

Systematic Review on Modern Learning Approaches, Critical Thinking Skills and Students Learning Outcomes

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Abstrak

Popularitas internet untuk menggunakan pendekatan pembelajaran modern dan digital menggantikan metode pengajaran lama dan konvensional. Dengan menerapkan TIK, lingkungan belajar yang ideal dapat diciptakan antara siswa dan guru. Tujuan utama dari artikel ulasan ini adalah untuk meninjau berbagai pendekatan dinamis untuk pembelajaran dan pendekatan pembelajaran keterampilan berpikir kritis dan hasil belajar siswa. Jenis penelitian ini adalah kualitatif. Penyelidikan saat ini dipimpin menggunakan strategi pencerahan yang dikumpulkan oleh prosedur perpustakaan, yang dikumpulkan dengan mempertimbangkan inovasi pendidikan, masalah terkait, dan buku referensi. Hasil penelitian menunjukkan bahwa pendekatan pembelajaran seperti pendekatan pembelajaran Game and Computer-Based atau Mobile Based lebih efektif dan terampil dibandingkan dengan pendekatan pembelajaran konvensional. Pendekatan pembelajaran kolaboratif seperti pendekatan pembelajaran Case-Based, Project-Based, dan Problem Based sangat konstruktif untuk komunikasi, hasil belajar, dan kemampuan berpikir analitis. Jadi, pendekatan pembelajaran yang praktis dan baru dikembangkan harus diterapkan pada hasil belajar siswa keterampilan berpikir kritis dan komunikasi tingkat tinggi.

Kata kunci: Keterampilan Berpikir Kritis, Pembelajaran Komunikatif, Pembelajaran Berbasis Teknologi

Abstract

The popularity of the internet for using modern and digital learning approaches replaced the old and conventional teaching methods. By applying ICT, an ideal learning environment can be created between students and teachers. The main objective of this review article is to review various dynamic approaches to learning and learning approaches to critical thinking skills and student learning outcomes. This type of research is qualitative. The current investigation was led using enlightenment strategies accumulated by library procedures, which were collected considering educational innovations, related issues, and referenced books. The study results indicate that learning approaches such as Game and Computer-Based or Mobile Based learning approaches are more effective and skilled than conventional learning approaches. Collaborative learning approaches such as Case-Based, Project-Based, and Problem Based learning approaches are very constructive for communication, learning outcomes, and analytical thinking skills. So, a practical and newly developed learning approach should be applied to student learning outcomes of high-level critical thinking and communication skills.

Keywords: Critical Thinking Skills, Communicative Learning, Technology Based Learning

History:

Received : March 19, 2021

Revised : March 21, 2021

Accepted : April 10, 2021

Published : April 25, 2021

Publisher: Undiksha Press

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Introduction

Learning is a basic need of humanity. The rapid flow of globalization should be absorbed and implemented in learning. The learning is a procedure that is related with the transmission of information (Hafeez, et al., 2020; Kalantarrashidi, Mohammadpour, & Sahraei, 2015; Yuzulia, 2020). The successful implementation of a learning strategy in classroom depends on the capability of teacher by using the learning approaches, practises, and strategies (Asyari, Henie, Muhdhar, & Ibrahim, 2016; Merchie & Keer, 2016). The traditional learning approaches i-e lecture, reciting and laboratory-based approaches do not develop the critical thinking and collective problem solving. Effective learning is very essential in the present era to develop the critical thinking skills. The teachers must use the modern learning approaches to develop the leaning skills in all the learners and to challenge

the global society (Kawka, et al., 2021; Nkulikiyinka, et al., 2020). Effective learning is very important for skilful and cognitive development of students in all the educational fields (Aina & Tuti, 2020; Zhu, Bonk, & Doo, 2020). In the 21st century, the revolution of internet, information and communication technology (ICT) has produced modern methods of learning like Mobile-Based learning, Digital-Game Based learning and Project-Based learning.

Mobile-Based Learning is a learning approach that can create a fun learning atmosphere (Chang, Wu, Chang, Tseng, & Wang, 2021; Lin, Hsia, & Hwang, 2021). This mobile-based learning can increase student motivation in learning. In addition, this approach can assist students in learning with total concentration (Park, Choi, Kim, & Lee, 2020; Troussas, Krouska, & Sgouropoulou, 2020). This approach can improve creativity, communication, and visualization while accepting challenges during learning. Students face many challenges in the learning process by solving complex problems systematically and well designed and competing with their peers. It can lead to an increase in learning abilities so that learning objectives can be achieved optimally. Digital Game-Based Learning is a fun learning approach. This approach involves all students so that it can motivate students in learning. Digital Game-based learning enhances students' experimentation, creativity, communication and visualization by accepting challenges during games (Kao, 2020; Sun et al., 2021). Students will face challenges and solve them in a complex and systematic way. Students are also able to compete with their friends (All, Castellar, & Looy, 2021; Li, Hwang, Chen, & Lin, 2021; Tapingkae et al., 2020). Learning activities like this will improve students' ability to achieve goals. Digital Game-based learning is becoming very popular. Project-Based Learning (PjBL) is a learning approach that requires students to think critically in working on projects given by the teacher (Mutakinati, Anwari, & Yoshisuke, 2018; Wu & Wu, 2020). This approach provides opportunities for students to develop critical thinking and communication skills through group discussions. PjBl leads to developing communication skills, knowledge, critical thinking skills, student learning outcomes which are very important for improving educational performance and long-term learning (Marzuki & Basariah, 2017; Yustina, Syafii, & Vebrianto, 2020).

