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Profile of Students Collaboration Skills, Critical Thinking, and Cognitive Learning Outcomes

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Abstract: Undergraduate graduates must achieve the Indonesian National Qualifications Framework level 6. The graduate profile can be accomplished by enhancing 21st-century competencies, namely collaboration, critical thinking, and cognitive learning outcomes. This study aimed to examine the profile of students' collaboration, critical thinking skills, and cognitive learning outcomes. This study included 73 students majoring in Biology from the Faculty of Mathematics and Natural Sciences at the State University of Malang. The study employed a quantitative descriptive. The method used was a survey. The instruments used were questionnaires for collaboration skills and tests for critical thinking and cognitive learning outcomes. Data analysis was accomplished by computing the average value of the indicators. The computation results were then applied to the criterion table and categorized accordingly. The results showed that students' collaboration skills were characterized as very good, with more than 75% of students scoring excellent or good on each criteria. Students' critical thinking skills remained moderate, with more than 75% of students scoring moderately on application, analysis, and evaluation markers. Students' cognitive learning outcomes were still classed as moderate, with the majority of students scoring moderately on all indicators. İt can be concluded that student collaboration skills are categorized as excellent, students' critical thinking skills are categorized as intermediate, and students' cognitive learning outcomes remain moderate.

Keywords: Collaboration; Critical Thinking; Cognitive Learning Outcomes.

Introduction

Undergraduate students, aligned to the Indonesian National Qualifications Framework (KKNI) level 6, have to demonstrate proficiency of theoretical ideas within their field, formulate procedural problem-solving strategies, make rational choices based on data analysis, and provide guidance in determining alternative solutions independently as well as collaboratively [1]. The profile can be accomplished through creative instructional strategies that strengthen learning quality and foster cognitive development in students [2]. In addition to teaching, the mastery of 21st-century skills is crucial for achieving the graduate profile. The 4Cs—communication, collaboration, creativity, and critical thinking—identified by the Partnership for 21st Century Skills, underscore the significance of these competencies, which are increasingly acknowledged as vital intellectual skills [3].

The idea of 21st-century skills is that schools should focus on teaching pupils the most applicable, practical, in-demand, and broadly useful abilities [4]. The 21st century skills as the essential necessities for the future viability of the organization. These skills include talents, learning attitudes, and competencies [5]. Those who have graduated from universities are expected to have the abilities since these competences are essential for successfully navigating and excelling in the complex and dynamic demands of the workforce in the 21st century [3].

Learning and working effectively in the digital age necessitates the ability to manage constantly expanding amounts of information, generate new knowledge, and collaborate with others. Collaboration is emphasized [6]. Having positive collaboration dispositions is considered vital for students to have greater creative self-efficacy [7], to more successfully acknowledge shared goals and shared benefits when working with others [8], to be more delighted with online courses [9], and to learn effectively in our global knowledge society [10]. The aspects are interconnected within the context of daily life [11]. Collaboration plays a significant role in enhancing students' mastery of knowledge and cognitive skills, including critical thinking and problem-solving [12]. Collaboration skills can enhance critical thinking abilities. Collaboration abilities allow students to study, synthesize, and evaluate ideas collectively [13]. Furthermore, collaboration can enhance learning performance [14].

Critical thinking is a type of thinking talent that is related to an individual's cognitive capacities. Critical thinking is defined as a complex combination of information, abilities, and predispositions that can be deliberately developed with appropriate stimuli [15]. Critical thinking capacity is a skill that every student must possess in order to keep up with advances and face future educational challenges; it is employed in decision making and issue solving in everyday life. A person with strong critical thinking abilities can think in various ways to develop new and better ideas, look at problems from multiple viewpoints, explore multiple techniques to investigation, and generate ideas with multiple considerations [16]. Collaborators in higher education institutions and corporate employers.

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Students with strong critical thinking can establish dedication and concern, which fosters active involvement; achieve lifetime learning and self-discipline; and change their actions to achieve long-term educational progress. Furthermore, critical thinking is a fundamental human talent for understanding and dealing with the world's various hazards and changes [17].

Cognitive learning outcomes are important in education because they are used to assess students' comprehension of the content under study. Furthermore, using the learning outcomes, teachers can measure the success of a learning activity (Miliinawati). Cognitive learning has been considered the most evident sign of educational quality, and it is usually tested through tests or continual evaluations [18][19]. Cognitive capacities play an important part in problem solving by processing the mental state associated with learning [20].

