



## The Effect of Problem-Based E-Learning on Students' Learning and Academic Efficacy during the COVID-19 Pandemic

**Mehdi Badali, Ph.D.**

Department of education, Tarbiat Modares University, Tehran, Iran

**Parvin Mirzaei, Ph.D.**

Department of psychology, Payame Noor University of Tehran, Tehran, Iran

**Nazanin Shafeifar, MSc.**

**Hoda Assadi, MSc.**

Department of Educational Psychology, Medical Sciences Branch, Islamic Azad University, Tehran, Iran

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### Abstract

In early 2020, the coronavirus outbreak compelled higher education institutions worldwide to cancel campus-based teaching and conduct a variety of electronic learning which led to assessment of the quality of e-learning and its results, such as learning and self-efficacy. Thus, this study aimed to determine the effect of problem-based e-learning (PBe-L) on the learning and academic efficacy of students during the COVID-19 pandemic in 'An Introduction of Educational Technology Course'. The research method was quasi-experimental with pre-test/ post-test design with experimental and control groups. The statistical population of this study consisted of undergraduate students in the field of educational sciences studying in the University of Tehran. 38 students were selected as the research sample using the available sampling method and were randomly divided into experimental and control groups. PBe-L was conducted for the experimental group and the control group experienced the direct learning approach. A researcher-made learning test and Morgan-Jinks Student Efficacy Scale (1999) were used. The results showed that the mean of learning and self-efficacy of the experimental group increased from 7.92 and 57.00 in the pre-test to 18.51 and 76.57 in the post-test respectively. The results of covariance showed that the mean scores of the post-test of the two groups were statistically significant ( $p \geq 0.005$ ). The results of this study showed that the use of PBe-L during the COVID-19 pandemic can be effective in increasing the students' learning and academic efficacy.

**Keywords:** Academic efficacy, COVID-19, e-Learning, problem based learning, learning

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**Corresponding Author:** Mehdi Badali

**Email:** badali.tech@gmail.com

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### Introduction

The global coronavirus disease (COVID-19) pandemic has had a massive impact on higher education around the world (Vijayan, 2021). COVID-19 grew quickly from its

first emergence to a truly global phenomenon (Murphy, 2020), and became a pandemic declared by the World Health Organization (WHO) on 11 March 2020 (World Health Organization, 2020). The sanitary emergency due to the COVID-19 virus obliged people to face up

several changes in their everyday life because WHO guidelines and countries' Health Systems imposed a lockdown of activities and social distancing to flatten the infection curve. One of these rapid changes involved students and professors that had to turn the traditional "in presence" classes in online courses facing several problems for educational delivery (Naddeo et al, 2021).

The most important government plan in Iran to deal with the COVID-19 crisis has been to implement a social distancing plan (Imani Jajromi, 2021). This has also led to the continuation of e-learning. E-learning is not a novel educational approach. It has been incorporated into higher education for years (Kentnor, 2015). In 1989, the University of Phoenix became the first institution to launch fully online Bachelor's and Master's degree programs. Subsequently, there was a steady increase in the delivery of online education across the world. In 2017, 19.5% of undergraduate students in the United States took at least one online course in their study (Tsang et al, 2021). E-learning in Iran, like other countries in the world became fully electronic in a very short time. In fact, this change was a rapid epidemic response, as well as a major challenge that all educators and learners must adapt to existing conditions and e-learning (Syakur & Sabat, 2020). In general, e-learning environments and online environments use an interactive network system, providing learners with the quality of teaching and learning through various content management (Li, 2007). With systematic design processes, online courses were developed for education with the maximal use of technologies, including websites, learning portals, video conferencing, and mobile apps, and instructors and students were equipped to perform remote teaching and learning activities. The effectiveness of online learning has also been reported in various studies (Shukor et al, 2015).

Acceptance of e-learning during the coronavirus crisis was a sudden and unplanned response (Bozkurt & Sharma, 2020). The most important problem that learners faced in such situations was the decrease in learning (Bahasoan et al, 2020). Adnan and Anwar (2020) reported that a sudden change of classroom to electronic platform has led to a decrease in students' academic performance and learning (due to unpreparedness for it). Also, other studies have shown that students' learning rate has decreased during the COVID-19 pandemic due to lack of high-speed Internet access, lack of social communication of learners, lack of necessary infrastructure for this type of education as well as incorrect use of teaching methods in e-learning (Adnan & Anwar, 2020; Demuyakor, 2020; Tejedor et al, 2021).

