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# Improving Critical Thinking Skills of Physics Teacher Prospectives Through Case Based Learning Models

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**Abstract:** In the complex information era, critical thinking skills become very important for educators to be able to analyze and solve problems effectively. This research aims to improve the critical thinking skills of prospective physics teachers through the application of the Case Based Learning (CBL) model. The CBL model is implemented by exposing students to realistic and relevant case studies, which encourage them to carry out in-depth analysis of limited information. This research is Action Research. The research subjects consisted of 29 prospective physics teacher students who were taking professional education courses. The results of the research show that there has been an increase in students' critical thinking skills, with the average score in cycle 1 being 80.04 to 88.792 in cycle 2. This increase reflects students' ability to provide basic explanations, and further explanations, make conclusions, and plan appropriate actions. The more effective it is based on the problem analysis that has been carried out the better. These findings confirm that the CBL model is empirically proven to be used to improve students' critical thinking skills.

**Keywords:** Action Research, Case Based Learning, Critical thinking skills, prospective physics teachers.

## INTRODUCTION

Currently, the world is in the 21st century. One of the main competencies needed to live in the current era of information and digitalization is critical thinking skills. These skills not only help in understanding complex arguments and information but also encourage individuals to think independently about the information received. They learn to not only passively receive information, but also to question and evaluate that information, which in turn can increase their confidence in making decisions (Penkauskiene et al., 2019). In addition, critical thinking skills enable individuals to analyze information in depth, evaluate arguments, interpret information make better decisions, and solve problems more efficiently (Heard et al., 2020; Deardorff, 2020). Critical thinking skills are logical, rational, and reflective thinking skills that focus on confidence in the decision-making process that will be carried out (Paul & Elder, 2006; Ennis, 2011). Critical thinking focuses on the skill of conveying logical reasons to identify everything that is relevant to solving problems (Cottrell, 2005). Critical thinking is a mental activity carried out by a person to determine decisions in solving problems faced in various ways through information obtained from various sources (Ratnaningtyas, 2016; Fisher, 2019).

In the educational context, critical thinking skills are very important for a prospective teacher to have. A teacher who has critical thinking skills will be able to evaluate various learning models or strategies, identify and understand students' unique needs, and overcome challenges that arise in the classroom more effectively (Raj et al., 2022). In other words, a teacher who has critical thinking skills can develop more effective learning approaches, facilitate discussions that stimulate students' thinking, and overcome challenges that may arise in the classroom in innovative ways (Sharma et al., 2012). In addition, by thinking critically, teachers tend to be able to teach students to become independent thinkers, encouraging them to question, explore, and develop logical arguments, thereby creating a dynamic and deep learning environment (Arisoy & Aybek 2021).

Apart from playing a role as a supporter of the 4 (four) main competencies of an educator (pedagogical competence, professional competence, social competence, and personality competence), critical thinking skills are also

important to train considering that current developments in information and communication technology have changed the way people learn and access information. In this context, prospective teachers need to be trained to be able to assess the quality of the information they encounter in cyberspace. Critical thinking skills will help them not to easily get trapped in wrong information, especially when this information is conveyed to students (Mittal et al., 2018). Therefore, practicing these skills in the education of prospective teachers is not only important but also urgent (Gupta et al., 2020).

Seeing the importance of critical thinking skills, prospective teachers should be trained in critical thinking skills while studying at university. Critical thinking skills can be trained and improved through various innovative learning methods. Learning methods such as group discussions, case studies, and problem-based projects have been proven effective in training students' critical thinking skills (Maia et al., 2023). The case study method has great potential to improve students' critical thinking skills because this approach encourages them to analyze real situations, consider various points of view, and formulate solutions based on relevant data (Du et al., 2013; Gold et al., 2019). By being faced with real-world cases, students are not only required to understand theory but also apply it in a practical context. This activity can certainly hone students' abilities to think critically and analytically. Analysis and solving cases through group discussions can also stimulate critical dialogue, allowing students to question assumptions, evaluate arguments, and learn from the perspectives of their peers Bowe et al., 2009; Williams, 2005; Naik et al., 2013).