The popularity of internet for using modern and digital learning approaches replaced the old and conventional methods of teaching (Cloonan, Cloonan, Schlitzkus, & Fingeret, 2020; Foldnes, 2016; Ghavifekr & Rosdy, 2015). Integration of ICT in all the educational fields is the use of mobile and computer for learning in classroom. To prepare the students according to the present digital era, the teachers are the main role for the application of ICT in the classrooms. By applying the ICT an ideal and dynamic learning environment can be created between students and teachers. ICT based learning and teaching is very important for policy making and the proper planning of any institution (Anwariningsih & Ernawati, 2013; Siddiq, et al., 2019). Various learning approaches like Problem-Based, Project-Based, Case-Based, Module-Based, Digital Game- Based and Computer-Based have been discussed and reviewed in the literature (Cloonan et al., 2020; Kristinawati, Susilo, & Gofur, 2018). But there are few studies found in the literature where impact of various learning approaches on critical thinking skills have been discussed. The present study is different from the previous one as it discusses the impacts of various learning approaches on the students learning outcomes and critical thinking skills. The primarily objectives of this review article are (1) Review of various learning approaches. (2) Influences of learning approaches on critical thinking skills and students learning outcomes.

Methods

The current investigation was led utilizing an enlightening strategy that accumulated by library procedure, which was gathered by considering educational innovation, related issues, articles and books which have referenced in the reference.

Results and Discussion

Various learning approaches i-e Problem-based, Project-based, Case-Based, Modules-Based learning, Digital Game-Based, Mobile and Computer Based learning have been discussed in this review article. Problem-based learning is stated as a learning procedure of working with problems, which involves identification, analysis, and solution. Problem-Based learning (PBL) is an “active learning” approach in which difficult and complex problems are presented for solution to develop the conceptual learning of students as compared to the conventional lectures approach. The teacher is the facilitator in the problem-based learning approach (Lukitasari, Purnamasari, Utami, & Sukri, 2019; Nuswowati, Susilaningsih, Ramlawati, & Kadarwati, 2017). The problem-based is a student-centered learning approach in which a problem is challenged to the students to get the new knowledge by applying their previous knowledge for the solution of the problem. The PBL is the most advanced learning approach in the history of learning. PBL is a constructive learning approach for the development of science learning skills (Fitria & Idriyeni, 2017; Mutakinati et al., 2018). The problem-based learning approach has been applied successfully for more than thirty years in the various fields of education. The Structural framework of Problem-based learning process is shown in figure 2. The problem-based learning is a pedagogical learning approach focused on dynamic and active students. In problem-based learning process technology can be utilized in many ways. The first is to integrate the PBL with distance or online learning technologies and the second is to use it with multimedia for the management of learning system. The application of technology in PBL helps learners to develop the conceptual framework about the real-life problems and improved learning skills (Balan, Yuen, & Mehrtash, 2019; Haji, Safriana, & Safitri, 2015).

The Project-Based learning (PjBL) is a learning approach in which critical thinking and communication skills are developed by working on a project in a specific period of time (Mutakinati & Anwari, 2018; Suryandari et al., 2018). In Project-Based learning there is a lot of opportunities for learners to develop the communication and critical thinking skills by group discussions. PjBL is an ideal educational practice that leads to the development of communication skills, knowledge, critical thinking skills, students learning outcomes that are very important for the improvement of educational performance and long-term learning. PjBL is a learning approach that is developed for the difficult and complex problems, long term learning activities, multidisciplinary assignments and result oriented. The results of many studies have been done showed that the Project-Based learning approach influences the students learning outcomes and critical thinking skills.

