

Shaping socio-critical thinking of junior students using problem-based learning and inquiry strategy

Muhamad Basyrul Muvid¹, Yudi Septiawan², Maulana Arafat Lubis³, Husniyatus Salamah Zainiyati⁴

¹Department of Information System, Faculty of Information System, Universitas Dinamika, Surabaya, Indonesia

²Department of Information System, Faculty of Information Technology, Institut Sains dan Bisnis Atma Luhur, Pangkal Pinang, Indonesia

³Department of Madrasah Ibtidaiyah Teacher Education, Faculty of Tarbiya and Teachers' Training, IAIN Padangsidempuan, Padang Sidempuan, Indonesia

⁴Department of Islamic Education, Faculty of Tarbiya and Teachers' Training, UIN Sunan Ampel, Surabaya, Indonesia

Article Info

Article history:

Received Jun 7, 2021

Revised Mar 4, 2022

Accepted Apr 1, 2022

Keywords:

Critical thinking

Inquiry strategy

Junior students

Problem-based learning

ABSTRACT

This research examined a pattern of integration between problem-based learning (PBL) strategy with inquiry in shaping the critical thinking framework and psychosocial of youth-level students. This study used a qualitative descriptive approach with a literature study method. The data sources were derived from documentation, books, and various related articles. Its analytical techniques used deductions, induction, interpretation, and comparison and analysis of multilayered texts. The results of this research showed that the PBL and inquiry strategies had substantial collation and synergy in the process of forming a framework of critical thinking and psychosocial of youth-level students. It was based on the process of implementing both strategies that emphasized the search for solutions to the problems encountered by conducting investigations, hypotheses, testing, data mining supported by teamwork, collaboration, communication, discussion, and coordination. Thus, the use of the PBL strategy and inquiry integratively is highly recommended in the learning process.

This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



Corresponding Author:

Muhamad Basyrul Muvid

Department of Information System, Faculty of Information System, Universitas Dinamika

Kedung Baruk, Rungkut District, Surabaya, East Java, 60298, Indonesia

Email: muvid@dinamika.ac.id

1. INTRODUCTION

The dynamic epoch that so fast demand human always to be creative and innovate as a step to keep exist amid the changes. The move is an effort to acclimate to the changes. Remember, people will be able to stage while able to accuse with the time; otherwise, they will miss even disappear swallowed time, while not able to adapt to the era. Create and innovate as a step to defend yourself and decorate yourself in order not to lag behind the progress of the times. Creating and innovating alone is not needed enough critical minds to map out the opportunities, opportunities, and needs.

This 21st-century requirement demands a quick response to the education world to prepare a generation that can compete globally and be ready to fight well. Therefore, it is necessary that the learning curriculum model in an educational institution that is engaged to create students who are productive, creative, innovative, critical, active, and reflective through the integration of attitudes, skills, and knowledge, and skills that will lead to changes in life and also their ability to adapt amid the dynamic era [1]–[3]. The teaching and learning process will be effective when the applied learning strategy can bring the desired change in the attitude of the students under the objectives previously formulated [4]. Meaningful learning

outcomes; Impressed for students will be prone to scarring in themselves both concerning the affective, cognitive, and psychomotor aspects [5], so that interesting learning will be able to provide a change in students. Also, students must be able to collaborate and communicate with, in addition to creative and critical thinking [6], coupled with the capabilities of meta-cognition, digital literacy, and technology, as well as problem-solving, are also the competencies that one needs to remain to exist in this modern century [7]. Among the learning strategies that can create exciting learning for students, can bring a change of thinking, and the formation of attitudes is the strategy of problem-based learning (PBL) and inquiry.

The second synergy of this strategy is expected to form a framework of critical thinking and psychosocial students, given that the teaching and learning process can not only use a single strategy. Therefore, the synergy between the learning-based problems of PBL and inquiry is needed as a step to bring change to the way students think and also the psychosocial formation of students. Problem-based learning as a skill in solving problems that have an essential role in helping someone innovates and thinks [8]. Problem-based learning is termed PBL based on cognitive psychology theory, especially on the theories of Piaget and Vygotsky (constructivism) [9]. The PBL is said to be a strategy of constructive learning because it uses problems as a learning process trigger [10]. Then, an inquiry learning strategy is a learning strategy that allows students to study concepts, develop skills in investigating, and gain an understanding of the concept of Science. [11] says that inquiry learning can explore and empower thinking skills. The inquiry strategy can foster a positive science stance [12] and trigger student cognition [13].

Critical thinking is the most valuable skill inherited by the educational institution to its students who are the goals and foundations of learning at all levels, as well as in all disciplines [14]. For that, critical thinking skills are indispensable to all educational graduates as an effort to solve all the challenges, problems, and necessities of life that are increasingly complex [15]. Meanwhile, psychosocial, according to Chaplin [16] in the psychology dictionary suggests that psychosocial is an offensive social relationship that includes psychological factors. Social psychology is a science that seeks to understand the origins and causes of individual behaviors and thoughts in the context of the social situation [17].

The PBL strategy and inquiry are problem-oriented; conflict. Resolving a person's problem requires cognitive intelligence, and self-reliance and confidence [18]–[20]. This cognitive intelligence will lead to the establishment of a framework of critical thinking and self-reliance as well as self-confidence will form the psychosocial students. In practice, the PBL and inquiry both have their own learning experience and knowledge to improve critical thinking, problem-solving, training communication skills (social interaction), and improving learning outcomes [10]. Thus, the forming a framework of critical thinking and psychosocial students can create.

Problem-based learning has a collection against the formation of critical thinking frameworks [21]. Critical thinking refers to the ability to analyze information, to determine the relevance of the information found and then interpret it in resolving the problem [22], so requires very high thought by involving the process of analysis, evaluation, fairness, and reflection [23]. Other studies have also mentioned that an inquiry strategy can establish students with critical and creative thinking that impacts student's cognitive learning outcomes [24], [25].

Research on the influence of the PBL and inquiry on the formation of critical thinking framework of students has been carried out. However, for psychosocial formation, it has not been revealed as well as the coloration and the integration of PBL with inquiry learning has also not been disclosed. Therefore, it is essential to conduct new research as an effort to uncover the confluence and integration between problem-based learning with inquisitions of learning in shaping the critical thinking frameworks and psychosis of students at youth levels. Then, the contribution value of this research is used as a basis for information and recommendation for the integrative implementation of PBL and inquiry strategies in the learning process.