The case-based learning (CBL) model is a case-based learning model that uses real cases to help students understand concepts and apply knowledge in practical contexts (Diggele et al., 2020; Nordquist et al., 2012). In a learning context, CBL allows students to engage in small group discussions, where they can analyze cases, collaborate with their peers, and develop critical thinking skills as well as the ability to give and receive feedback Hempel et al., (2016); Jamkar et al., (2007). This method aims to promote learning that is deep and relevant to real-world situations, as well as increasing the transfer of declarative knowledge into procedural knowledge in practice. Apart from that, using the CBL model also encourages students to conduct research to look for additional, more in-depth information. Delving into the context and background of the case hones their ability to evaluate information sources and assess the reliability of the data. Especially in this era, the abundance of information makes the skill of filtering and using relevant information very valuable (Penkauskiene et al., 2019; Ng, 2019).

Overall, the CBL model has great potential to improve student's critical thinking skills and help them be ready to face challenges and make the right decisions in the future. To maximize the effectiveness of the CBL model, lecturers need to design cases that are realistic, challenging, and relevant. A good case should spark in-depth discussion and encourage students to consider various aspects of the problem. Lecturers must also be able to act as facilitators, assisting students in analysis and reflection and encouraging critical questions. In this research, researchers assigned students to identify cases or problems in the world of education and then asked students to provide relevant solutions related to their role as professional educators. This activity allows students to search for cases and information openly and in depth through various information sources available in the current digital era.

## METHODS

This type of research is Classroom Action Research. Action research is research that aims to solve problems and improve the quality of learning in the classroom. Action research is participatory, reflective, and carried out in cycles involving planning, implementing actions, observing and reflecting. Each cycle aims to evaluate the success of the actions taken and plan improvements for the next cycle. The following are the general stages of action research (Oranga et al., 2020).

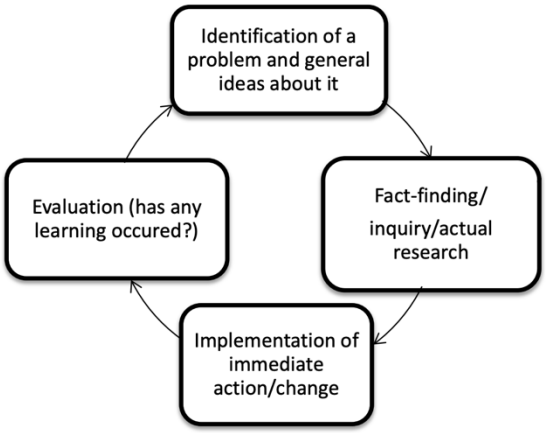


**Figure 1.** Action Research model Adapted from Lewin

Figure 1 above shows that the first stage of classroom action research is problem identification activities. At this stage, the researcher identifies and describes the problem to be solved. Once a problem is identified, the next step is the development of a research plan, which includes planning strategies to address the problem. Once the action plan is prepared, the next stage is action implementation, where the plan is implemented in practice. After implementation, researchers reflect to evaluate the effectiveness of the actions taken and consider new variables that may emerge. This process is cyclic so that after reflection, researchers can return to the planning, implementation, and evaluation stages. In this research, research was carried out in 2 (two) cycles. In each cycle, prospective physics teacher students are given treatment by applying the CBL learning model. The stages of the CBL learning model are shown in Figure 1 (Maia et al., 2023; Rhodes et al., 2020); Yalçınkaya et al., 2012). The research subjects were 29 prospective physics teacher students in the third semester who were taking professional education courses. Research data was analyzed using descriptive statistics