The capacity for critical analysis among students appears to be lacking, particularly in their evaluative skills [21]. The critical thinking abilities of students tend to be diminished in those exhibiting low levels of academic engagement [22]. The levels of critical thinking, creativity, and collaboration skills among students are notably deficient [23]. The deficiency in collaboration skills can be attributed to the constraints placed on students, which inhibit their ability to engage freely in cooperative endeavors aimed at achieving objectives. Students concentrate solely on the assigned tasks. The interplay of collaborative efforts and analytical reasoning significantly influences the educational achievements of students. The cognitive learning outcomes of students have not reached their full potential [24]. The skill profiles of students require enhancement and are categorized into low-level, immersive, trial-and-error, and organized types, all of which are affected by the self-efficacy of the students [25]. Several studies have investigated the profile of students' 21st-century skills. However, this study examined the profile of collaboration and critical thinking skills, as well as the implications for reaching cognitive learning objectives and KKNI level 6 in biology education.

Research Methods

This research is a quantitative descriptive study. The method utilized was a survey. This study included 73 students majoring in Biology from the Faculty of Mathematics and Natural Sciences at the State University of Malang. The sample was determined using a random sampling procedure. The instruments employed consisted of questionnaires assessing collaborative skills and assessments for critical thinking skills, as per [26]. Cognitive learning results of students were assessed by cognitive ability tests. The validity and reliability of all instruments was assessed using Pearson's product-moment correlation coefficient and Cronbach's Alpha. The results of the validity and reliability tests suggested that all of the test items demonstrated both validity and reliability. The collected data were further examined utilizing measures of collaborative skills, critical thinking, and cognitive learning outcomes. The findings of the data analysis were further delineated according to the criteria for cooperation skills, critical thinking, and cognitive learning outcomes as presented in Table 1.

Table 1. Students' collaboration, critical thinking, and cognitive learning outcomes criteria

Score	Category
$3.33 \leq x \leq 4$	Excellent
$2.66 \leq x < 3.33$	Good
$1.66 \leq x < 2.66$	Intermediate
$1 \leq x < 1.66$	Low

Source: Adaptation [27]

Results and Discussion

The 21st century skills especially creativity, critical thinking, communication, and critical thinking placed them as the top priority in educational and professional institution. Collaboration and critical thinking are crucial for students to achieve excellence academic performances. Mastery of 21st century skills and strong learning outcomes enable students to become world leaders because they are capable of solving challenges and have broad ideas.

Figure 1 demonstrates that many students have expert collaboration abilities, with more than 75% having expert levels for each indicator of working effectively, demonstrating respect, compromise, and accountability. Students' excellent collaboration abilities are a result of their exposure to working in groups through cooperative learning activities and biology practicum. According to the compromise indicator, 8.2% of students were at the basic level. These findings suggest that some students continue to make compromises just to expedite the completion of assignments, rather than to attain common goals. Furthermore, collaboration can enhance learning performance [14]. Negotiation is an essential component of collaboration, in which students must share their ideas with their partners, consider the opinions of others, and try to alter their own ideas and actions accordingly. groups. Cooperation focuses on students' overall attitudes toward collaboration and working in pairs or small groups, such as their perceptions of the effectiveness and/or preferences for the working mode [28]. Collaboration consists of cooperation between two or more persons, the nature of autonomous and voluntary cooperation, agreement on the mechanism of interaction, issue domain partition, collaborative decision-making, and the presence of a common purpose [29]. Consequently, unskilled group members demonstrated an inability to perform collaborative tasks effectively, including a lack of constructive and critical argumentation [30]. Compromise skills are crucial in these contexts, as students must navigate differing opinions, manage conflicts, and achieve constructive agreements in both real and virtual settings [31].

Figure 2 indicates that the majority of students exhibit critical thinking skills at an intermediate level. A significant number of students continue to struggle with the processes of analysis, synthesis, and application. The data indicates that over 50% of students are positioned at the intermediate and basic levels across each indicator. In the assessment criteria, a number of students fall within the high and medium ranges. The majority of students have successfully identified data to formulate conclusions that align with the established facts. This outcome is reflected in the percentage of students exceeding 50% on the metric for utilizing data to enhance critical thinking skills [32]. Students' inadequate application abilities are caused by a lack of mastery of

information for problem solving. Students typically use one or two sources to address difficulties. Poor synthesis skills are caused by students just considering one point of view while drawing conclusions. Both variables are associated with student self-efficacy, particularly in problem-solving. The study also revealed a significant correlation between self-efficacy and critical thinking; notably, as students' self-efficacy increased, so did their level of academic engagement [33].