2. RESEARCH METHOD

This was a library research study. It is study and education of books, literature, notes, and reports that have to do with the problem (the solved topic) [26]. The data source is derived from the documentation, references, and related articles. Data collection techniques derived from the literature are the collection of data sourced from documents or records in the form of books, journals, articles, images, or electronics available to obtain a variety of information relating to the research object [27]. Its analytical techniques use a deduction and induction approach [28], interpretation [29], comparison [30], and analysis of multilayered texts [31]. Thus, it can later describe and find and detail the problem-based learning collation and integration with inquiry learning and find the meeting point of similarities and differences between them in shaping the critical thinking and psychosocial framework of youth (adolescent-level students).

3. RESULTS AND DISCUSSION

3.1. Results of the literature review analysis

PBL is conducted to provide a positive response to the critical thinking, creative and social attitude of students through cooperation, brainstorm, discussion, and interactions among individuals with others. This is built in the process of implementing the PBL in teaching and learning activities. According to Rusman, the problem-based learning curriculum helps to improve the progression of lifelong learning skills in open, reflective, critical, and active learning patterns. The problem-based learning curriculum facilitates the success of solving problems, communication, group work, and interpersonal skills better than any other approach [32]. PBL is an effort to create meaningful learning, where students can solve the problems they face in their way according to their knowledge and experience, then apply them in the real world, then with problem-based learning can integrate knowledge and skills simultaneously and implement them in a relevant context and can improve the ability of critical thinking, foster student initiatives in working, internal motivation for learning, and can develop interpersonal relationships in the working group [33], so that the PBL not only emphasizes the cognitive aspect, also aspects of attitudes and skills [34].

PBL is one of the student-centered learning approaches by optimizing student roles to perform various studies, observations, trials, integrating theories and practices, and applying knowledge and skills to find and develop the right solution for defined problems; being faced [35]. The PBL is a very consistent learning strategy with the constructivist theory that directs students to be the ones who dare to take responsibility for learning and to complete problems [36]. Besides, the 21st century model PBL strategy was also implemented to require students to take a more active role in learning and demanded that they better appreciate the diversity of culture, religion, ethnic and taste [37]. PBL has a strong role in giving personal attention to students [38]. The PBL strategy is a pedagogical subject based on which students are told in an outline of the material given or problems presented which are often determined by the teacher. The students are instructed to find a solution to solve the problem [39]. They must identify what to know. They learned it and used new knowledge to solve the problem [40]. The PBL as a learning model varies with a student-centered general approach, small group, and collaboration-focused learning activities. With this, the PBL puts itself as an effective alternative to traditional learning models [41].

Also, the PBL effectively requires teachers to provide a high level of attention to students to recognize when and where they need the most, and guidance to find answers [31]. This means that the PBL in addition to opening communication between students, also with teachers. Through discussion, collaboration, and good coordination will form a high psychosocial in students. Collaboration in finding a way out of the problem will result in interpersonal skills that can create skills, political awareness, leadership skills, social sensitivity, fairness, and diversity attitudes [42].

The PBL strategy in shaping the critical thinking framework is seen from the students' efforts in finding solutions to the problems given (faced). It requires skill and intelligence to identify the problem to find a way out. Meanwhile, the strategy of PBL in forming psychosocial students lies in the concept of team collaboration, communication between individuals and between groups, discussion through a presentation, and coordination. Thus, the process of social interaction happens so that each student can appreciate the opinions of others, giving the opportunity of others to speak; help in finding solutions; answer and care about each other by giving feedback.

The relationship of PBL with the interpersonal attitude of students can be used as a reference. In addition to forming a framework of critical thinking, PBL is also able to form psychosocial [42]: i) Students can listen to the opinions of others; ii) Students can work or collaborate cooperatively with a group of people; iii) Students can think logically in resolving the problem; iv) Students can communicate well to others; v) Students successfully resolve problems or issues with other groups; vi) Students may associate with the crowd; vii) Students can find effective ways to resolve the problem; viii) Students can understand the position of others, by attempting to place themselves in the person's position; ix) Students find it easier to make friends; x) Students can solve problems with discussion methods (deliberation) [42]. Traditional learning with learning using the PBL system shows significant results i.e. learning with the PBL able to improve a more positive learning attitude and higher motivation for learning [43].

The orientation of the PBL implementation involves five phases [44]: i) Students orientation to authentic problems; ii) Organizing students; iii) Guiding the investigation to obtain solutions and answers; iv) Develop and present works; and v) Analyzing and evaluating the troubleshooting process. In line with that, the PBL delivers students to: i) Be more aware and aware of the subject matter; ii) To improve the focus and relevant knowledge; iii) Encourage always to think; iv) Build teamwork, leadership, social skills; v) Learning skills (lifelong learning skills); and vi) Motivating learners.

As such, the PBL as one of the learning strategies that can build two competencies in students is the competency of critical thinking and social competence, in addition to creative capability. That is, the PBL can integrate between aspects of knowledge, attitudes, and skills. Thus, PBL as a learning strategy can build

two competencies in students, namely critical thinking competence and social competence. It means that PBL can integrate aspects of knowledge, attitudes, and skills [45]. It starts from problem-solving activities on a communicative and collaborative problem so that a harmonious pattern of social interaction can be realized but has the power of critical reasoning [46]. Figure 1 shows the PBL strategy in shaping the critical thinking and psychosocial framework of youth level students.