The success of education depends on students' increased learning (Raes et al, 2020). One of the

variables that is directly related to learning and academic performance is academic efficacy (Honicke & Broadbent, 2016). Academic efficacy is one of the important factors that influences academic performance (Hayat, Shateri, Amini & Shokrpour, 2020). Academic efficacy refers to the student's beliefs and attitudes toward their capabilities to achieve academic success, as well as their ability to fulfill academic tasks and the successful learning of the materials (Bandura, 2006). Alyami et al. (2017) conducted a study on 214 university students and revealed that academic efficacy has a positive and significant effect on their academic performance. Other studies have shown that academic efficacy has a considerable effect on the students' learning, motivation, and academic performance (Abellán-Roselló & Gómez-Artiga, 2017; Alhadabi & Karpinski, 2020; Doménech-Betoret et al, 2017; Wu et al, 2020).

In e-learning, the role of teachers and the teaching methods they choose are crucial to the success or failure of education (Aboagye et al, 2021). Moreover, learning strategies or models have a considerable influence on the success of a student in the educational environment. These strategies, particularly, determine which courses require a learning model leading to the development of students' cognitive abilities, among which PBL model had many potentials for the purpose (Faqiroh, 2020). There are several approaches to teaching in electronic environments, which are mainly divided into active and inactive categories (Moreno-Guerrero et al, 2020). In inactive methods, the teacher plays the main role (Seok, 2008). In these methods, although a large amount of content is transferred from the teacher to the students, learning does not result in problem solving (Badali et al, 2020) and therefore, some new teaching methods based on problem-solving are considered (Mansoori et al, 2017). These methods are emerged in pedagogical philosophy as a field of research related to students' learning and educational creativity in education (Jin & Bridges, 2014). Active teaching methods are based on a constructivist approach that emphasizes the role and activity of the learner (O'Connor, 2020).

One of the active teaching methods is the PBe-L. PBe-L is a teaching method in which complex real-world problems are used as the vehicle to promote students' learning of concepts and principles as opposed to direct presentation of facts and concepts (Arifin et al, 2018). In the PBe-L, efforts are made for collaborative learning and active interaction of learners (Dawood et al, 2021). To begin the PBe-L, a problem must be raised, then the instructor, as a mentor, facilitates the problem-solving in the learners. The instructor's tasks in this approach include scaffolding, orienting exploration, strengthening understanding of difficult concepts,

introducing sources, and providing appropriate feedback (Prabandaru et al, 2020).

A review of research shows that the use of PBL can affect the level of learning and satisfaction in electronic environments (Badali et al, 2020), learning and academic achievement (Gezim & Xhomara, 2020) and academic performance (Mansoori et al, 2017). Some research has also shown that problem-oriented education has an effect on academic efficacy (Lee, 2020; Saputro et al, 2020), but its effect on the electronic environment during pandemic corona conditions is ambiguous. Thus, due to the existence of COVID-19 conditions and universities turning to e-learning and the need to pay attention to the quality of this type education and also due to the research gap in this field, this research investigated the effect of PBe-L on students' learning and academic efficacy during the pandemic COVID-19.

## Method

### Research design

The study adopted a quasi-experimental design with a pretest-posttest and the control group.

### Participants

The study took place in Tehran University, Iran. The statistical population of this study consisted of undergraduate students in the field of educational sciences at the University of Tehran. 40 students were selected as the research sample using the available sampling method and were randomly divided into experimental and control groups. After conducting the research, one student from each group was excluded from the research due to excessive absence and the number of research samples was reduced to 38 and 19 people in each group. The participants were 38 BSc students in the field of Educational Sciences who enrolled for the course "Educational Technology". The course aims to help students learn what educational technology is, its history, its fields such as e-learning, MOOCs (Massive Open Online Course), educational simulation, virtual laboratory, Augmented reality (AR) and Virtual reality (VR), etc. as well as using various types of educational technologies in classrooms. This course gives students awareness on the relevant ethical issues when using these technologies and the Internet in classroom settings. The average age of the participants was 19.32 (SD = 0.86). Almost, 75 % of the students were female and 25% were male. The data was collected from 38 students who enrolled in the same course in one semester.