Learning approaches such as cooperative learning and discussion methods also contribute to students' insufficient critical thinking development. This is because these learning models and approaches do not prepare students to use various resources to solve real-world problems. In cooperative learning, students tend to use just one or two sources. The learning models and methods employed significantly influence the critical thinking abilities of students with suboptimal skills in this area [34]. Their claim emphasizes the importance of educators being mindful of how to cultivate healthy thinking habits in their students [35].

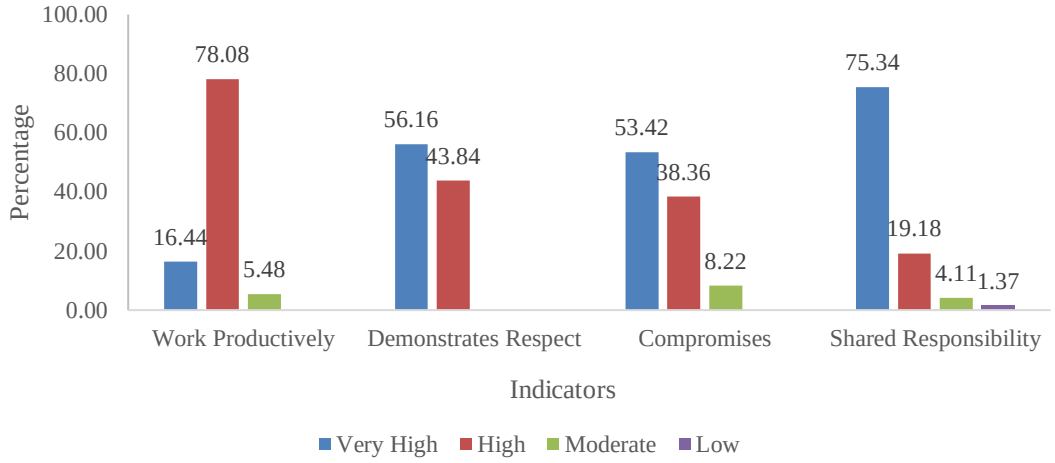

Figure 1. Students' Collaboration Skills Profile

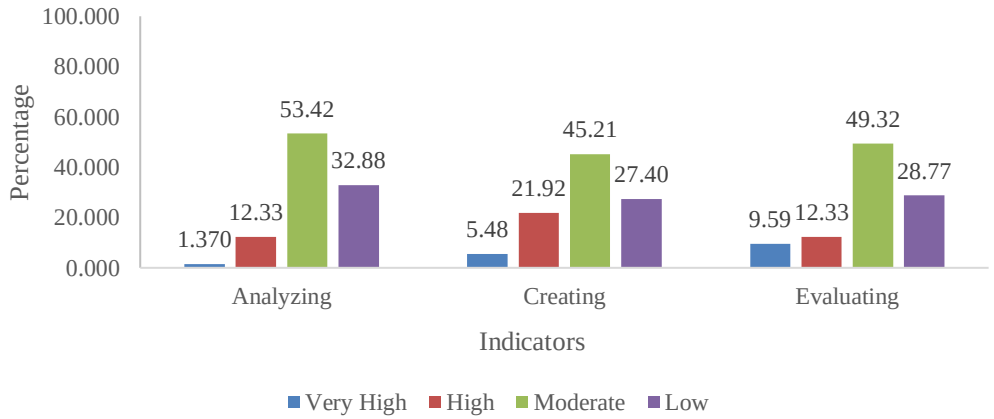

Figure 2. Students' Critical Thinking Skills Profile

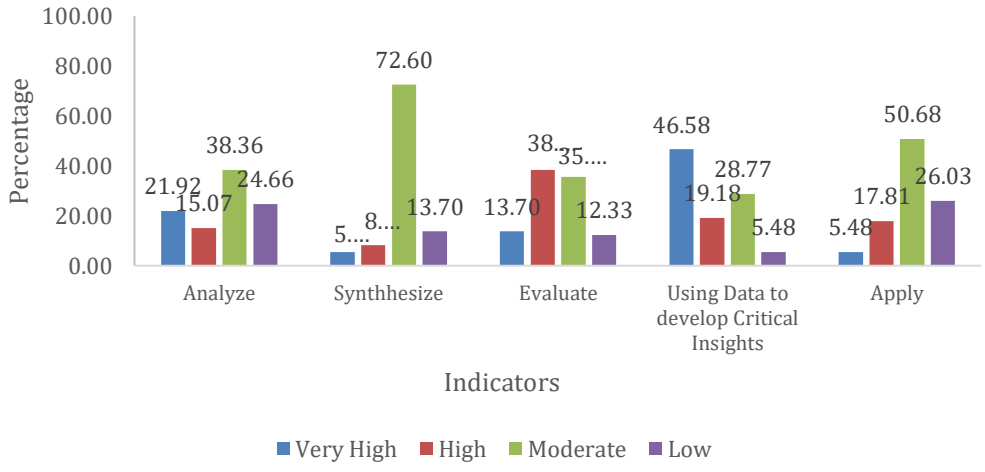

Figure 3. Students' Cognitive Learning Outcomes Profile

Figure 3 showed that the majority of students scored in the middle to low range for each indication. In the analyzing indication, 53.42% of pupils were at a medium level, with 32.88% at a poor level. 45.21% of students demonstrated a medium level, while 27.40% exhibited a low level regarding the indicator of creation. According to the evaluation indicator, 49.32% of students achieved a moderate level, while 28.77% attained a low level. The lack of analyzing and creating skills is due to trouble developing ideas when completing coursework assignments alone. The majority of students struggle to think creatively and generate ideas intuitively and spontaneously. Deadlock of ideas is the most significant issue contributing to the difficulty of creating ideas among technical students. The deadlock of ideas reflects a deficiency in critical thinking skills [36]. Based on observations and interviews conducted with educators, there are three key observations can be made: the learning process remains predominantly teacher-centered, students are unable to pose or respond to questions, and the learning model lacks diversity, indicating a need for an innovative approach which leads to poor performance in cognitive learning outcomes [37]. Academic performance is consistently linked to effective learning and study strategies influenced by cognitive processes [38].

Conclusion

