students (28%) achieving this score. In contrast, the convention aspect had the highest number of students scoring high in critical thinking ability, with 13 individuals (22%). Lastly, within the score range of 41-50 (very high), the supporting reasons aspect had the highest number of students, with 8 individuals (13%).

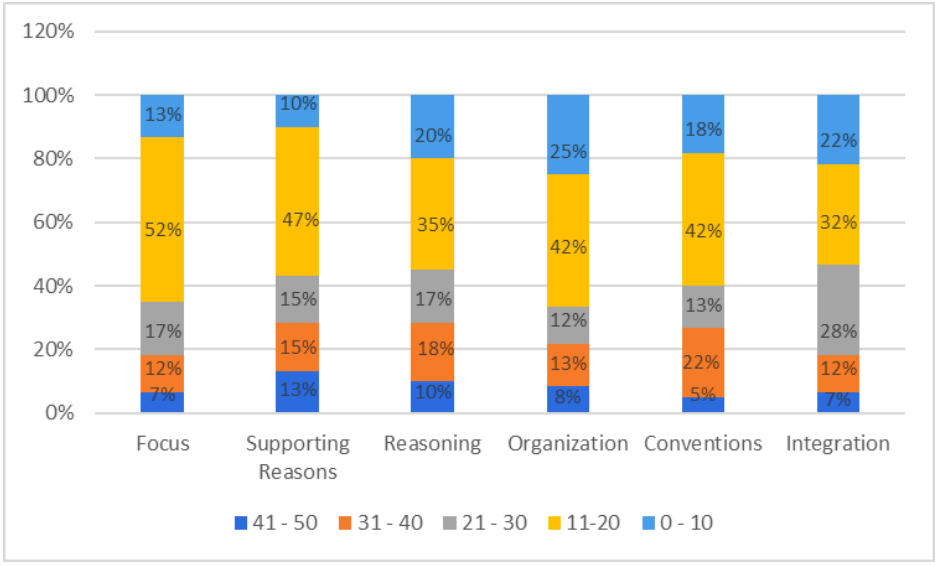

Figure 1. Diagram of critical thinking score results

3.2. Discussion

Almost all aspects of critical thinking that are reviewed focus, supporting reasons, reasoning, organization, conventions, and integration, most students only score in the range of 11-20. With an average score of m<14 in each aspect, the researcher found findings that can be presented. Critical thinking skills in engineering or vocational students according to research results [40], [45], Critical problem-solving skills are of utmost importance and a vital ability that individuals must possess. Vocational high school graduates, equipped with the necessary knowledge and skills, are well-prepared to enter the workforce. In the realm of

engineering, the ability to critically analyze and solve problems is particularly crucial [46], [47]. It can be argued that a relationship exists between the critical thinking capabilities of students and their proficiency in problem-solving. The strength of this correlation is heavily dependent on the degree to which students comprehend the information they are presented with. Therefore, the primary determinant is the level of understanding students possess regarding the information they acquire.

Other influences on the development of critical thinking skills can also be caused by the effects of technology, learning models, and experimental outcomes [48], [49]. Besides, the validity of the question is the accuracy of the question as a measurement tool [35]. The validity of each item is assessed through statistical testing using a correlation search, which examines the relationship between the item and the construct it is intended to measure [50]. Statistical analysis was conducted to assess the validity of the items using the r-product moment table with a significance level of α=5%. The findings from the validity calculation indicated that the observed correlation coefficient (r count) was greater than the critical value (r table). This outcome was observed for all questions ranging from number 1 to number 10. Consequently, it can be inferred that the questions employed for measurement purposes are highly suitable. Furthermore, the capacity of individuals to effectively seek out information and data is significantly influenced by their cognitive processing strategies [51]. The limited capability to offer critical responses and opinions can be attributed, in part, to the teaching strategies employed [20]. Hence, individuals must cultivate their cognitive abilities from a young age, enabling them to develop critical thinking skills.

We are aware that teaching strategy is a proven factor based on research findings [14], [52]. The ability to cultivate critical thinking skills in students, particularly in the context of hybrid learning models, necessitates the expertise of a skilled educator [53]. The application of the learning model in the Surakarta region is a recent development. By employing effective teaching techniques and strategies, students can be guided to utilize their critical thinking abilities to explore and acquire additional information using technology [18], [54]. The outcome of this is certainly inseparable from the characteristics of hybrid learning that make students the subject of learning so that in the process, they can freely explore the material through the utilization of the internet.