Case-Based learning (CBL) approach is a dynamic approach that develops conceptual knowledge of students to improve their critical thinking and communication skills by questioning, discussion and sharing the results of specific case (Gholami et al., 2021; Lall & Datta, 2021). In CBL approach the problem is presented at the start of the learning to mentally prepare the students to solve the complex real-life problems. Case-Based Learning (CBL) teaching methodology adopted across several disciplines aims to facilitate active learning by applying the students’ theoretical knowledge to real- world scenarios. CBL has been widely used in science education, business, medicine, law and health sciences. The Case-Based learning approach is a venue for the students to apply the knowledge gained in the classroom and explore the new knowledge by solving the case-based real-life problems. The classroom teacher is a key role in the CBL to help the students in resolving different case-based complex problems according to the situations related to the real-life from theoretical knowledge to practical knowledge (Farha, Zein, & Kawas, 2021; Sapeni & Said, 2020). The Case-Based learning approach is very important learning approach in the clinical field as it enables students to dynamically participate in the real-life problems develop their

own content of knowledge. The students resolving problems with CBL approach can develop solutions independently instead of the knowledge delivered to them in the classroom by the teachers or from textbooks. CBL is an active learning approach as it increases the communication and critical thinking skills by engaging the learners. It is particularly beneficial for the students having lower educational performances. CBL is a long-term pedagogical conceptual framework that is used in many clinical and medical based disciplines to resolve the case problems (Khalid et al., 2021; Sapeni & Said, 2020).

Table 1. Difference between CBL and PBL

| Item | CBL | PBL |
|----------------------------|--|---|
| Goals | It is designed for the students to learn about the clinical cases, management and diagnosis. Theoretical knowledge of classroom is applied for practical applications. | It is a process learning approach in which already presented problem is solved. Information's are gathered after solving the problem. |
| Focus | To get the Clinical case-based knowledge. To solve the specific problem related to the profession. | Problem solving. |
| Advanced study | Advanced study is required to solve the specific case. Students must have baseline knowledge for case-based problems. | Little advancement is required in study. Information is usually gathered during the problem solving. |
| Role of learner | Learner participation, advanced knowledge and questioning about case problem. | Actively participation in the session and explore the knowledge during the problem solving. |
| Role of teacher | For specific learning objective a case is provided, discussion is done and tried to know the correct answers. | A case is provided according to the information provided and problem-solving approach is applied. |
| Amount of content | Can be one to many. Usually more than one case. | Only one case for a session |
| Learning objectives | Discrete learning objectives. | Loosely followed if at all. |
| Outcomes | Outcomes are measured to see the objectives are met or not. | The process is the outcome |

Module-based learning is a series of systematic learning activities based on curriculum tailored to the competencies to be achieved students. The advantages of the module are designed to be used by students learning because it comes on its own, so with the module students should not rely on the teacher to be able to achieve the expected competencies by learning activities. The module-based learning is self-learning process in which the students learn themselves independently. The students discuss the learning module with each other's and get their specific goals. The Digital Modules are innovations that can be used by teachers in solving the problems of Government-issued module or textbook. These innovations can be done by utilizing the development of IT technology in schools (Alias & Siraj, 2012; Mills, Roper, & Cesare, 2021). The objective of module-based learning is to make students expert in the specific subject matter. The module-based learning developed the critical thinking skills so that they can apply the different procedures to resolve the given problems according to their learned knowledge. Learning module is the source of learning in which the students test themselves by solving different problem-based exercises. Main advantage of module-based learning is that students can use the learning materials

independently within the institution and outside of the institution. Learning module increases the ability of self-learning, communication and critical thinking skills (Alias & Siraj, 2012; Mills et al., 2021).

The Digital Game-Based learning is a modern learning approach in which students learn by fun. Digital Game-Based learning motivates the students and help them to learn with full concentration and engagement. Digital Game based learning enhance the experimentation, creativity, communication and visualization of the students by accepting the challenges during the game. During the Digital Game process, the learners have to face many challenges by solving a systematic and well-designed complex problem and to compete with their fellows. This competition increases the motivation and learning ability of students and they can easily achieve their goals. Due to rapid increase in advancement of ICT, the learning with Digital Game-based has also become popular and transferred to the mobile technology (All et al., 2021; Kao, 2020).

Information and communication Technology has made the education more self-motivated and self-directional both in learning and teaching. ICT has an impact on the relationship between students and the teachers. It has also improved the learning management system. The learning and teaching management system have become very effective due to rapid advancement of information and communication technology. Now there are new mediums of instructions and learning are easily available. The mobile and computer-based medium have become the effective and popular source of learning and instruction in the 21st century. The application of mobile and computer technology in all fields of education enables the teachers to make the teaching and learning more effective. This technology-based learning makes the teachers and students to get the multiple sources of information and shifted from conventional method of learning to conceptual and community-based learning (Kalantarrashidi et al., 2015; Lukitasari et al., 2019). The application of mobile and computer technology in the learning and teaching process enhance the learning through engagement of teachers and students (Churchill, King, & Fox, 2013; Yudhiantara & Saehu, 2017). The mobile and computer technology provide hands on and immediate learning. Mobile and computer technology is easily transportable and make the real time, moveable, communicative, conceptual and seamless learning. The mobile and computer-based learning is also beneficial for students self-confident, self-dependent and critical thinking skills. The innovative teaching methods can be applied for students learning by information and communication technology.