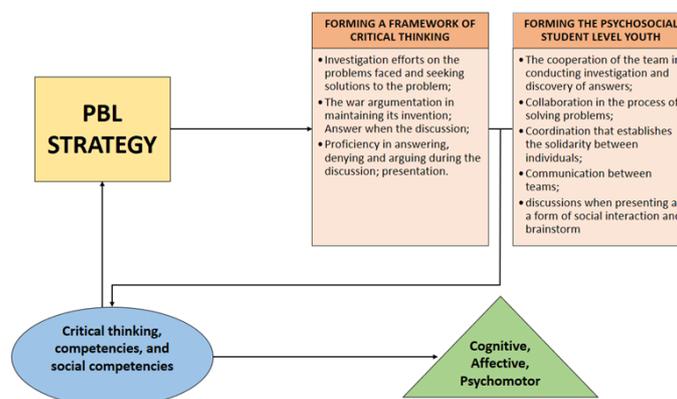


Figure 1. Strategy chart of problem-based learning

The inquiry strategy is one of the most effective learning strategies that are combined with a variety of learning activities that are based on critical and analytical thinking in finding and finding an answer to the problem [47]. Inquiry learning can effectively and significantly develop essential skills of thinking [48], [49], the inquiry strategy can also practice students' critical thinking skills [50], which will be in line with the formation of a student's creative thinking [51] that inquiry learning can improve creative thinking. The opinion of Al Jarf is strengthened by several researchers [52]–[54]. In this way, learning the inquirers can create more exciting and active learning that helps students to train and form a critical thinking style that later also forms a creative thinking framework.

This is in line with the research conducted by Panasan [55] which explains that inquiry-based learning promotes students both in terms of cognitive, analytical thinking, and the satisfaction of learning so that inquiry has relatively high sufficient criteria. Inquiry provides evidence as a teaching strategy that is openly capable of forming; improve the skills of critical thinking [56]. Through research and project-based efforts in the Inquisition's learning, students are indirectly educated in analytical, critical, and skilled thinking [55]. So that they can impact their learning outcomes [57]. This is because the teaching of uniqueness is supported on the knowledge of the learning process that is oriented to the activities and the process of thinking to generate new knowledge through the research stage to find evidence and to analyze the results of the investigation [58] so that the inquiry strategy puts students as the main actors (student-centered).

The critical thinking framework could be established in this strategy through its implementation steps. According to Sanjaya [59], there are six steps to establish critical thinking, such as orientation, formulating the problem, filing hypotheses, collecting data, testing the hypothesis, and formulating conclusions. Testing this hypothesis could also be by analyzing the results of the hypothesis [60]. These steps, in particular, the test step; analyzing hypotheses requires strong, capable and competent thinking supported by a broad source of knowledge. Hence, this step will form a framework of critical thinking which eventually manages to find an answer to the analysis of the results compiled; is formulated in conclusion as the last step of this inquiry strategy.

Besides, learning of inquisitions according to Piaget [61] and Hamruni [62] is influenced by four factors: i) Maturation related to physiological and anatomical growth (brain, body, and nerve growth); ii) The physical activity associated with physical actions, activity, the student thought; iii) Social experience relating to relationships; interactions with others through social involvement; iv) Equilibration related to adjustments between existing knowledge and newly discovered knowledge. Through social expertise, it is a psychosocial student formed, with communication, collaboration and interaction built will educate them on social issues, tolerant of dissent friends, and appreciate any what others convey. The process of investigation expressions and analysis of the students are not forgotten by teamwork, communication between the team, and the discussion with the team; other teams to exchange information, knowledge and also complement each other.

It shows that the implementation of the student inquiry strategy taught also build a community of practices that later resulted in a work (findings from the investigation efforts). In view, the inquiry strategy is racing against an authentic research-based activity, so that students can take action as scientists do, namely experiencing the process of knowing and justification [63].

Through the community of such practices, students at youth levels are trained to form solid cooperation, assist, support, and exchange information, so that the student will indirectly be sensitive to the surrounding social conditions. Through this community of practice, students at the youth level are trained to form solid cooperation, help each other, support, and exchange information [64]. So that students will indirectly be sensitive to the surrounding social conditions which are not only limited to critical and skillful. It is urgent to equip students to become intellectual and humanists [65]. Figure 2 shows the inquiry strategy chart in shaping the critical thinking and psychosocial framework of youth level students.

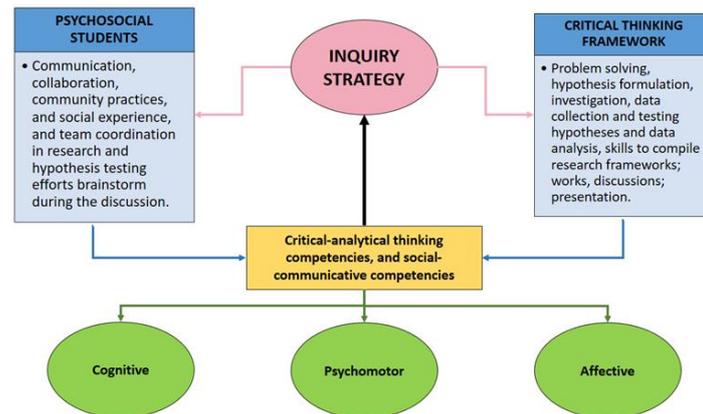


Figure 2. Inquiry strategy chart in the formation of critical thinking and psychosocial frameworks

3.2. Discussion

Based on the results between the PBL and inquiry strategies can be integrated into the teaching process to form the critical thinking and psychosocial framework of students at the youth level. In view, the orientation of both (PBL and inquiry) does not differ considerably; only the implementation is slightly different. PBL and inquiry as a strategy based on the investigation process, sharpen knowledge, problem-solving skills, and develop scientific and demanding participation, cooperation, and communication in the expression; Investigation of the problems faced [66], [67]. Its second orientation is what ultimately establishes the critical thinking and psychosocial framework of students [49], [68], [69].

Building a critical thinking style has become the focus and attention in the global era that demands the world market work need to answer increasingly complex social challenges [70]. Critical thinking skills become an essential need to develop student's skills and creativity. Critical thinking has a relationship with high-level thinking skills [71] such as the ability to analyze, synthesize, evaluate, and be developed to form creative thinking abilities [72].

The higher order thinking concept is the cornerstone of critical thinking students to explore and analyze the ideas, ideas, and information that students have solved. From the analysis, students can communicate the outcome of arguments in front of the class during the discussion; Presented so that the classroom learning became active [73]. PBL is not only a transfer of knowledge but also develops the student's potential consciously through more dynamic and applicative capabilities [32]. Critical and creative thinking can be developed with language skills. The activity of thinking is preceded by excitatory language (reading, listening, discussing) and the result of thinking is more meaningful if expressed through the language symbols both verbal and written [73].