The deficiency in students' capacity to formulate coherent and cohesive ideas, responses, and viewpoints is indicative of a deficiency in critical thinking skills. A weak proficiency in organizing thoughts can lead to a decline in students' overall knowledge level. This underscores the significance of fostering critical thinking skills among students [55]. As previously stated, vocational students must possess the ability to effectively address a multitude of challenges to successfully navigate the realm of employment [56]. Hybrid learning models offer a valuable opportunity for teachers in the Surakarta region to foster an innovative learning environment. By incorporating technology into their teaching practices, educators can effectively cater to the diverse information requirements of their students [57], [58]. The distribution of knowledge information within educational institutions is characterized by an inherent unevenness. This unevenness is not only evident in the varying levels of access to information that students have but also in the broader implications it has on their overall knowledge acquisition. Furthermore, the distribution of knowledge information plays a crucial role in fostering the development of students' critical thinking skills [24], [59].

Therefore, by engaging in this hybrid approach to education, educators can alleviate concerns regarding students' skill acquisition. Hybrid learning serves as a groundbreaking educational approach in the context of the ongoing pandemic, blending information and communications technology (ICT) tools seamlessly into the learning process to enhance goal attainment [60]. Furthermore, the development of critical thinking skills is crucial for future academic success and should be thoroughly examined as a key variable in educational achievements. It is noteworthy that the adoption of hybrid learning in Indonesia is a direct response to the educational policies implemented during the COVID-19 crisis. Therefore, this research indirectly contributes to improving the quality of learning in various higher education contexts, particularly regarding technology and internet-assisted learning strategies. Additionally, this research will practically imply the emergence of continuous potential for implementing hybrid learning in universities, thus becoming one of the strategic options to ensure that learning can continue and acquire 21st-century skills.

4. CONCLUSION

Based on the discussion conducted, the research concludes that the implementation of hybrid learning leads to relatively low levels of critical thinking among students. This is evident in the low scores obtained in all aspects of critical thinking that were tested. Among the six aspects, the focus aspect had the highest number of students scoring low. The focus aspect serves as the foundation for other critical thinking skills. The findings of this study regarding the low levels of critical thinking among vocational high school students are crucial for educational institutions and teaching staff to take note of. This competency is essential for graduates to possess to thrive in the competitive industrial world. The research also identified

numerous factors that contribute to students' critical thinking skills. However, future studies can further explore the development of innovative media and learning strategies to enhance critical thinking abilities. It is recommended to conduct these studies with a larger and more representative sample size to accurately measure their impact.

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BIOGRAPHIES OF AUTHORS

Asrowi a professor in the Department of Science Education at the Faculty of Teacher Training and Education, Sebelas Maret University. His research interest includes inclusive education topic, special educational needs issues, and psychological practice. He can be contacted at email: asrowi@staff.uns.ac.id.

Iwan Maulana is an Assistant Lecturer in the Master of Department of Science Education, and a student of the Doctoral Program of Education, Faculty of Teacher Training and Education, Sebelas Maret University. His research focuses on educational technology, augmented reality, multimedia, learning management systems, instructional media, and design instructional. He can be contacted at email: Imaw1993@student.uns.ac.id.

Mochamad Kamil Budiarto is a Doctoral student in the Department of Science Education, Faculty of Teacher Training and Education, Sebelas Maret University, and a Tutor Tuton at Universitas Terbuka. He has many publications in scientific journals and his research focuses on the fields of educational technology, interactive learning media, e-learning, and entrepreneurial learning. He can be contacted at email: mkbudiarto@student.uns.ac.id.

Taufq Subhanul Qodr is an Assistant Lecturer in the Master Department of Science Education, Faculty of Teacher Training and Education, Sebelas Maret University. Now he is continuing his studies in the Doctoral Program majoring in Science Education at Sebelas Maret University. His research focuses on Educational Technology, Virtual Reality, Multimedia, and Learning Management Systems. He can be contacted at: taufiqsubhanul@student.uns.ac.id.