Critical thinking skills can be developed through many student-cantered learning approaches such as computer based solving problem, cooperative learning and digital storytelling (Khan & Masood, 2015; Leonard & Nwanekezi, 2018). It is very important to develop the critical thinking skills as it increases the capability of decision and conclusion power in the students to solve the real-life complex problems. The Critical thinking is stated as a reasoning skill in which a person gathers, processes and uses the information accurately and precisely to determine the right way to get the goals.

Table 2. Critical Thinking Skills in Instructional Design

| Instructional Design | Features | Reasons |
|---------------------------------|---|--|
| Learner Analysis | Critical Thinking Skills | To find the right instruction for solution |
| Context Analysis | Organized teaching and learning environment in school climate | To select instructional strategy, method and technique |
| Instructional Objectives | As incorporated with context | Developing objectives |

| Instructional Design | Features | Reasons |
|--------------------------------|---|--|
| | analysis and learners | according to the context and learners |
| Strategy of instruction | Critical thinking skills: Questioning, discussion, PBL, project | Analytical thinking development |
| Evaluation methods | Formative by performance assessment or authentic | Multiple solution of problem by different angles |

Batdi (2014) conducted a meta-analysis-based research by taking 90 studies done from 2006-2013 in which post and pre-test experiments had been utilized. He found that the Problem-Based approaches were more efficient as compared to conventional learning approaches. Problem-Based learning must be applied to the students to increase their thinking skills and problem-solving capabilities (Haji et al., 2015; Mutakinati et al., 2018). Moreover, by applying PBL approach the conceptual framework significantly improved. PjBL approach has an influence on improving the learning ability (Wu & Wu, 2020; Yustina et al., 2020). Case-Based learning (CBL) is a type of constructive learning in which the students get the information, develop new ideas and make ultimate decision on the basis of current and previous knowledge (Brandon & All, 2010). The five Types of abilities knowledge and skills developed by Case-Based Learning Process is illustrated in figure 9.

In CBL approach the students learn by a real-life problem. The results of the study indicated that the CBL approach developed more critical thinking, learning ability and self-confidence as compared to the conventional learning method (Roca, Reguant, & Canet, 2016). The application of Module-Based problem-solving approach enables the students to find the solution of problem independently. The Module-Based learning approach creates high level of critical thinking and learning skills (Fadli et al., 2020). DGBL is a student centered learning approach which is based on video games in learning context to develop and achieve educational targets (Hwang, Yang, & Wang, 2013). These skills can be successfully applied in the practical and industrial life. In order to produce learners with higher order thinking skills characteristics, it is necessary for the learners to have some skills like critical thinking, innovation, problem solving, innovation, creativity, leadership, collaboration, communication, media, Information and technology skills. Effects of various modern learning approaches on students learning outcomes have been reviewed in the table 3.

Table 3. Learning Approaches and Students Learning Outcomes

| Approaches | Student learning outcomes | References |
|-------------------------------|---|---|
| Problem-Based Learning | Problem-based learning approach is an effective strategy to increase the students learning outcomes. | (Preeti, Ashish, & Shriram, 2013) |
| Project-Based Learning | There were significant differences between students who were taught using PjBL learning and by conventional learning, both on the parameters of learning outcomes and creative thinking skills. | (Rahardjanto, 2019) |
| Case-based Learning | The findings show that interactions in the use of case studies have the potential to increase desirable learning outcomes. | (Nkhoma, Sriratanaviriyakul, & Quang, 2017) |
| Module-based Learning | One effective media for applying scientific approach is e-module based on learning cycle 7E. | (Istuningsih, Baedhowi, & |

| Approaches | Student learning outcomes | References |
|---|---|--------------------------------------|
| | The results showed that it can improve the students' learning outcomes | Sangka, 2018) |
| Digital game-based Learning | The current study predicted that the DGBL approach would improve the students' English learning performance, English learning motivation, and willingness to communicate in English during the learning activity enabled by the TEBG game-based learning materials. | (Yeh, Hung, & Hsu, 2017) |
| Mobile and computer-based Learning | Based on the results of the study, it can be concluded that mathematics mobile learning can be used as an alternative learning media that can improve learning autonomous and learning outcomes of elementary students. | (Suprianto, Ahmadi, & Suminar, 2019) |

Discussion

The various modern learning approaches and influences of these learning approaches on critical thinking skills and students learning outcomes have been discussed in this review article. The problem-based learning is the learning with problems. The important stages for the problem-based learning are identification of a problem, understanding the nature of problem, assign tasks for the solving problem, discuss the questions about the problem, use the new knowledge and skills for the solution of problem. The review shows that the problem-based learning approach increases the students' capacity for problem solving, students learning outcomes and critical thinking skills in all field of education. The project-based learning is a type of learning in which the students work on the project by applying their previous knowledge to explore new knowledge. The six principles for the Project-based learning are curriculum should be centered around and driven by the project, assessment should be constructively aligned with the objectives and activities of the project, activities should include real world challenges and authentic topics, and involve the use of technology, students should engage in problem solving that involves multi-disciplinary knowledge, students should participate in decision-making processes for identifying learning needs, choice of topic, and materials, and students should work collaboratively in teams, assuming responsibility for their learning. The review shows that the project-based learning is the best practice for the enhancement of learning and to develop communication and critical thinking skills and students learning outcomes (Hidayat et al., 2019; Mutakinati et al., 2018).