According to Trianto [74], Vygotsky's theory of learning occurs when children work or learn to handle tasks that are not yet studied, but those tasks are still within reach of their abilities. Vygotsky believes that higher mental functions, in general, appear in conversations or interwork between individuals before the higher mental functions are absorbed into the individual. Vygotsky theory's relationship with the PBL is to train the ability of a student's thinking to have a responsibility in solving problems so educate them for self-reliant [35], [74]–[76]. Similarly, the inquiry also directs students to the independence of learning in search of solutions; solve the problem of his investigation efforts which in the end can increase the knowledge of empirical, skills and attitudes [77].

The ability to solve this problem and independence will process to the establishment of the social and mental attitude of students to always be sensitive to the issues related to others and surrounding so that the pattern of integration will both lead to students' independence in finding and overcoming problems faced with not forgetting the social element. Because, in finding solutions, the way out of the problem cannot be done individually, it is necessary to cooperate with the team, coordination, collaboration, and communication so that the social contact indirectly occurs. These social contacts will give birth to mutual respect, contributing and forming solidarity among others. According to Yamin [33], adolescent psychosocial indicators include: i) Easy to associate, interact; ii) Understand what the object is facing; iii) Easy dialogue, discussion, and brainstorm; iv) Able to adapt to social conditions; v) Sensitive to social issues; vi) Able to find solutions (solve the problems). Point number six is a uniting between psychosocial with a framework of critical thinking as a result of integration between the PBL and inquiry strategies.

Psychosocial factors in the growth of talented children, especially in the youth, are acknowledged to be profoundly repentant in the multifaceted theory [78], [79]. Considering cognitive ability alone is not enough to be able to lead talented children into a superior and committed personal height, need to be supported capabilities; social-emotional intelligence. Child sustainability is determined by the dynamic interaction between retail strength and a supportive environment, which can stimulate or inhibit the ability of children [80]. Students who are familiarized with social interaction will be confident, self-reliant, and brave. Self-efficacy is part of the cognitive-social theory that products that to succeed in performing duties and goals, one needs to believe in his success [81]. Self-efficacy allows one to control certain situations and provide positive results [82]. One of the benefits of this self-effectiveness is to self-study is that it affects the extent to which students can engage in some of the most challenging tasks (the breakdown of literature). Students with high self-efficacies will likely succeed in challenging situations compared to students who have a lack of self-efficacy [83].

Integration of PBL and inquiry strategy is one of the social-emotional developments of students, in addition to the competency of critical thinking. Social-emotional development gives individuals the skills to experience, cope with, and efficiently manage personal and social challenges. From here, psychosocial will be formed. When students can overcome challenges both personally and socially well, they will balance their psychosocial and emotional resilience [84]. The social interaction in implementing the PBL and inquiry strategies formed through communication, collaboration, and coordination.

The discussion will be able to equate the ego that Erikson [85] said the development of the ego is always changing based on the experience and new information that we get in interacting with others. These ego equations will affect the development of the student's personality, so being a student who quickly receives input, opinions of others, appreciates the difference. Erikson's psychosocial theory explains that social interactions will be able to affect a person's personality, as social pressures and environmental forces have a more significant impact, in addition to biological encouragement [85], [86]. For that reason, the implementation of the PBL and inquiry strategy integration in adolescent level students is very appropriate to form psychosocial, in addition to his thought skeleton. Considering that the adolescence of Erikson is a period of search for identity or identity crisis, there were four status identities in adolescents, namely identity diffusion or confusion, moratorium, foreclosure, and identity achieved [87], [88].

The integration of PBL and inquiry directs students to solve problems by utilizing their logic and reason against all sources of information found. In addition, the integration also brings together various views on the findings produced to formulate a solution that will later be presented [89]. The formed solution cannot exist if there is no good solidarity, collaboration, and coordination. Thus, cultures such as critical thinking and social spirit can be owned by each student at the adolescent level [90]. Figure 3 shows the integration of PBL and inquiry in shaping the critical thinking framework and psychosocial youth level students.

PBL and inquiry strategies have similarities. This equation can then be a meeting point between the two, while the difference will be a press point between the ends. Both the PBL and inquiry can be identified in the second orientation namely the provision of problems (problems, investigations, data searches, data analysis, reporting, and presentations) which are conducted in a group. So, there is a social interaction in the search for solutions to the problem that faced it.

PBL and inquiry both emphasize a critical, creative, and innovative thought process actually to answer all existing problems. Given today's education should be in the 21st-century education that is capable of equipping students with the competencies needed in the 21st century, known as "Four C", critical thinking and problem solving, communication and collaboration, and creativity and innovation [91]. Critical thinking will also gain skills, i.e. professional skills as they tackle complex problems [53], [92]–[94]. This professional skill ultimately establishes a social attitude, thus becoming a sensitive, responsive, and comparative student who can integrate with their mind maps in analyzing a problem (to describe an issue faced) [50], [95]. This is the meeting point between the PBL and inquiry strategies.

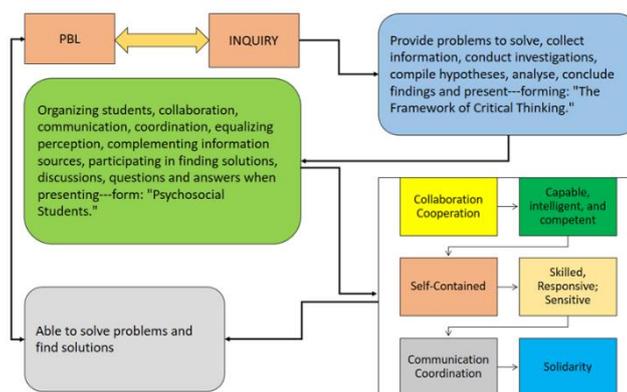


Figure 3. PBL and inquiry strategy integration chart

Meanwhile, the point of the press between the PBL and inquiry is in the systematics aspect of its implementation (mechanism). The PBL only demands that students identify and organize learning tasks with problems [96], [97]; the inquisition requires students to formulate short answers (hypotheses) [74] before conducting data retrieval (information). Then, the PBL emphasizes the evaluation stage after the analysis process before entering the conclusion, while the inquiry is only on the process of collecting and analyzing only. That is, that between the PBL and inquiry is no significant difference; only the process of implementation is different.