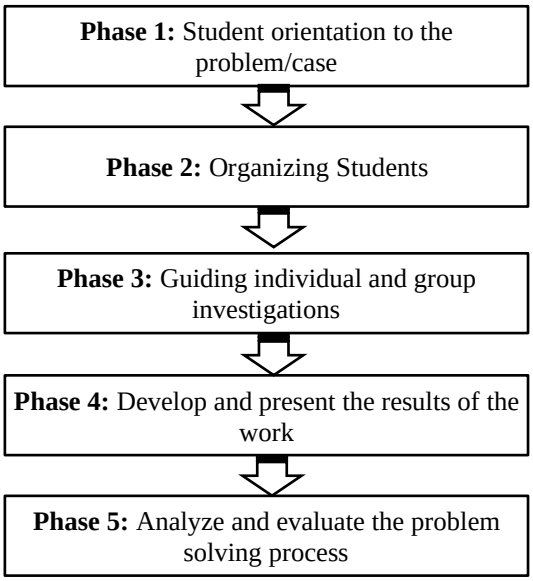


**Figure 2.** Stages of the Case Based Learning (CBL) Model

## FINDINGS AND DISCUSSION

The following are the results of data analysis of the critical thinking skills of prospective physics teacher students after being given treatment in the form of applying the CBL model in cycle 1 and cycle 2.

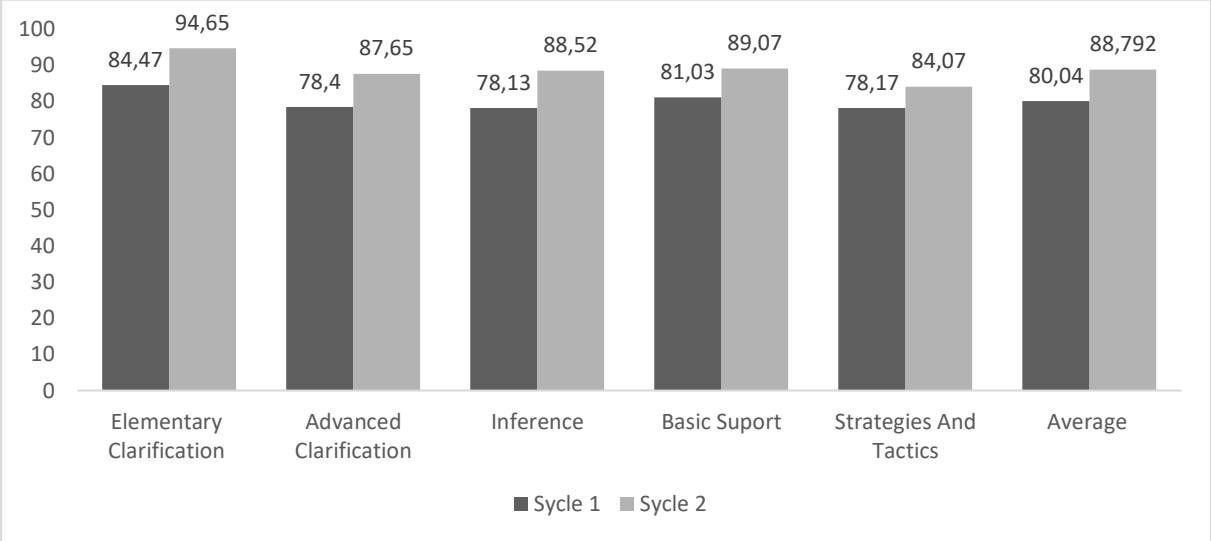


**Figure 3.** Data on students' critical thinking skills in cycle 1 and cycle 2

To understand the changes that occurred between the first cycle and the second cycle, we will look at the numbers presented in the table and analyze the improvement in each indicator of critical thinking skills. The student score for the critical thinking skills indicator for the aspect of the ability to provide basic explanations related to the tasks given (elementary clarification) in cycle 1 was 84.47 and cycle 2 was 94.65. This figure shows that students' ability to provide basic explanations regarding the assignments given received a very good score. For students' skills in providing further explanation (advanced clarification), cycle 1 received a score of 78.40 and cycle 2 of 87.65. There was an increase of 9.25 from cycle 1 to cycle 2. This increase reflected that participants were increasingly able to provide more in-depth and complex explanations after experiencing the first cycle. They may have gained more experience in crafting more detailed explanations and touching on broader aspects of the topics covered.