The case-based learning approach is another type of learning in which the learner considers a special case and apply the knowledge gained in the class to perform the practice. This type of learning is widely applied in the field of medical. The important process for case-based learning is to develop the case, analysed the case by grouping, brainstorming, indicate the learning objectives, new findings, share the results and improvement. The review shows that case-based learning develops the communication skills, clinical judgement and critical thinking skills and better students learning outcomes (Gholami et al., 2021; Sapeni & Said, 2020). The module-based learning is a self-learning approach that provides opportunities for learners to test yourself by the exercises proposed in the module. The important contents for module-based learning are objectives and learning outcomes, course contents, teaching methods and resources, assessment and monitoring and review. The review shows that module-based learning approach is an important learning approach as it contains activities for critical thinking development. The module-based learning approach also increases the students learning outcomes. The technology-based learning approaches have gained the keen

interest in the past few years. The technology-based learning approaches like game-based and mobile and computer-based learning approaches are very important for the development of communicative and critical thinking skills. The digital game-based learning is a challenging based learning in which the learners solve the complex problems. The game-based learning increases the critical thinking skills and learning achievement of the learners. The mobile and computer-based learning approach is one of the most important learning approaches in this era. The important work process with mobile and computer-based learning is to familiarize, utilization, integration, reorganization and evaluation.

Conclusion

The various modern learning approaches and their influences on critical thinking skills and learning outcomes have been reviewed in this study. The review shows that the various new and practical based learning approaches are more effective than the traditional methods of learning. The practical and technology-based learning approaches develop more communication, students learning outcomes and critical thinking than the old and traditional methods of learning.

References

- Aina, & Tuti. (2020). Improving Teacher Performance In Classroom Learning Process Through Collaborative Educational Supervisions In Elementary Schools. *Primary Jurnal Pendidikan Guru Sekolah Dasar*, 9(2). <https://doi.org/http://dx.doi.org/10.33578/jpfkip.v9i2.7894>.
- Alias, N., & Siraj, S. (2012). Effectiveness of Isman Instructional Design Model in Developing Physics Module based on Learning Style and Appropriate Technology. *Procedia - Social and Behavioral Sciences*, 64. <https://doi.org/https://doi.org/10.1016/j.sbspro.2012.11.002>.
- All, A., Castellar, E. N. P., & Looy, J. Van. (2021). Digital Game-Based Learning effectiveness assessment: Reflections on study design. *Computers & Education*, 167. <https://doi.org/https://doi.org/10.1016/j.compedu.2021.104160>.
- Anwariningsih, & Ernawati. (2013). Development of Interactive Media for ICT Learning at Elementary School based on Student Self Learning. *Journal of Education and Learning*, 7(2), 121–128. <https://doi.org/http://dx.doi.org/10.11591/edulearn.v7i2.226>.
- Asyari, M., Henie, M., Muhdhar, I. Al, & Ibrahim, H. S. (2016). Improving critical thinking skills through the integration of problem based learning and group investigation. *International Journal for Lesson and Learning Studies*, 5(1), 36–44. <https://doi.org/http://dx.doi.org/10.1108/IJLLS-10-2014-0042>.
- Balan, L., Yuen, T., & Mehrtash, M. (2019). Problem-Based Learning Strategy for CAD Software Using Free-Choice and Open-Ended Group Projects. *Procedia Manufacturing*, 32, 339–347. <https://doi.org/10.1016/j.promfg.2019.02.223>.
- Batdi, V. (2014). The effects of a problem-based learning approach on students' attitude levels: A meta-analysis. *Educational Research and Reviews*, 9(9). <https://doi.org/http://dx.doi.org/10.5897/ERR2014.1771>.
- Chang, H.-Y., Wu, H.-F., Chang, Y.-C., Tseng, Y.-S., & Wang, Y.-C. (2021). The effects of a virtual simulation-based, mobile technology application on nursing students' learning achievement and cognitive load: Randomized controlled trial. *International Journal of Nursing Studies*, 120. <https://doi.org/https://doi.org/10.1016/j.ijnurstu.2021.103948>.
- Churchill, D., King, M., & Fox, B. (2013). Learning design for science education in the 21st century. *Zbornik Instituta Za Pedagoska Istrazivanja*, 45(2), 404–421.