4. CONCLUSION

This study concluded that the PBL and inquiry strategies, as well as combinations have impacts on the framework of the development of critical thinking and psychosocial youth level students. PBL and inquiry are considered to be the effective and efficient in encouraging students to solve problems. The ability to solve problems with these diverse research and collaboration processes successfully make students think critically, creatively, innovative and sensitive to the social world. Therefore, the use of PBL and inquiry with integration patterns in the classroom is highly recommended.

It is essential to know that there may be unique circumstances in this study that cannot be easily applied to all learning materials. There may be variables that influence other knowledge hidden (gender, learning style, learning motivation, environment, and facilities) that make a difference in forming students' critical and psychosocial frameworks. These variables were not discussed in this study. It is also advisable for the next researcher to consider conducting a deeper investigation on the same topic as the form of field research.

REFERENCES

- [1] V. S. Andriani, "The Effectiveness of Inquiry Learning Method to Enhance Students' Learning Outcome: A Theoretical and Empirical Review," *Journal of Education and Practice*, vol. 7, no. 3, pp. 38–42, 2016.
- [2] A. Refaat Kabeel and S. Abd El-Mohsen Mosa Eisa, "The correlation of critical thinking disposition and approaches to learning among Baccalaureate nursing students," *Journal of Education and Practice*, vol. 7, no. 32, pp. 91–103, 2016.
- [3] F. Taghva, N. Rezaei, J. Ghaderi, and R. Taghva, "Studying the Relationship between Critical Thinking Skills and Students' Educational Achievement (Eghlid Universities as Case Study)," *International Letters of Social and Humanistic Sciences*, vol. 25, pp. 18–25, 2014, doi: 10.18052/www.scipress.com/ILSHS.25.18.
- [4] O. E. Oghenewede, "Effects of Discovery and Inquiry Approaches in Teaching and Learning of Biology on Secondary Schools Students' Performance in Delta State, Nigeria," *Journal of Research in Education and Society*, vol. 1, no. 1, pp. 30–39, 2010.
- [5] A. D. Corebima, "Biology learning which empowers students' thinking skills," *Paper Presented at Pelatihan Strategi Metakognitif pada Pembelajaran Biologi untuk Guru-guru Biologi SMA di Kota Palangkaraya*, 2006.
- [6] H. Boholano, "Smart social networking: 21st Century teaching and learning skills," *Research in Pedagogy*, vol. 7, no. 2, pp. 21–29, 2017, doi: 10.17810/2015.45.
- [7] S. Kim, M. Raza, and E. Seidman, "Improving 21st-century teaching skills: The key to effective 21st-century learners," *Research in Comparative and International Education*, vol. 14, no. 1, pp. 99–117, 2019, doi: 10.1177/1745499919829214.
- [8] N. Özüçberoğlu and Ç. K. Çağanağa, "Making it count: Strategies for improving problem-solving skills in mathematics for students and teachers' classroom management," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 14, no. 4, pp. 1253–1261, 2018, doi: 10.29333/ejmste/82536.
- [9] S. Hubackova, "Learning Innovations," *Procedia - Social and Behavioral Sciences*, vol. 15, no. 8, pp. 2232–2236, 2011, doi: 10.1016/j.sbspro.2011.04.085.