Inclusion criteria of the study included: 1. being an undergraduate student of educational sciences; 2.

choosing an educational technology course; 3. participating in the research with satisfaction. Exclusion criteria included: 1. absence of more than two sessions in each class; and 2. distorted research questionnaires.

## Instruments

**Learning Test:** To measure learning, a multiple-choice test with 20 questions was created by researchers from the content of the courses related to 8 sessions. To evaluate the validity of this test, the opinions of relevant instructors and experts and a two-dimensional target-content table were used. Also, Cronbach's alpha was used to measure the reliability of the test, which showed that the reliability of this test is .77.

**Academic Efficacy Scale:** The Academic Efficacy Questionnaire was developed by Jinks and Morgan in 1999. This scale has 30 questions. The items on this Likert scale have a four-point answer of 4 (strongly agree), 3 (somewhat agree), 2 (somewhat disagree) and 1 (strongly disagree). Questions 4, 5, 15, 16, 19, 20, 22, 23 are scored in reverse. The scale makers reported the internal consistency of the scale using Cronbach's alpha method as .87 (Jinks & Morgan, 1999). The validity and reliability of the Academic Efficacy Questionnaire in Iran were evaluated by Mazaheri and Sadeghi (2016). The results showed that the validity was confirmed and the reliability was 0.73. In this study, reliability was obtained using Cronbach's alpha as .80.

## Procedure

For both groups, the pre-tests of learning and academic effectiveness were conducted online. Then, selected materials were presented for both groups. PBe-L instructional design used for the experimental group is explained below.

## The process of PBe-L

Regarding teaching the subject with the problem-solving approach and the duties of the teacher and students, an agreement was made between the course instructor (both the teacher and the researcher) and the students. The tasks of students in this project were to actively participate in small groups, comment on other students' solutions, search the internet for problem solving, discuss the problem with classmates, and present the result of the problem-solving process in the classroom. The teacher's duties were also to coach and facilitate the class process. Based on the topic of the course and consultation with content experts and experienced instructors, for each session, an issue related to the topic of the course was identified to be presented as an issue in the next week. At this stage, an attempt was made to

design an interesting problem for the learners to provide the students with a mental engagement with the subject during the week.

The issue and the related topics were discussed in the class, to activate learners' minds to learn. During this time, students need to be prepared to perceive the basics of the issue through studying and Internet searches. A virtual social networking group had also been set up to facilitate the course instructor and her assistant in a timely manner. The problem was raised in the class and students in different groups offered ideas to solve it. The group representative and each member of the group had to argue while defending their hypothesis. In this way, all members of the group tried to come up with the right solutions to solve the problem with strong reasoning. The instructor, as the facilitator, guided the class and finally gave a summary of the situation or problem, and the main hypotheses for solving the problem were partially agreed upon.

Teaching for the control group was done in a conventional way and with a direct approach in the electronic environment. For this group, the teaching

method was direct and linear in which the instructor prepared the materials in advance and taught using different slides. The method used for this group was mostly lecturing or theatrical.

Teaching was held for both groups for two months and one session per week (a total of 8 sessions). In the eighth session of this study, the post-tests of learning and academic efficiency were performed for both groups. Thus, the necessary data for statistical calculations were provided.

### Data Analysis

Findings were analyzed using SPSS software version 23 and the covariance method. Before using the covariance method, its assumptions were tested using the Kolmogorov-Smirnov test and Levene's test.

### Findings

The following table shows the descriptive information of the research groups and variables.

**Table 1**

*Mean and Standard Deviation of the Variables in Experimental and Control Groups in Pre-Test and Post-Test (n=38)*

Variable	Group	Test	Mean	Std. Deviation
learning	experimental	Pre-test	7.92	2.01
		Post-test	18.51	1.93
	control	Pre-test	8.71	1.38
		Post-test	17.03	1.89
academic efficacy	experimental	Pre-test	57.00	12.53
		Post-test	76.57	17.94
	control	Pre-test	60.92	10.49
		Post-test	62.00	9.96

Table 1 shows that the mean of the experimental group after the problem-based method training has increased from 7.92 to 18.51. Also, the mean score of the control group after experiencing the conventional method has increased from 8.71 to 18.03. Comparison of academic motivation results shows that the mean of pre-test and post-test of the experimental group changed from 57.00 to 76.57 but the mean of the control group did not differ significantly.