Students' ability to draw conclusions from the assignments given (inference) for cycle 1 received a score of 78.13 and for cycle 2 it was 88.52. The Inference indicator shows a fairly large increase, namely 10.39 points. This indicates that participants are increasingly skilled at drawing conclusions or making appropriate inferences based on the information provided. This skill is very important in critical thinking because it allows participants to construct strong and in-depth arguments based on existing data and evidence. In the Basic Support indicator, there was an increase of around 8.04 points. This increase indicates that participants are getting better at providing basic support for their arguments or claims. This reflects an increase in participants' ability to use relevant data, information, or examples to strengthen their arguments, which is an important element of critical thinking. The increase in the strategies and tactics indicator was the smallest compared to other indicators, with an increase of 5.90 points. Although this change is smaller, it still shows that participants are increasingly able to plan and implement strategies for solving problems. This increase may reflect a strengthened ability to think strategically and take more effective action after going through the first cycle.

Overall, the average critical thinking skills of participants increased by around 8.752 points, from 80.04 in the first cycle to 88.792 in the second cycle. This shows significant progress in the participants' critical thinking skills after following the second cycle. This average increase reflects an even improvement in all indicators of critical thinking skills. The results of the data analysis above show that students' critical thinking skills have improved on average. This increase shows that participants are increasingly able to understand, explain, and analyze problems critically, as well as plan more effective actions based on this analysis. CBL is case-based learning that allows students to directly analyze real situations or complex problems, break them down into simpler parts, and develop in-depth explanations based on existing evidence (Suartama et al., 2022; Asih et al., 2022 ). This

process encourages students to not only remember information but also develop the ability to provide appropriate clarification regarding basic concepts relevant to the case at hand. By focusing on case discussions that require in-depth understanding, students are trained to question assumptions and construct structured arguments.

Another indicator of critical thinking skills is the skill of providing further explanations. At this level, participants are expected to be able to provide more in-depth explanations, linking information to a wider or applicable context. This is a more complex stage than basic clarification, requiring deeper analysis and a more comprehensive understanding of the issue. The CPL model has been proven to be able to improve students' skills in providing further explanations (advanced clarification). In the CBL model, students are faced with real situations or cases that require them to analyze, evaluate, and prepare in-depth explanations (Hung et al, 2015; Yan et al, 2024). When students are asked to provide further explanations, they not only repeat the information they have learned, but also must dig deeper, connect relevant concepts, and consider various perspectives to provide a comprehensive explanation. This process encourages students to think critically, organize arguments logically, and explain their thinking in a clear and structured way. With the CBL model, students are trained to be able to formulate and defend more detailed explanations, which in turn can strengthen their critical thinking skills.

Another indicator of critical thinking skills is inference. Inference refers to the ability to draw conclusions or make guesses based on existing information (Inference). It involves using logic and evidence to support conclusions that can be drawn from given data or arguments. Based on the results of the data analysis, it can be seen that students' skills in drawing conclusions or making guesses based on existing information after being taught using the CBL model received a very good score. In CBL, students are faced with case studies that require analysis of limited or incomplete information (Suartama et al., 2022; Asih et al., 2022). This process requires students to draw logical and rational conclusions based on available evidence, even though the information may be ambiguous or complex. In making appropriate inferences, students must identify patterns, and cause-and-effect relationships, and consider various factors that can influence the situation in the case. Through group discussions and case-based problem-solving, students are trained to connect the data or facts provided with existing knowledge, as well as make predictions or assumptions that are supported by evidence. This trains students to think critically, question existing information, and draw deeper and more precise conclusions. Thus, CBL not only sharpens students' inference skills but also strengthens their ability to think critically in dealing with complex problems (Suartama et al., 2022; Asih et al., 2022).