The research findings indicate that the profile of student collaboration skills is categorized as excellent. The critical thinking skills of students are categorized as intermediate. Indicators of well-developed critical thinking skills in pupils include the utilization of data to formulate critical perspectives. The cognitive learning outcomes of students remain categorized as moderate. The findings indicated that strengthening critical thinking skills and cognitive learning outcomes through the development of models, methods, strategies, and educational media is essential for accomplishing the KKNI level 6.

Author's Contribution

Lianto, as the main author, was responsible for data collection. Sri Rahayu Lestari and Hendra Susanto were the instrument's validators and supervisors, and they significantly directed the research.

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References

[1] T. K. B. Dikti, "Capaian Pembelajaran Lulusan Program Studi," 2014.

[2] J. R. Honra and S. L. C. Monterola, "Fostering cognitive flexibility of students through design thinking in biology education," *Cogent Education*, vol. 11, no. 1, 2024, doi: 10.1080/2331186X.2024.2415301.

[3] H. Herlinawati, M. Marwa, N. Ismail, Junaidi, L. O. Liza, and D. D. B. Situmorang, "The integration of 21st century skills in the curriculum of education," *Heliyon*, vol. 10, no. 15, Aug. 2024, doi: 10.1016/j.heliyon.2024.e35148.

[4] J. U. Ama and U. G. Emetarom, "European Journal of Education Studies Equipping Higher Education Students with The 21 St Century Skills beyond Computer and Technological Skills for Future Effective Participation in The Global Economy," 2020, doi: 10.5281/zenodo.2588851.

[5] M. E. Bakay, "21st Century Skills for Higher Education Students in EU Countries: Perception of Academicians and HR Managers," *International Education Studies*, vol. 15, no. 2, p. 14, Feb. 2022, doi: 10.5539/ies.v15n2p14.

[6] P. Häkkinen, S. Järvelä, K. Mäkitalo-Siegl, A. Ahonen, P. Näykki, and T. Valtonen, "Preparing teacher-students for twenty-first-century learning practices (PREP 21): a framework for enhancing collaborative problem-solving and strategic learning skills," *Teachers and Teaching: Theory and Practice*, vol. 23, no. 1, pp. 25–41, Jan. 2017, doi: 10.1080/13540602.2016.1203772.