Then the covariance method was used. Before using analysis of covariance, its assumptions were tested using Kolmogorov-Smirnov and Levene's test. Considering that in Kolmogorov-Smirnov and Levene's test, the level of significance was higher than 0.05, it can be

stated that the data were normal ( $Z = .632$ ,  $\text{sig} = 2.314$ ) indicating that there is a linear relationship between the dependent variable and the variable for the groups. Finally, considering that the significance level of F values obtained is higher than 0.05, and the pre-test and post-test regression slopes in the experimental and control groups were not significantly different, it is claimed that the assumption of homogeneity of regression slopes was confirmed ( $F = 1.078$ ,  $\text{sig} = 1.673$ ). Therefore, the assumptions of the analysis of covariance test are observed.

In Tables 2 and 3, the results of the analysis of covariance are reported.

**Table 2***The Results of Univariate ANCOVA for Post-Test Scores of the Learning*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	18.101	2	9.051	5.879	.008	.320
Intercept	364.516	1	364.516	236.772	.001	.904
Pre-test	.021	1	.021	.014	.004	.160
grope	16.519	1	16.519	10.730	.003	.300
Error	38.488	35	1.540			
Total	8842.875	38				
Corrected Total	56.589	37				

Table 2 demonstrates that there is a significant difference between the mean of the experimental and control groups in the post-test, that is, the difference between the mean of learning between the two groups, one with a PBe-L and the other with the conventional

method, with %95 of confidence is significant ( $F=10.730$ ,  $P\leq 0/005$ ). Considering the mean of learning in the two groups in the post-test, it can be concluded that PBe-L is more effective on students' learning during the COVID-19 pandemic than the conventional method.

**Table 3.***The Results of Univariate ANCOVA for Post-Test Scores of the Academic Efficacy*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	4548.305 <sup>a</sup>	2	2274.153	14.454	.001	.536	
Intercept	408.587	1	408.587	2.597	.120	.094	
Pre-test	3062.019	1	3062.019	19.462	.001	.438	
grope	2194.556	1	2194.556	13.948	.001	.358	
Error	3933.409	35	157.336				
Total	142896.000	38					
Corrected Total	8481.714	37					

According to Table 3, there is a significant difference between the mean of the experimental and control groups in the post-test, that is, the difference between the mean of academic efficacy between the two groups, one with a PBe-L and the other with the conventional method, with %95 of confidence is significant ( $F=13.948$ ,  $P\leq 0/005$ ). Considering the mean of the two groups in the post-test, it can be concluded that PBe-L is more effective on students' academic efficacy during the COVID-19 pandemic than the conventional method.

## Discussion

The aim of this study was to determine the effectiveness of BPeL on students' learning and academic efficiency. The first result of the study showed that the BPeL method was significantly more effective than the conventional method. This result is in line with the results of previous studies such as those of Badali et al. (2020) as well as Gezim and Xhomara (2020) which showed that the use of problem-based approach is effective on learners' learning and performance.

After the corona outbreak, universities turned to e-learning (Edelhauser & Lupu-Dima, 2020) and to make e-learning effective, different teaching techniques and approaches have been used. Traditional teaching approaches are teacher-centered and learners participate passively in learning activities while using a BPeL method can engage students more (Kibret et al, 2020). According to the BPeL, learning occurs while solving a genuine and meaningful problem. In fact, the central problem creates a learning situation that activates the learner's prior knowledge and motivates them to engage in the learning process (Gardner, 2020). Increasing the level of cognitive engagement and activating the learner's mind in the BPeL process can also increase the level of learning.

According to many education experts, if we accept the pivotal and fundamental role of university students in learning through searching and problem solving, explaining the dimensions of problem-based learning is also essential (Ozturk et al, 2008). Socrates pointed out the importance of problem-solving and the questions that cause the learner to think before accepting an idea,

as well as the importance of seeking evidence, careful testing, reasoning, hypothesis making, and glorifying basic concepts. In fact, it can be stated that education with a problem-oriented approach, based on the constructivist paradigm, is designed with the aim of self-directed, independent and learner-centered learning. In this approach, learners actively pursue learning and thus strengthen their learning skills and analyze educational issues; thus, using this educational approach can make the teaching method more effective on the rate of learning during corona conditions.