Another indicator of critical thinking skills is inference. This indicator measures students' ability to provide basic reasons or supporting evidence that underlies the arguments or claims they make. To build a strong and convincing argument, students must be able to identify relevant evidence, whether in the form of data, facts, or theories, that supports the opinion or solution they are proposing. This process requires students to explore existing sources of information, evaluate the credibility and relevance of the evidence, and relate it to the context of the case being discussed. In group discussions, students are taught to convey the basic reasons underlying their opinions in a logical and structured manner, while considering various perspectives and existing evidence. This not only hones their ability to provide appropriate reasons but also trains them to be more critical in assessing and selecting the strongest and most relevant evidence. Thus, CBL encourages students to think more deeply and systematically in supporting their arguments, which in turn improves their critical thinking skills (Dickinson et al., 2018).

Another indicator of critical thinking skills is Strategies and Tactics. This indicator includes the ability to plan and implement effective strategies or tactics to solve problems or achieve certain goals. It tests participants' ability to think strategically in dealing with complex problems. To formulate an effective strategy, students must analyze the various factors involved in the case, consider alternative solutions, and predict the consequences of each existing option. They must also identify appropriate tactics to implement the strategy in an efficient manner. In this process, students are trained to think critically and creatively, break down problems into detailed steps, and choose the most appropriate approach based on existing resources and conditions. Group discussions and reflection on decisions

made also help students to evaluate their chosen tactics, increase their understanding of the effectiveness of strategies, and refine their approaches in the future (Dickinson et al., 2018). Thus, CBL provides opportunities for students to hone their skills in planning and implementing effective strategies while improving their abilities in critical and adaptive thinking.

## CONCLUSION

Based on the results of data analysis and discussions that have been carried out, the Case Based Learning (CBL) model has proven to be effective in improving the critical thinking skills of prospective physics teacher students. Through this learning model, students are exposed to case studies that require in-depth analysis of limited information, so that they are trained to draw logical and rational conclusions. The process of group discussion and case-based problem-solving allows students to connect data with existing knowledge, as well as develop the ability to provide strong arguments based on evidence. The research results showed a significant increase in students' critical thinking skills, which was reflected in the increase in the average score of critical thinking skills after following cycle 1 and cycle 2.

## REFERENCES

Arisoy, B., & Aybek, B. (2021). The effects of subject-based critical thinking education in mathematics on students' critical thinking skills and virtues. Eurasian Journal of Educational Research, 21(92). https://doi.org/10.14689/ejer.2021.92.6

Asih, F., E., Poedjiastoeti, S., Lutfi, A., Novita, D., Ismono, I., & Purnamasari, A.P., (2022). The Practicality and Effectiveness of Case Study-Based Module on Chemical Thermodynamics Course (Ideal and Real Gases) as Learning Tool During the Covid-19 Pandemic. *Journal of Technology and Science Education*, 12(2), 466-483. Doi: https://doi.org/10.3926/jotse.1654

Bowe, C.M., Voss, J., & Thomas Aretz, H. (2009) Case method teaching: An effective approach to integrate the basic and clinical sciences in the preclinical medical curriculum. Med. Teach. 31, 834–841. Doi: 10.1080/01421590902922904

Cottrell, S. (2005). *Critical Thinktng Skills*. Palgrave Macmillan.

Deardorff, D.K., (2020). *Manual for Developing Intercultural Competencies.* United Nations Educational, Scientific and Cultural Organization.

Dickinson, B.L., Lackey, W., Sheakley, M., Miller, L., Jevert, S., & Shattuck, B., (2018). Involving a real patient in the design and implementation of case-based learning to engage learners. *Advances Physiology Education*, 42, 118–122. Doi: doi:10.1152/advan.00174.2017.