[7] Y. Kong and C. Wang, "The effects of self-efficacy on the use of self-regulated learning strategies and project-based writing performance," *International Journal of English for Academic Purposes: Research and Practice*, vol. 2022, no. Spring, pp. 21–39, Mar. 2022, doi: 10.3828/ijeap.2022.3.

[8] D. W. Johnson and R. T. Johnson, "An educational psychology success story: Social interdependence theory and cooperative learning," *Educational Researcher*, vol. 38, no. 5, pp. 365–379, Jun. 2009, doi: 10.3102/0013189X09339057.

[9] N. Wengrowicz, W. Swart, R. Paul, K. Macleod, D. Dori, and Y. J. Dori, "Students' Collaborative Learning Attitudes and Their Satisfaction with Online Collaborative Case-Based Courses," *American Journal of Distance Education*, vol. 32, no. 4, pp. 283–300, Oct. 2018, doi: 10.1080/08923647.2018.1511509.

[10] J. Voogt, O. Erstad, C. Dede, and P. Mishra, "Challenges to learning and schooling in the digital networked world of the 21st century," *J Comput Assist Learn*, vol. 29, no. 5, pp. 403–413, Oct. 2013, doi: 10.1111/jcal.12029.

[11] S. Li, J. Pöysä-Tarhonen, and P. Häkkinen, "Students' collaboration dispositions across diverse skills of collaborative problem solving in a computer-based assessment environment," *Computers in Human Behavior Reports*, vol. 11, Aug. 2023, doi: 10.1016/j.chbr.2023.100312.

[12] D. Kuhn, "Thinking Together and Alone," *Educational Researcher*, vol. 44, no. 1, pp. 46–53, 2015, doi: 10.3102/0013189X15569530.

[13] A. A. Gokhale, "Collaborative Learning Enhances Critical Thinking," *Journal of Technology Education*, vol. 7, no. 1, pp. 22–30, 1995, doi: 10.21061/jte.v7i1.a.2.

[14] L. Aldieri, M. Kotsemir, and C. P. Vinci, "The impact of research collaboration on academic performance: An empirical analysis for some European countries," *Socioecon Plann Sci*, vol. 62, pp. 13–30, Jun. 2018, doi: 10.1016/j.seps.2017.05.003.

[15] P. Ellerton, "On critical thinking and content knowledge: a critique of the assumptions of cognitive load theory 'Thinking is the method of intelligent learning,'" 2010.

[16] L. M. Murawski, "Critical Thinking in the classroom... and beyond," *Journal of Learning in Higher Education*, vol. 10, no. 1, pp. 25–30, 2014.

[17] B. Thornhill-Miller *et al.*, "Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education," Mar. 01, 2023, *MDPI*. doi: 10.3390/jintelligence11030054.

[18] K. Michaelowa, "Primary Education Quality in Francophone Sub-Saharan Africa: Determinants of Learning Achievement and E• ciency Considerations." [Online]. Available: www.elsevier.com/locate/worlddev

[19] Y. Shi, Y. Ma, J. MacLeod, and H. H. Yang, "College students' cognitive learning outcomes in flipped classroom instruction: a meta-analysis of the empirical literature," *Journal of Computers in Education*, vol. 7, no. 1, pp. 79–103, Mar. 2020, doi: 10.1007/s40692-019-00142-8.

[20] X. F. Lin, S. Y. Wong, W. Zhou, W. Shen, W. Li, and C. C. Tsai, "Undergraduate Students' Profiles of Cognitive Load in Augmented Reality–Assisted Science Learning and Their Relation to Science Learning Self-efficacy and Behavior Patterns," *Int J Sci Math Educ*, vol. 22, no. 2, pp. 419–445, Feb. 2024, doi: 10.1007/s10763-023-10376-9.

[21] M. A. F. I. Q. As-Syauqi, F. Rachmadiarti, R. Raharjo, and M. Budiyanto, "Profile of College Students' Critical Thinking Skills Assisted by Problem-Based Learning Models on Electromagnetic Material," *IJORER : International Journal of Recent Educational Research*, vol. 5, no. 1, pp. 168–181, Jan. 2024, doi: 10.46245/ijorer.v5i1.543.

[22] S. Lv, C. Chen, W. Zheng, and Y. Zhu, "The Relationship Between Study Engagement and Critical Thinking Among Higher Vocational College Students in China: A Longitudinal Study," *Psychol Res Behav Manag*, vol. 15, pp. 2989–3002, 2022, doi: 10.2147/PRBM.S386780.