During the COVID-19 pandemic, one of the main problems for students is the lack of academic efficacy. This study showed that this deficiency is partially eliminated by using the BPeL. Explaining the effectiveness of the BPeL on academic efficiency, it can be held that BPeL gives students the opportunity to solve their problems through thinking, exploring, researching and searching the Internet in corona conditions. This experience can both increase their academic efficacy and at the same time increase their motivation (Saputro et al, 2020). The BPeL strengthens students' curiosity and allows students to actively and independently explore and seek problem-solving with the support of the instructor. In the process of such exploration, they learn to connect with their classmates and respect each other's results and ideas. This process of exploration as well as cooperating in the classroom can increase academic efficiency (Sitohang, Sumiati & Susanti, 2021). Studies have shown that most learners prefer active teaching methods such as the problem-based approach, and in their opinion, good teachers are those who activate the learners in learning and motivate them (Lee, 2020). The research of Saputro et al. (2020) and Sitohang et al. (2021) showed that activating learners through using problem-solving activities increases their academic efficacy.

Because of abundant ambiguity and disruption in the new normal, tailor-made schemes and structured learning programs in the workplace will not address the disruptive conditions in the different communities. Thus, problem-based learning (PBL) programs would be the most suitable alternative. PBL programs also help the workplace adopt 'learner centered approach' faster without undermining the educational and training requirements. The combination of both learner-centered and problem-based learning approaches has been proved to be effective in some fields such as medical sciences and engineering fields. These experiences need to be transformed into other disciplines in the new normal to enhance the capacity and viability towards newly realized life and livelihood challenges (Buheji & Buheji, 2020).

## Conclusion

The results obtained from this study indicate that BPeL is more effective in increasing the learning and academic efficacy of students. Students in the BPeL environment performed better than the conventional method. BPeL is a student-centered approach. Excessive exposure to a student-centered approach might be the reason for the statistically significant increase in the mean scores on both dependent variables. It is a method that shifts the leading role from teachers to students and is based on the guided self-learning. If it is applied properly, the degree of satisfaction is high, especially for students.

Moreover, PBeL is more effective than traditional methods (based mainly on lectures) at improving learning, problem-solving and self-learning skills, and has no worse results (and in many studies better results) in relation to academic performance. Despite that, it seems that its use is not universally widespread, probably because it requires greater human resources and continuous training for its implementation. In any case, more comparative and randomized studies and/or other systematic reviews and meta-analysis are required to determine which educational strategies could be most suitable for the training of future generation.

The use of available sampling method was a limitation for this study. Also, due to the lack of conditions for performing the follow-up test, it was not possible to measure the durability of the results. In addition, the current study was limited to 38 students at Tehran University, thus it will be useful to conduct further research with a larger sample. As the current study is quantitative research, using interviews for future studies will strengthen quantitative findings.

Based on the findings, it is suggested that BPeL should be used more frequently in higher education to further enhance learning and academic efficacy of students. It is also suggested to pay attention to the BPeL in order to improve students' engagement, learning and academic efficacy. Finally, further studies can also investigate the effect of BPeL on learning and academic efficacy at other conditions.

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## Conflicts of Interest

No conflicts of interest declared.

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## References

- Aboagye, E., Yawson, J. A., & Appiah, K. N. (2021). COVID-19 and e-learning: The challenges of students in tertiary institutions. *Social Education Research*, 2(1), 1-8.