Diggele, V.C., Burgess, A., & Mellis, C. (2020). *Planning, preparing and structuring a small group teaching session*. *BMC Medical Education*, 2, 20, 462. Doi: https://doi.org/10.1186/s12909-020-02281-4

Du, G.F., Li, C.Z., Shang, S.H.; Xu, X.Y., Chen, H.Z., & Zhou, G., (2013). Practising case-based learning in oral medicine for dental students in China. *European Journal Dental Education*, 17, 225–228. Doi: https://doi.org/10.1111/eje.12042

Ennis, R. H. (2011). The Nature of Critical Thinking: An Outline of Critical Thinking Disposition and Abilities. *University of Illinois.* [online] tersedia: http://faculty.education.illinois.edu/rhennis/documents/TheNatureofCriticalThinking_51711_000.pdf.

Ennis, R.H. (1985). A Logical Basic for Measuring Critical Thnking Skills. *Educational Leadership*, 43 (2): 44-48. Retrieved from: https://www.semanticscholar.org/paper/A-Logical-Basis-for-Measuring-Critical-Thinking-Ennis/80a7c7d4a98987590751df4b1bd9adf747fd7aaa

Fisher, A. (2009). *Berpikir Kritis sebuah Pengantar*. Jakarta: Erlangga

Gold, J.M., Collazo, R.A., Athauda, G., Obeso, V.T., & Toonkel, R.L. (2019). Taking CBL to the Lecture Hall: A Comparison of Outcomes Between Traditional Small Group CBL and a Novel Large Group Team-Based CBL Teaching Method. *Medical Science Educator*, 30, 227–233. Doi: 10.1007/s40670-019-00871-6

Gupta, M. M., Jankie, S., Pancholi, S. S., Talukdar, D., Sahu, P. K., & Sa, B. (2020). Asynchronous environment assessment: A

pertinent option for medical and allied health profession education during the covid-19 pandemic. *Education Sciences*, 10(12). https://doi.org/10.3390/educsci10120352.

Heard, J., Scoular, C., Duckworth, D.m Ramalingam, D., & Teo, L., (2020). *Critical Thinking: Skill Development Framework.* Australian Council for Educational Research.

Hempel, D., Sinnathurai, S., Haunhorst, S., Seibel, A., Michels, G., Heringer, F., Recker, F., & Breitkreutz, R. (2016). Influence of case-based e-learning on students' performance in point-of-care ultrasound courses: A randomized trial. *European Journal of Emergency Medicine* 23(4), 298–304. 10.1097/MEJ.0000000000000270

Hung, J.C., Shih, T.K., & Jin, Q., (2015). Special Issue on "Massive Open Online Courses (MOOCs)". *International Journal of Distance Education Technologies,* 13 (3).

Jamkar, A.V., Burdick, W., Morahan, P., Yemul, V.Y., Sarmukadum, & Singh, G. (2007). Proposed model of case based learning for training undergraduate medical student in surgery. *Indian J. Surg.* 69, 176–183. Doi: 10.1007/s12262-007-0016-2

Maia D., Andrade R., Afonso J., Costa P., Valente C., & Mendes. J.E., (2013). Academic Performance and Perceptions of Undergraduate Medical Students in Case-Based Learning Compared to Other Teaching Strategies: A Systematic Review with Meta-Analysis. *Education Science*, 13 (238), 1-25. https://doi.org/10.3390/educsci13030238

Maia, D., Andrade, R., Afonso, J., Costa, P., Valente, C., & Mendes, J.E. (2023). Academic Performance and Perceptions of Undergraduate Medical Students in Case-Based Learning Compared to Other Teaching Strategies: A Systematic Review with Meta-Analysis. *Education Science*, 13, (238), 1-25. Doi: **https://doi.org/10.3390/educsci13030238**