[23] M. N. Aufa *et al.*, "Profile of students' critical thinking, creativity, and collaboration skills on environmental pollution material," in *Journal of Physics: Conference Series*, IOP Publishing Ltd, Jan. 2021. doi: 10.1088/1742-6596/1760/1/012027.

[24] D. Rulia Sitepu and K. Afni, "Designing general biology practicum e-modules using canva to enhance science process skills of pre-service teachers," *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi dan Biologi*, vol. 7, no. 2, 2024.

[25] X. F. Lin, S. Y. Wong, W. Zhou, W. Shen, W. Li, and C. C. Tsai, "Undergraduate Students' Profiles of Cognitive Load in Augmented Reality–Assisted Science Learning and Their Relation to Science Learning Self-efficacy and Behavior Patterns," *Int J Sci Math Educ*, vol. 22, no. 2, pp. 419–445, Feb. 2024, doi: 10.1007/s10763-023-10376-9.

[26] L. Greenstein, *Assessing 21st Century Skills: A Guide to Evaluating Mastery and Authentic Learning*. California: Corwin, 2012.

[27] Kementerian Pendidikan dan Kebudayaan. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 81A Tahun 2023 tentang Implementasi Kurikulum. 2013.

[28] S. Li, J. Pöysä-Tarhonen, and P. Häkkinen, "Students' collaboration dispositions across diverse skills of collaborative problem solving in a computer-based assessment environment," *Computers in Human Behavior Reports*, vol. 11, Aug. 2023, doi: 10.1016/j.chbr.2023.100312.

[29] C. Newell and A. Bain, "Academics' perceptions of collaboration in higher education course design," *Higher Education Research and Development*, vol. 39, no. 4, pp. 748–763, Jun. 2020, doi: 10.1080/07294360.2019.1690431.

[30] H. Le, J. Janssen, and T. Wubbels, "Collaborative learning practices: teacher and student perceived obstacles to effective student collaboration," *Cambridge Journal of Education*, vol. 48, no. 1, pp. 103–122, Jan. 2018, doi: 10.1080/0305764X.2016.1259389.

[31] J. Daryanto, M. Wiraman, T. Budiharto, and A. Yahya, "The profile of compromise skills in collaborative learning environments in elementary schools," vol. 11, no. 2, pp. 71–78, 2024, doi: 10.26555/jpsd.v11i2.a30299.

[32] S. S and K. Moghadam, "Relationship between Achievement Goals and Academic Self-Efficacy; Mediation Role of Academic Engagement," *Bimonthly of Education Strategies in Medical Sciences*, vol. 6, no. 8, pp. 13–0, 2016.

[33] T. L. Xu, J. N. Zhao, Y. Y. Zhang, and G. L. Jing, "Correlation among academic self-efficacy, professional identity, and professional attitude of higher vocational nursing students," *Frontiers of Nursing*, vol. 8, no. 1, pp. 43–47, Mar. 2021, doi: 10.2478/fon-2021-0005.

[34] A. Muhlisin, H. Susilo, M. Amin, and F. Rohman, "Improving critical thinking skills of college students through RMS model for learning basic concepts in science," 2016.

[35] B. Golden, "Enabling critical thinking development in higher education through the use of a structured planning tool," *Irish Educational Studies*, vol. 42, no. 4, pp. 949–969, 2023, doi: 10.1080/03323315.2023.2258497.

[36] M. H. Yee, J. Md. Yunos, W. Othman, R. Hassan, T. K. Tee, and M. M. Mohamad, "Disparity of Learning Styles and Higher Order Thinking Skills among Technical Students," *Procedia Soc Behav Sci*, vol. 204, pp. 143–152, Aug. 2015, doi: 10.1016/j.sbspro.2015.08.127.

[37] E. S. Kurniawan, Mundilarto, and E. Istiyono, "Improving student higher order thinking skills using Synectic-HOTS-oriented learning model," *International Journal of Evaluation and Research in Education* , vol. 13, no. 2, pp. 1132–1140, Apr. 2024, doi: 10.11591/ijere.v13i2.25002.

[38] M. A. Qureshi, A. Khaskheli, J. A. Qureshi, S. A. Raza, and S. Q. Yousufi, "Factors affecting students'

learning performance through collaborative learning and engagement," *Interactive Learning Environments*, vol. 31, no. 4, pp. 2371–2391, 2023, doi: 10.1080/10494820.2021.1884886.