- Adnan, M., & Anwar, K. (2020). Online learning amid the COVID-19 pandemic: Students' perspectives. *Online Submission*, 2(1), 45-51.
- Alhadabi, A., & Karpinski, A. C. (2020). Grit, self-efficacy, achievement orientation goals, and academic performance in University students. *International Journal of Adolescence and Youth*, 25(1), 519-535.
- Alyami, M., Melyani, Z., Al Johani, A., Ullah, E., Alyami, H., Sundram, F., et al. (2017). The impact of self-esteem, academic efficacy and perceived stress on academic performance: A cross-sectional study of Saudi psychology students. *Eur J Educ Sci (EJES)*, 4(3), 51-68.
- Arifin, I. F., Musaddad, A. A., & Sudiyanto, S. (2018). PBL (Problem Based Learning) model based on constructivist socioculturalism: Theory and concept of the millennial era of learning model. *Yupa: Historical Studies Journal*, 2(2), 115-125.
- Badali, M., Hatami, J., Farrokhnia, M., & Noroozi, O. (2020). The effects of using Merrill's first principles of instruction on learning and satisfaction in MOOC. *Innovations in Education and Teaching International*, 1-10.
- Bahasoan, A. N., Ayuandiani, W., Mukhran, M., & Rahmat, A. (2020). Effectiveness of online learning in pandemic COVID-19. *International Journal of Science, Technology & Management*, 1(2), 100-106.
- Bandura, A. (2006). Guide for constructing self-efficacy scales. *Self-efficacy Beliefs of Adolescents*, 5(1), 307-337.
- Bozkurt, A., & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to Corona Virus pandemic. *Asian Journal of Distance Education*, 15(1), 1-6
- Buheji, M., & Buheji, A. (2020). Characteristics of 'problem-based learning' in post-COVID-19 workplace. *Human Resource Management Research*, 10(2), 33-39.
- Syakur, A., & Sabat, Y. (2020). The effectiveness of cooperative learning (STAD and PBL type) on e-learning sustainable development in higher education. *Journal of Development Research*, 4(1), 53-61.
- Dawood, O., Rea, J., Decker, N., Kelley, T., & Cianciolo, A. T. (2021). Problem-based learning about problem-based learning: Lessons learned from a student-led initiative to improve tutor group interaction. *Medical Science Educator*, 31(2), 395-399.
- Demuyakor, J. (2020). Coronavirus (COVID-19) and online learning in higher institutions of education: A survey of the perceptions of Ghanaian international students in China. *Online Journal of Communication and Media Technologies*, 10(3), e202018.
- Doménech-Betoret, F., Abellán-Roselló, L., & Gómez-Artiga, A. (2017). Self-efficacy, satisfaction, and academic achievement: The mediator role of students' expectancy-value beliefs. *Frontiers in Psychology*, 8(1), 1193.
- Edelhauser, E., & Lupu-Dima, L. (2020). Is Romania prepared for eLearning during the COVID-19 pandemic? *Sustainability*, 12(13), 5438.
- Faqiroh, B. Z. (2020). Problem based learning model for junior high school in Indonesia (2010-2019). *Indonesian Journal of Curriculum and Educational Technology Studies*, 8(1), 42-48.
- Gardner, J., Barclay, M., Kong, Y., & LeVally, C. (2020). Designing an accelerated graduate evaluation course using the first principles of instruction and interactive media. *Journal of Educational Technology Systems*, 48(4), 493-517.
- Gezim, B. A. R. A., & Xhomara, N. (2020). The effect of student-centered teaching and problem-based learning on academic achievement in science. *Journal of Turkish Science Education*, 17(2), 180-199.
- Hayat, A. A., Shateri, K., Amini, M., & Shokrpour, N. (2020). Relationships between academic efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: A structural equation model. *BMC Medical Education*, 20(1), 1-11.
- Honicke, T., & Broadbent, J. (2016). The influence of academic efficacy on academic performance: A systematic review. *Educational Research Review*, 17, 63-84.
- Imani Jajromi, H. (2021). Social consequences of the outbreak of coronavirus in Iranian society. *Social impact assessment, Corona Special Letter*.
- Jin, J., & Bridges, S. M. (2014). Educational technologies in problem-based learning in health sciences education: A systematic review. *Journal of Medical Internet Research*, 16(12), e251.
- Jinks, J., & Morgan, V. (1999). Children's perceived academic efficacy: An inventory scale. *The Clearing House*, 72(4), 224-230.
- Kentnor, H. E. (2015). Distance education and the evolution of online learning in the United States. *Curriculum and Teaching Dialogue*, 17(1), 21-34.
- Kibret, S., Teshome, D., Fenta, E., Hunie, M., Taye, M. G., Fentie, Y., & Tamire, T. (2021). Medical and health science students' perception towards a problem-based learning method: A case of Debre Tabor University. *Advances in Medical Education and Practice*, 12(1), 781.
- Lee, O. S. (2020). The effect of the problem-based learning on critical thinking disposition, academic efficacy and self-leadership of nursing students-diagnostic tests and nursing. *Journal of Digital Convergence*, 18(5), 279-285.
- Lin, H. F. (2007). Measuring online learning systems success: Applying the updated DeLone and McLean model. *Cyberpsychology & Behavior*, 10(6), 817-820.
- Mansoori, S., Abedini-baltork, M., Lashkari, H., & Bagheri, S. (2017). Effectiveness of problem-based learning on student's academic performance: A quasi-