Mittal, R. K., Garg, N., & Yadav, S. K. (2018). 'Quality assessment framework for educational institutions in technical education: a literature survey,' on the Horizon. On the Horizon, 26(3), 270-280. https://doi.org/10.1108/OTH-08-2017-0066

Naik, A. & Sangle, D. (2013). Comparative Study of Case Based Learning (CBL) with Didactic Lectures as a Teaching–Learning (TL) Method for Improvement of Ethical Skills of M. Sc. Pharmaceutical Medicine Students. *Research Journal of Pharmacy and Technology (RJPT),* 6(8), 912–915. Doi: 10.5958/0974-360X

Nordquist, J., Sundberg, K., Johansson, L., Sandelin, K., & Nordenström, J., (2012). Case-based learning in surgery: Lessons learned. *World Journal of Surgary*. 36 (5), 945–955. Doi: 10.1007/s00268-011-1396-9

Oranga, J., Obuba, E. & Nyakundi, E. (2020). Education as an Instrument of Poverty Eradication in Kenya: Successes and Challenges. *Open Journal of Social Sciences*, 8, 410-424. Doi: 10.4236/jss.2020.89031

Paul, R & Elder, L. (2006). *International Critical Thinktng Test*. Foundation for Critical Thinking.

Penkauskiene, D., Railiene, A., & Goncalo, C. (2019). *How is critical thinking valued by the labour market? Employer perspectives from different European countries*. *Studies in Higher Education*, 44 (5), 804–815. Doi: https://doi.org/10.1080/03075079.2019.1586323

Raj, T., Chauhan, P., Mehrotra, R., & Sharma, M., (2022). Importance of Critical Thinking in the Education. *World Journal of English Language*, 12 (3), 126-133. Doi: https://doi.org/10.5430/wjel.v12n3p126

Ratnaningtyas, Y. (2016). Kemampuan Berpikir Kritis Siswa SMP Kelas VIII dalam Menyelesaikan Soal Higher Order Thinking Ditinjau dari Kemampuan Matematika. *Jurnal Ilmiah Pendidikan Matematika*, 1 (5), 86-94. Doi: https://doi.org/10.26740/mathedunesa.v5n1.p%25p

Rhodes, A., Wilson, A., & Rozell, T., (2020). Value of Case-Based Learning within STEM Courses: Is It the Method or Is It the Student?. *Cross-Disciplinary Research In Biology Education Article*, 19:ar44, 1–11. Retrieved from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8711838/pdf/cbe-19-ar44.pdf

Sharma, S., Vijayaraghavan, V., Tandon, P., Kumar, D. R. V., Sharma, H., & Rao, Y.

(2012). Dental education: Current scenario and future trends. Journal of Contemporary Dental Practice, 13(1), 107-110. Doi: https://doi.org/10.5005/jp-journals-10024-1103

Suartama, I.K., Triwahyuni, E., & Suranata, K., (2022). Context-Aware Ubiquitous Learning Based on Cas e Methods and Team-Based Projects: Design and Validation. *Education Science*, 12 (802), 1-18, Doi: https://doi.org/10.3390/educsci12110802

Williams, B. (2005). Case based learning—A review of the literature: Is there scope for this educational paradigm in prehospital education? *Emerg. Med. J.*, 22, 577–581. Doi: 10.1136/emj.2004.022707

Yalçınkaya, E., Boz, Y., & Baker, Ö, E., (2012). Is case-based instruction effective in enhancing high school students' motivation toward chemistry?. *Science Education International*, 23 (2), 102-116. Retrieved from: https://eric.ed.gov/?id=EJ975553

Yan, Y., Zhang, Y., Jia, S., Huang, Y., Liu, X., Liu, Y., Zhu, H., & Wen, H., (2024). Using case-based learning supported by role-playing situational teaching method in endocrine physiology education. *Advances Physiology Education*, 48: 498–504. Doi: https://doi.org/10.1152/advan.00232.2023