- <https://doi.org/10.2298/ZIPI1302404C>.
- Cloonan, M. R., Cloonan, D. J., Schlitzkus, L. L., & Fingeret, A. L. (2020). Learners with Experience in Surgical Scrub Benefit from Additional Education with an Interactive E-Learning Module. *Journal of the American College of Surgeons*, 4(2). <https://doi.org/https://doi.org/10.1016/j.jamcollsurg.2020.08.521>.
- Fadli, M. R., Sudrajat, A., Zulkarnain, A., Setiawan, R., & Amboro, K. (2020). The Effectiveness of E-Module Learning History Inquiry Model to Grow Student Historical Thinking Skills Material Event Proclamation of Independence. *Decision Making*, 6(7). Retrieved from <http://sersc.org/journals/index.php/IJAST/article/view/20146>.
- Farha, R. J. A., Zein, M. H., & Kawas, S. Al. (2021). Introducing integrated case-based learning to clinical nutrition training and evaluating students' learning performance. *Journal of Taibah University Medical Sciences*, 12. <https://doi.org/https://doi.org/10.1016/j.jtumed.2021.03.005>.
- Fitria, Y., & Idriyeni, I. (2017). Development of Problem-Based Teaching Materials for The Fifth Graders of Primary School. *Jurnal Ta'dib*, 20(2), 99–106. <https://doi.org/http://dx.doi.org/10.31958/jt.v20i2.747>.
- Foldnes, N. (2016). The flipped classroom and cooperative learning: Evidence from a randomised experiment. *SAGE Journal*, 17(1). <https://doi.org/https://doi.org/10.1177%2F1469787415616726>.
- Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, 1(2). Retrieved from <https://ijres.net/index.php/ijres/article/view/79>.
- Gholami, M., Changae, F., Karami, K., Shahsavari, Z., Veiskaramian, A., & Birjandi, M. (2021). Effects of multi-episode case-based learning (CBL) on problem-solving ability and learning motivation of nursing students in an emergency care course. *Journal of Professional Nursing*, 37(3). <https://doi.org/https://doi.org/10.1016/j.profnurs.2021.02.010>.
- Hafeez, M., Tahira, F., Kazmi, Q. A., & Zahid, M. (2020). Analysis of moral reasoning of teachers and the students with respect to Kohlberg's theory of moral development. *International Journal of Business Strategy and Social Sciences*, 3(1). Retrieved from <http://www.sciencepublishinggroup.com/journal/paperinfo?journalid=391&doi=10.11648/j.ijnpt.20200601.12>.
- Haji, A. G., Safriana, & Safitri, R. (2015). The use of problem based learning to increase students' learning independent and to investigate students' concept understanding on rotational dynamic at students of SMA Negeri 4 Banda Aceh. *Jurnal Pendidikan IPA Indonesia*, 4(1), 67–72. <https://doi.org/10.15294/jpii.v4i1.3503>.
- Hidayat, S., Agusta, E., Siroj, R. A., & Hastiana, Y. (2019). Lesson Study & Project Based Learning sebagai Upaya Membentuk Forum Diskusi dan Perbaikan Kualitas Pembelajaran Guru IPA. *Jurnal Pengabdian Kepada Masyarakat*, 4(2). <https://doi.org/https://doi.org/10.22146/jpkm.31423>.
- Hwang, G. J., Yang, L. H., & Wang, S. Y. (2013). A concept map-embedded educational computer game for improving students' learning performance in natural science courses. *Computers & Education*, 69. <https://doi.org/https://doi.org/10.1016/j.compedu.2013.07.008>.
- Istuningsih, W., Baedhowi, B., & Sangka, K. B. (2018). The effectiveness of scientific approach using e-module based on learning cycle 7e to improve students' learning outcome. *International Journal of Educational Research Review*, 3(3). <https://doi.org/http://dx.doi.org/10.24331/ijere.449313>.