- [10] N. Kholis, "The Importance of Problem Based Learning in Islamic Higher Education," *Nadwa: Jurnal Pendidikan Islam*, vol. 12, no. 2, pp. 335–362, 2019, doi: 10.21580/nw.2018.12.2.2532.
- [11] D. Llewellyn, *Teaching high school science through inquiry and argumentation*. Corwin, Sage Company, 2009.
- [12] W. H. Obe, "Helping development of inquiry skills," in *The Teaching of Science in Primary Schools*. David Fulton Publishers, 2021, pp. 183–197.
- [13] J. Breivik, "Critical Thinking in Online Educational Discussions Measured as Progress through Inquiry Phases: A Discussion of the Cognitive Presence Construct in the Community of Inquiry Framework," *International Journal of e-Learning & Distance Education*, vol. 32, no. 1, pp. 1–16, 2016.
- [14] C. Thompson, "Critical Thinking across the Curriculum: Process over Output," *International Journal of Humanities and Social Science*, vol. 1, no. 9, p. p4, 2011.
- [15] S. Živković, "A Model of Critical Thinking as an Important Attribute for Success in the 21st Century," *Procedia - Social and Behavioral Sciences*, vol. 232, pp. 102–108, 2016, doi: 10.1016/j.sbspro.2016.10.034.
- [16] J. P. Chaplin, *Dictionary of psychology*. Random House Publishing Group, 2010.
- [17] D. Frings, *Social Psychology: The Basics*. Routledge, 2018, doi: 10.4324/9781315147888.
- [18] G. Ancel, "Problem-solving training: effects on the problem-solving skills and self-efficacy of nursing students," *Egitim Arastirmalari - Eurasian Journal of Educational Research*, vol. 16, no. 64, pp. 231–246, 2016, doi: 10.14689/ejer.2016.64.13.
- [19] G. Ançel, S. Erkal İlhan, and Z. Biyikli Gençtürk, "An Analysis of the Relationship Between Self-Efficacy Beliefs and Perceived Problem Solving Ability Among Nursing and Midwifery Students," *Turkiye Klinikleri Journal of Nursing*, vol. 7, no. 1, pp. 20–28, 2015, doi: 10.5336/nurses.2013-38266.
- [20] M. Bars and B. Oral, "The relation among metacognitive awareness, self-efficacy towards teaching profession and problem solving skills of teacher candidates," *Egitim Arastirmalari - Eurasian Journal of Educational Research*, vol. 17, no. 72, pp. 107–128, 2017, doi: 10.14689/ejer.2017.72.6.
- [21] S. A. Rodzalan and M. M. Saat, "The Perception of Critical Thinking and Problem Solving Skill among Malaysian Undergraduate Students," *Procedia - Social and Behavioral Sciences*, vol. 172, pp. 725–732, 2015, doi: 10.1016/j.sbspro.2015.01.425.
- [22] R. M. Gagné, "Some reflections on thinking skills," *Instructional Science*, vol. 17, no. 4, pp. 387–390, 1988, doi: 10.1007/BF00056223.
- [23] L. S. Jeevanantham, "Why teach critical thinking?" *Africa Education Review*, vol. 2, no. 1, pp. 118–129, 2005, doi: 10.1080/18146620508566295.
- [24] Y. Septiawan, "'Merdeka Belajar' as the embryo of educational development," in *Building world-class Indonesian education*, Goresan Pena (in Indonesian), 2020, pp. 21–34.
- [25] J. Siburian, A. D. Corebima, Ibrohim, and M. Saptasari, "The correlation between critical and creative thinking skills on cognitive learning results," *Eurasian Journal of Educational Research*, vol. 2019, no. 81, pp. 99–114, 2019, doi: 10.14689/ejer.2019.81.6.
- [26] S. Arikunto, *The research procedure: A practical approach*. Rineka Cipta (in Indonesian), 2002.
- [27] M. Nazir, *Research methodology*. Ghalia Indonesia (in Indonesian), 2005.
- [28] S. Hadi, *Research methodology (Vol. I)*. Andi Ofset (in Indonesian), 1984.
- [29] J. Murray, "Qualitative research methods," in *Principles of Social Psychiatry*. John Wiley & Sons, Ltd, 2010, doi: 10.1002/9780470684214.ch7.
- [30] M. Abdurrahman and S. A. Muhidin, *Practical guide to understanding research*. Pustaka Setia (in Indonesian), 2011.
- [31] L. Cohen, L. Manion, and K. Morrison, *Research Methods in Education*, 8th ed. Routledge, 2017, doi: 10.4324/9781315456539.
- [32] Rusman, *Learning models*. Raja Grafindo Persada (in Indonesian), 2013.
- [33] M. Yamin, *Strategies and methods in the learning model*. Grafindo Persada Press Group (in Indonesian), 2013.
- [34] E. F. Rusydiyah and S. Jazil, "Perceptions of faculty of education students in using problem based learning to increase human literacy," *Talent Development & Excellence*, vol. 12, no. 1, pp. 65–84, 2020.
- [35] J. R. Savery, "Overview of Problem-based Learning: Definitions and Distinctions," *Interdisciplinary Journal of Problem-Based Learning*, vol. 1, no. 1, 2006, doi: 10.7771/1541-5015.1002.
- [36] G. Coombs and M. Elden, "Introduction to the special issue: Problem-based learning as social inquiry—PBL and management education," *Journal of Management Education*, vol. 28, no. 5, pp. 523–535, 2004, doi: 10.1177/1052562904267540.
- [37] S. J. Altshuler and L. A. Bosch, "Problem-based learning in social work education," *Journal of Teaching in Social Work*, vol. 23, no. 1–2, pp. 201–215, 2003, doi: 10.1300/J067v23n01_13.
- [38] S. Suebnukam and P. Haddawy, "A Bayesian approach to generating tutorial hints in a collaborative medical problem-based learning system," *Artificial Intelligence in Medicine*, vol. 38, no. 1, pp. 5–24, 2006, doi: 10.1016/j.artmed.2005.04.003.
- [39] J. Ridderikhoff, "Medical problem-solving: an exploration of strategies," *Medical Education*, vol. 25, no. 3, pp. 196–207, 1991, doi: 10.1111/j.1365-2923.1991.tb00052.x.
- [40] H. Barrows, "Is it truly possible to have such a thing as dPBL?" *Distance Education*, vol. 23, no. 1, pp. 119–122, 2002, doi: 10.1080/01587910220124026.
- [41] V. L. Patel, D. R. Kaufman, and J. F. Arocha, "Conceptual change in the biomedical and health sciences domain," in *Advances in instructional psychology: Educational design and cognitive science*. Routledge, 2000, pp. 329–392.
- [42] K. Diaz, N. Ramia, D. Bramwell, and F. Costales, "Civic Attitudes and Skills Development Through Service-Learning in Ecuador," *Journal of Higher Education Outreach and Engagement*, vol. 23, no. 3, pp. 124–144, 2019.
- [43] A. H. Dehkordi and M. S. Heydarnejad, "The impact of problem-based learning and lecturing on the behavior and attitudes of Iranian nursing students. A randomized controlled trial," *Danish Medical Bulletin*, vol. 55, no. 4, pp. 224–226, 2008.
- [44] M. Maulidiya and E. Nurlaelah, "The effect of problem based learning on critical thinking ability in mathematics education," *Journal of Physics: Conference Series*, vol. 1157, no. 4, 2019, doi: 10.1088/1742-6596/1157/4/042063.
- [45] M. D. Saputra, S. Joyoatmojo, D. K. Wardani, and K. B. Sangka, "Developing critical-thinking skills through the collaboration of Jigsaw model with problem-based learning model," *International Journal of Instruction*, vol. 12, no. 1, pp. 1077–1094, 2019, doi: 10.29333/iji.2019.12169a.
- [46] M. Y. C. A. Kek and H. Huijser, "The power of problem-based learning in developing critical thinking skills: Preparing students for tomorrow's digital futures in today's classrooms," *Higher Education Research and Development*, vol. 30, no. 3, pp. 329–341, 2011, doi: 10.1080/07294360.2010.501074.
- [47] S. Gustinwati, *Learning Strategies*. PT Remaja Rosdakarya (in Indonesian), 2020.
- [48] S. Avsec and S. Kocijancic, "The effect of the use of an inquiry-based approach in an open learning middle school hydraulic turbine optimisation course," *World Transactions on Engineering and Technology Education*, vol. 12, no. 3, pp. 329–337, 2014.
- [49] M. Duran and I. Dökme, "The effect of the inquiry-based learning approach on student's critical-thinking skills," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 12, no. 12, pp. 2887–2908, 2016, doi: 10.12973/eurasia.2016.02311a.