- experimental study. *Research in Medical Education*, 9(1), 1-8.
- Mazaheri, Z., & Sadeghi A. (2016). Construction and evaluation of validity and reliability of students' academic efficacy questionnaire. *New Educational Approaches*, 10(2), 61-80.
- Moreno-Guerrero, A. J., Aznar-Díaz, I., Cáceres-Reche, P., & Alonso-García, S. (2020). E-learning in the teaching of mathematics: An educational experience in adult high school. *Mathematics*, 8(5), 840.
- Murphy, M. P. (2020). COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy*, 41(3), 492-505.
- Naddeo, A., Califano, R., & Fiorillo, I. (2021). Identifying factors that influenced wellbeing and learning effectiveness during the sudden transition into eLearning due to the COVID-19 lockdown. *Work*, (Preprint), 1(1), 1-23.
- O'Connor, K. (2020). Constructivism, curriculum and the knowledge question: Tensions and challenges for higher education. *Studies in Higher Education*, 1-11.
- Ozturk, C., Muslu, G. K., & Dicle, A. (2008). A comparison of problem-based and traditional education on nursing students' critical thinking dispositions. *Nurse education today*, 28(5), 627-632.
- Prabandaru, R. D., Lismadiana, L., & Nanda, F. A. (2020). Problem-based learning approach to improve service skills of badminton in physical education learning. *International Journal of Education and Learning*, 2(1), 14-24.
- Raes, A., Vanneste, P., Pieters, M., Windey, I., Van Den Noortgate, W., & Depaepe, F. (2020). Learning and instruction in the hybrid virtual classroom: An investigation of students' engagement and the effect of quizzes. *Computers & Education*, 143, 103682.
- Saputro, A. D., Atun, S., Wilujeng, I., Ariyanto, A., & Arifin, S. (2020). Enhancing pre-service elementary teachers' self-efficacy and critical thinking using problem-based learning. *European Journal of Educational Research*, 9(2), 765-773.
- Seok, S. (2008). Teaching aspects of e-learning. *International Journal on E-learning*, 7(4), 725-741.
- Shukor, N. A., Tasir, Z., & Van der Meijden, H. (2015). An examination of online learning effectiveness using data mining. *Procedia-Social and Behavioral Sciences*, 172, 555-562.
- Sitohang, G. J., Sumiati, A., & Susanti, S. (2021). The effect of problem based instruction model based on learning video and educational games media on the self-efficacy of students of class X SMK N 17 Jakarta. *Journal Corner of Education, Linguistics, and Literature*, 1(2), 106-113.
- Tejedor, S., Cervi, L., Pérez-Escoda, A., Tusa, F., & Parola, A. (2021). Higher education response in the time of coronavirus: Perceptions of teachers and students, and open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 43.
- Tsang, J. T., So, M. K., Chong, A. C., Lam, B. S., & Chu, A. M. (2021). Higher education during the pandemic: The predictive factors of learning effectiveness in COVID-19 online learning. *Education Sciences*, 11(8), 446.
- Vijayan, R. (2021). Teaching and learning during the COVID-19 pandemic: A topic modeling study. *Education Sciences*, 11(7), 347.
- World Health Organization (2020). World Health Organization coronavirus disease (COVID-19) dashboard. *World Health Organization*.
- Wu, H., Li, S., Zheng, J., & Guo, J. (2020). Medical students' motivation and academic performance: The mediating roles of self-efficacy and learning engagement. *Medical Education Online*, 25(1), 1742964.