- Kalantarrashidi, S. A., Mohammadpour, E., & Sahraei, F. (2015). Effect of Blended Learning Classroom Environment on Student's Satisfaction. *Journal of Education and Training Studies*, 3(5), 225–230. <https://doi.org/https://doi.org/10.11114/jets.v3i5.1013>.
- Kao, C.-W. (2020). The effect of a digital game-based learning task on the acquisition of the English Article System. *System*, 95. <https://doi.org/https://doi.org/10.1016/j.system.2020.102373>.
- Kawka, M., MH.Gall, T., Fang, C., Liu, R., & Jiao, R. (2021). Intraoperative video analysis and machine learning models will change the future of surgical training. *Intelligent Surgery*, 1(1). <https://doi.org/https://doi.org/10.1016/j.isurg.2021.03.001>.
- Khalid, A. M., Sohail, M., Naiyar, I., Khalid, H., & Baig, M. (2021). Perceptions of medical students in Pakistan, KSA, and the US regarding the significance of case-based learning. *Journal of Taibah University Medical Sciences*, 16(3). <https://doi.org/https://doi.org/10.1016/j.jtumed.2021.02.011>.
- Khan, F. M. A., & Masood, M. (2015). The Effectiveness of an Interactive Multimedia Courseware with Cooperative Mastery Approach in Enhancing Higher Order Thinking Skills in Learning Cellular Respiration. *Procedia - Social and Behavioral Sciences*, 176, 977–984. <https://doi.org/10.1016/j.sbspro.2015.01.567>.
- Kristinawati, E., Susilo, H., & Gofur, A. (2018). ICT Based-Problem Based Learning on Students' Cognitive Learning Outcomes. *Jurnal Pendidikan Sains*, 6(2), 38–42. <https://doi.org/http://dx.doi.org/10.17977/jps.v6i2.11683>.
- Lall, M., & Datta, K. (2021). A pilot study on case-based learning (CBL) in medical microbiology; students perspective. *Medical Journal Armed Forces India*, 77(1). <https://doi.org/https://doi.org/10.1016/j.mjafi.2021.01.005>.
- Leonard, N. C., & Nwanekezi, A. U. (2018). Effects of Guided Inquiry and Task Hierarchy Analysis Model in Cooperative Learning Strategy on Chemistry Students' Performance in Imo State. *European Scientific Journal, ESJ*, 14(25), 54–62. <https://doi.org/10.19044/esj.2018.v14n25p54>.
- Li, F.-Y., Hwang, G.-J., Chen, P.-Y., & Lin, Y.-J. (2021). Effects of a concept mapping-based two-tier test strategy on students' digital game-based learning performances and behavioral patterns. *Computers & Education*, 24. <https://doi.org/https://doi.org/10.1016/j.compedu.2021.104293>.
- Lin, Y.-N., Hsia, L.-H., & Hwang, G.-J. (2021). Promoting pre-class guidance and in-class reflection: A SQIRC-based mobile flipped learning approach to promoting students' billiards skills, strategies, motivation and self-efficacy. *Computers & Education*, 160. <https://doi.org/https://doi.org/10.1016/j.compedu.2020.104035>.
- Lukitasari, Purnamasari, Utami, & Sukri. (2019). Blended-Problem-Based Learning: How its impact on students' critical thinking skills? *Jurnal Pendidikan Biologi Indonesia*, 5(3), 425–434. <https://doi.org/https://doi.org/10.22219/jpbi.v5i3.10048>.
- Marzuki, & Basariah. (2017). The Influence Of Problem-Based Learning And Project Citizen Model In The Civic Education Learning On Student's critical Thinking Ability And Self Discipline. *Cakrawala Pendidikan*, 6(3), 382–400. Retrieved from <https://journal.uny.ac.id/index.php/cp/article/view/14675/pdf>.
- Merchie, E., & Keer, H. Van. (2016). Mind mapping as a meta-learning strategy: Stimulating pre-adolescents' text-learning strategies and performance? *Contemporary Educational Psychology*, 46. <https://doi.org/https://doi.org/10.1016/j.cedpsych.2016.05.005>.
- Mills, K., Roper, F., & Cesare, S. (2021). Accelerating student learning in communication and research skills: the adoption of adaptive learning technologies for scenario-based modules. *Technology, Change and the Academic Library*, 75. <https://doi.org/https://doi.org/10.1016/B978-0-12-822807-4.00007-5>.
- Mutakinati, & Anwari. (2018). Analysis Of Students ' Critical Thinking Skill Of Middle