- [50] S. Zubaidah, N. M. Fuad, S. Mahanal, and E. Suarsini, "Improving creative thinking skills of students through Differentiated Science Inquiry integrated with mind map," *Journal of Turkish Science Education*, vol. 14, no. 4, pp. 77–91, 2017, doi: 10.12973/tused.10214a.
- [51] R. Al-Jarf, "Enhancing Freshman Students' Writing Skills With a Mind-Mapping Software," *SSRN Electronic Journal*, no. 2002, 2021, doi: 10.2139/ssrn.3901075.
- [52] Ö. Keleş, "Elementary Teachers' Views on Mind Mapping," *International Journal of Education*, vol. 4, no. 1, 2012, doi: 10.5296/ije.v4i1.1327.
- [53] A. Michalopoulou, "Inquiry-Based Learning through the Creative Thinking and Expression in Early Years Education," *Creative Education*, vol. 05, no. 06, pp. 377–385, 2014, doi: 10.4236/ce.2014.56047.
- [54] D. Weinstein, "Teaching idea. Mind maps: A lesson in creativity," *The Utah Journal of Literacy*, vol. 17, no. 1, pp. 44–51, 2014.
- [55] M. Panasan and P. Nuangchalerm, "Learning Outcomes of Project-Based and Inquiry-Based Learning Activities," *Journal of Social Sciences*, vol. 6, no. 2, pp. 252–255, 2010, doi: 10.3844/jssp.2010.252.255.
- [56] C. Friedel, T. Irani, R. Rudd, M. Gallo, E. Eckhardt, and J. Ricketts, "Overtly Teaching Critical Thinking and Inquiry-Based Learning: A Comparison of Two Undergraduate Biotechnology Classes," *Journal of Agricultural Education*, vol. 49, no. 1, pp. 72–84, 2008, doi: 10.5032/jae.2008.01072.
- [57] A. Abdi, "The Effect of Inquiry-based Learning Method on Students' Academic Achievement in Science Course," *Universal Journal of Educational Research*, vol. 2, no. 1, pp. 37–41, 2014, doi: 10.13189/ujer.2014.020104.
- [58] C. von Secker, "Effects of inquiry-based teacher practices on science excellence and equity," *Journal of Educational Research*, vol. 95, no. 3, pp. 151–160, 2002, doi: 10.1080/00220670209596585.
- [59] W. Sanjaya, *Learning strategy oriented to educational process standards*. Kencana Prenada Media Grup (in Indonesian), 2008.
- [60] E. Mulyasa, *Becoming a professional teacher creates creative and fun learning*. Bandung: Remaja Rosdakarya (in Indonesian), 2011.
- [61] S. Falck, *The psychology of intelligence*. Routledge, 2020, doi: 10.4324/9781003042365.
- [62] Hamruni, *Active learning strategies and models are fun*. UIN Sunan Kalijaga Yogyakarta (in Indonesian), 2009.
- [63] W. A. Sandoval and B. J. Reiser, "Explanation-driven inquiry: Integrating conceptual and epistemic scaffolds for scientific inquiry," *Science Education*, vol. 88, no. 3, pp. 345–372, 2004, doi: 10.1002/sc.10130.
- [64] N. Davidson and C. H. Major, "Boundary crossings: Cooperative learning, collaborative learning, and problem-based learning," *Journal on Excellence in College Teaching*, vol. 25, no. 3–4, pp. 7–55, 2014.
- [65] E. Sulistiani, S. B. Waluya, and Masrukan, "The analysis of student's critical thinking ability on discovery learning by using hand on activity based on the curiosity," *Journal of Physics: Conference Series*, vol. 983, no. 1, 2018, doi: 10.1088/1742-6596/983/1/012134.
- [66] J. Markušić and J. Sabljčić, "Problem-Based Teaching of Literature," *Journal of Education and Training Studies*, vol. 7, no. 4, p. 20, 2019, doi: 10.11114/jets.v7i4.4066.
- [67] B. Akpan and T. J. Kennedy, *Science Education in Theory and Practice*. Springer Cham, 2020.
- [68] J. L. Branch and D. G. Solowan, "Inquiry-based learning: The key to student success," *School Libraries in Canada*, vol. 22, no. 4, pp. 6–12, 2003.
- [69] D. M. DiPasquale, C. L. Mason, and F. W. Kolkhorst, "Exercise in inquiry," *Journal of College Science Teaching*, vol. 32, no. 6, pp. 388–393, 2003.
- [70] G. Cruz, R. Payan-Carreira, and C. Dominguez, "Critical thinking education in the portuguese higher education institutions: a systematic review of educational practices," *Revista Lusofona de Educacao*, vol. 38, no. 38, pp. 43–61, 2017, doi: 10.24140/issn.1645-7250.rle38.03.
- [71] D. Page and A. Mukherjee, "Using Negotiation Exercises to Promote Critical Thinking Skills," *Developments in Business Simulation and Experiential Learning: Proceedings of the Annual ABSEL Conference*, 2006, vol. 33, pp. 71–78, [Online]. Available: <https://journals.tdl.org/absel/index.php/absel/article/view/500>.
- [72] Y. Hadzigeorgiou, P. Fokialis, and M. Kabouropoulou, "Thinking about Creativity in Science Education," *Creative Education*, vol. 03, no. 05, pp. 603–611, 2012, doi: 10.4236/ce.2012.35089.
- [73] A. Fisher, *Critical thinking: An introduction*. Cambridge University Press, 2009.
- [74] Trianto, *Integrated learning media: In practice theory*. Prestasi Pustaka (in Indonesian), 2014.
- [75] K. H. Tseng, F. K. Chiang, and W. H. Hsu, "Interactive processes and learning attitudes in a web-based problem-based learning (PBL) platform," *Computers in Human Behavior*, vol. 24, no. 3, pp. 940–955, 2008, doi: 10.1016/j.chb.2007.02.023.
- [76] B. Veli, "The effects of a problem based learning approach on students attitude levels: A meta-analysis," *Educational Research and Reviews*, vol. 9, no. 9, pp. 272–276, 2014, doi: 10.5897/err2014.1771.
- [77] R. Ergul, Y. Simsekli, S. Calis, Z. Ozdilek, S. Gocmencelebi, and M. Sanli, "The Effects of Inquiry-Based Science Teaching On Elementary School Students' Science Process Skills And Science Attitudes," *Bulgarian Journal of Science and Education Policy (BJSEP)*, vol. 5, no. 1, pp. 48–69, 2011.
- [78] J. S. Renzulli, "The three-ring conception of giftedness: A developmental model for promoting creative productivity," in *Conceptions of Giftedness: Second Edition*. Cambridge University Press, 2005, pp. 246–279, doi: 10.1017/CBO9780511610455.015.
- [79] R. J. Sternberg, "Successful intelligence: A model for testing intelligence beyond IQ tests," *European Journal of Education and Psychology*, vol. 8, no. 2, pp. 76–84, 2015, doi: 10.1016/j.ejeps.2015.09.004.
- [80] D. Papadopoulos, "Psychological framework for gifted children's cognitive and socio-emotional development: A review of the research literature and implications," *Journal for the Education of Gifted Young Scientists*, vol. 8, no. 1, pp. 305–323, 2020, doi: 10.17478/jegys.666308.
- [81] A. Bandura, "Guide to the construction of self-efficacy scales," in *Self-efficacy beliefs of adolescents*. Greenwich, CT: Information Age Publishing, 2006, pp. 307–337.
- [82] G. Geitz, D. J. Ten Brinke, and P. A. Kirschner, "Changing learning behaviour: Self-efficacy and goal orientation in PBL groups in higher education," *International Journal of Educational Research*, vol. 75, pp. 146–158, 2016, doi: 10.1016/j.ijer.2015.11.001.
- [83] M. K. Kurtuldu and D. Bulut, "Development of a self-efficacy scale toward piano lessons," *Kuram ve Uygulamada Egitim Bilimleri*, vol. 17, no. 3, pp. 835–857, 2017, doi: 10.12738/estp.2017.3.0209.
- [84] M. Neihart and L. S. Yeo, "Psychological issues unique to the gifted student," in *APA handbook of giftedness and talent*. American Psychological Association, 2017, pp. 497–510, doi: 10.1037/0000038-032.
- [85] E. H. Erikson, *Identity and life cycle*. W W Norton & Co., 1980.
- [86] N. J. Salkind, *An Introduction to Theories of Human Development*. SAGE Publications, Inc., 2004, doi: 10.4135/9781483328676.
- [87] D. E. Papalia and G. Martorell, *Experience Human Development*. McGraw-Hill, 2014.