- School Through Stem Education Project-Based Learning. *Jurnal Pendidikan IPA Indonesia*, 7(1), 54–65. <https://doi.org/10.15294/jpii.v7i1.10495>.
- Mutakinati, L., Anwari, I., & Yoshisuke, K. (2018). Analysis of students' critical thinking skill of middle school through stem education project-based learning. *Jurnal Pendidikan IPA Indonesia*, 7(1), 54–65. <https://doi.org/10.15294/jpii.v7i1.10495>.
- Nkhoma, M., Sriratanaviriyakul, N., & Quang, H. L. (2017). Using case method to enrich students' learning outcomes. *Active Learning in Higher Education*, 18(1). <https://doi.org/10.1177%2F1469787417693501>.
- Nkulikiyinka, P., Yan, Y., Güleç, F., Manovic, V., & Clough, P. T. (2020). Prediction of sorption enhanced steam methane reforming products from machine learning based soft-sensor models. *Energy and AI*, 2. <https://doi.org/10.1016/j.egyai.2020.100037>.
- Nuswawati, M., Susilaningsih, E., Ramlawati, & Kadarwati, S. (2017). Implementation of problem-based learning with green chemistry vision to improve creative thinking skill and students' creative actions. *Jurnal Pendidikan IPA Indonesia*, 6(2), 221–228. <https://doi.org/10.15294/jpii.v6i2.9467>.
- Park, K.-B., Choi, S. H., Kim, M., & Lee, J. Y. (2020). Deep learning-based mobile augmented reality for task assistance using 3D spatial mapping and snapshot-based RGB-D data. *Computers & Industrial Engineering*, 146. <https://doi.org/10.1016/j.cie.2020.106585>.
- Preeti, B., Ashish, A., & Shriram, G. (2013). Problem based learning (PBL)-an effective approach to improve learning outcomes in medical teaching. *Journal of Clinical and Diagnostic Research: JCDR*, 7(12).
- Rahardjanto, A. (2019). Hybrid-PjBL: Learning Outcomes, Creative Thinking Skills, and Learning Motivation of Preservice Teacher. *International Journal of Instruction*, 12(2). Retrieved from <https://eric.ed.gov/?id=EJ1211050>.
- Roca, J., Reguant, M., & Canet, O. (2016). Learning outcomes of “The Oncology Patient” study among nursing students: A comparison of teaching strategies. *Nurse Education Today*, 46. <https://doi.org/10.1016/j.nedt.2016.08.018>.
- Sapeni, M. A.-A. R., & Said, S. (2020). The effectiveness of case-based learning in increasing critical thinking of nursing students: A literature review. *Enfermería Clínica*, 30(2). <https://doi.org/10.1016/j.enfcli.2019.07.073>.
- Siddiq, F., Hatlevik, O. E., Olsen, R. V., Throndsen, I., & Scherer, R. (2019). Taking a future perspective by learning from the past – A systematic review of assessment instruments that aim to measure primary and secondary school students' ICT literacy. *Educational Research Review*, 16. <https://doi.org/10.1016/j.edurev.2016.05.002>.
- Sun, L., Ruokamo, H., Siklander, P., Li, B., & Devlin, K. (2021). Primary school students' perceptions of scaffolding in digital game-based learning in mathematics. *Learning, Culture and Social Interaction*, 28. <https://doi.org/10.1016/j.lcsi.2020.100457>.
- Suprianto, A., Ahmadi, F., & Suminar, T. (2019). The development of mathematics mobile learning media to improve students' autonomous and learning outcomes. *Journal of Primary Education*, 8(1). Retrieved from <https://journal.unnes.ac.id/sju/index.php/jpe/article/view/19641>.
- Suryandari, Sajidan, Rahardjo, Prasetyo, & Fatimah. (2018). Project-Based Science Learning And Pre-Service Teachers' Science Literacy Skill And Creative Thinking. *Cakrawala Pendidikan*, 37(3). Retrieved from <https://journal.uny.ac.id/index.php/cp/article/view/17229/pdf>.
- Tapingkae, P., Panjaburee, P., Hwang, G.-J., & Srisawasdi, N. (2020). Effects of a formative

- assessment-based contextual gaming approach on students' digital citizenship behaviours, learning motivations, and perceptions. *Computers & Education*, 159. <https://doi.org/https://doi.org/10.1016/j.compedu.2020.103998>.
- Troussas, C., Krouska, A., & Sgouropoulou, C. (2020). Collaboration and fuzzy-modeled personalization for mobile game-based learning in higher education. *Computers & Education*, 144. <https://doi.org/https://doi.org/10.1016/j.compedu.2019.103698>.
- Wu, T. T., & Wu, Y. T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. *Thinking Skills and Creativity*, 35(January), 100631. <https://doi.org/10.1016/j.tsc.2020.100631>.
- Yeh, Y. T., Hung, H. T., & Hsu, Y. J. (2017). Digital game-based learning for improving students' academic achievement, learning motivation, and willingness to communicate in an english course. *International Congress on Advanced Applied Informatics*. <https://doi.org/https://doi.org/10.1109/IIAI-AAI.2017.40>.
- Yudhiantara, R. A., & Saehu, A. (2017). Mobile-Assisted Language Learning (MALL) in Indonesian Islamic Higher Education. *IJELTAL (Indonesian Journal of English Language Teaching and Applied Linguistics)*, 2(1), 21–31. <https://doi.org/10.21093/ijeltal.v2i1.52>.
- Yustina, Syafii, W., & Vebrianto, R. (2020). The effects of blended learning and project-based learning on pre-service biology teachers' creative thinking skills through online learning in the COVID-19 pandemic. *Jurnal Pendidikan IPA Indonesia*, 9(3), 408–420. <https://doi.org/10.15294/jpii.v9i3.24706>.
- Yuzulia, I. (2020). EFL teachers' perceptions and strategies in implementing learner autonomy. *Journal of Linguistics and Language Teaching*, 6(1), 36–54. <https://doi.org/http://dx.doi.org/10.29300/ling.v6i1.2744>.
- Zhu, M., Bonk, C. J., & Doo, M. Y. (2020). Self-directed learning in MOOCs: Exploring the relationships among motivation, self-monitoring, and self-management. *Educational Technology Research and Development*, 68(5), 2073–2093. <https://doi.org/10.1007/s11423-020-09747-8>.