- [88] J. Santrock, *Child development*, 11th ed. McGraw-Hill Humanities/Social Sciences/Languages, 2007.
- [89] D. Ebert, "Problem-Based Learning for Math and Science: Integrating Inquiry and the Internet," *Mathematics Teacher*, vol. 102, no. 2, p. 160, 2008.
- [90] P. Thaiposri and P. Wannapiroon, "Enhancing Students' Critical Thinking Skills through Teaching and Learning by Inquiry-based Learning Activities Using Social Network and Cloud Computing," *Procedia - Social and Behavioral Sciences*, vol. 174, pp. 2137–2144, 2015, doi: 10.1016/j.sbspro.2015.02.013.
- [91] R. Setianingsih, C. Sa'dijah, A. R. As'ari, and M. Muksar, "Investigating Fifth-Grade Students' Construction of Mathematical Knowledge through Classroom Discussion," *International Electronic Journal of Mathematics Education*, vol. 12, no. 3, pp. 383–396, 2021, doi: 10.29333/iejme/619.
- [92] R. Hasan, M. Lukitasari, S. Utami, and A. Anizar, "The activeness, critical, and creative thinking skills of students in the Lesson Study-based inquiry and cooperative learning," *Jurnal Pendidikan Biologi Indonesia*, vol. 5, no. 1, 2019, doi: 10.22219/jpbi.v5i1.7328.
- [93] A. J. Khoiriyah and H. Husamah, "Problem-based learning: Creative thinking skills, problem-solving skills, and learning outcome of seventh grade students," *Jurnal Pendidikan Biologi Indonesia*, vol. 4, no. 2, 2018, doi: 10.22219/jpbi.v4i2.5804.
- [94] B. B. Yazar Soyadi, "Creative and Critical Thinking Skills in Problem-based Learning Environments," *Journal of Gifted Education and Creativity*, vol. 2, no. 2, pp. 71–71, 2015, doi: 10.18200/jgedc.2015214253.
- [95] R. L. Dewi and T. Suyanto, "Application of problem based learning (PBL) as an effort to increase students' critical thinking skills," *Jurnal Mahasiswa Unesa*, vol. 3, no. 4, pp. 1372–1389, 2016, [Online]. Available: <http://ejournal.unp.ac.id/index.php/bahana/article/view/112168>.
- [96] M. Hosnan, *Scientific and Contextual Approach in 21st Century Learning*. Ghalia Indonesia, 2014.
- [97] D. C. Berliner and R. C. Calfee, "Mathematics teaching and learning strategies," in *Handbook of Educational Psychology*. Routledge, 2004, doi: 10.4324/9780203053874-24.

BIOGRAPHIES OF AUTHORS



Muhamad Basyrul Muvid    is a Doctoral Candidate of Islamic Education Program at the State Islamic University (UIN) Sunan Ampel Surabaya. Recently, he is a permanent lecturer at the University of Dynamics (UNDIKA), Surabaya, Indonesia. Muvid's research interests lie in the Islamic education and educational policy. He can be contacted at email: muvid@dinamika.ac.id.



Yudi Septiawan    is an English Lecturer at Stisipol Pahlawan 12 Sungai Liat, Bangka, Indonesia. He graduated his master in International Relations Major from University of Indonesia in 2015. However, he has been teaching English since 2017. He is passionate about raising the quality of teaching and learning of students and their development in the schools and in the higher education settings. Yudi's research interests lie in the English teaching, linguistics, educational policy, and international relations issues. He can be contacted at email: yudiseptiawan89@gmail.com.



Maulana Arafat Lubis    is a lecturer at the State Islamic Institute of Padangsidimpuan, North Sumatera, Indonesia. He completed his master from State University of Medan in 2016. His research interests lie in the primary education and educational policy. He can be contacted at email: maulanaarafat62@gmail.com.



Husniyatus Salamah Zainiyati    is Professor of Technology and Innovation in Islamic Education Learning, Sunan Ampel State Islamic University (UIN) Surabaya. Her research studies on the evaluation of learning, learning innovation, educational technology and learning media. She can be contacted at email: husniyatussalamah@uinsby.ac.id.