The role of inductive learning models on the students self-regulated learning in math journaling

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Abstract

Students' self-regulated learning has become an essential element of student's success in the education sector and therefore, needs the attention of policymakers and scholars alike. Thus, the current study investigates into the role of different learning styles such as just-in-time learning, case-based learning, inquiry learning, project-based learning and problem-based learning on students' self-regulated learning in the context of public sector universities in Indonesia. Questionnaires are used by researchers to gather the data from respondents. The purposive sampling technique is used to select the student respondents who are using math journaling. Researchers also execute the PLS-SEM for the purpose of analysis and tests the validity, reliability and relationships among variables. The results indicate that all learning styles such as just-in-time learning, case-based learning, inquiry learning, project-based learning and problem-based learning have a positive nexus with students' self-regulated learning in public sector universities in Indonesia. This study provides valuable insights to policymakers regarding formulating new policies about student self-regulated learning.

Keywords: Just-in-time learning, inquiry learning, project-based learning, problem-based learning, students' self-regulated learning

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Introduction

The capability to get familiar with, understand, and manage a provided learning environment can be taken as self-regulated learning. Students act to set goals, and monitor themselves; self-guidance, evaluation, and reinforcement of strategies are essential parts of one's self-regulation ability (Cerezo, Bogarín, Esteban, & Romero, 2020; Kikulwe & Asindu, 2020; Malla & Brewin, 2020; Putratama, Sutriyono, & Pratama, 2019). Self-regulation must not be mixed with cognitive potential or academic ability of the students. On the other hand, self-control is the procedure of passing self-directions and combination of students' conducts in which the students instill their cognitive potential into certain skills or continuous behavior through self-development on the basis instructed actions, and feedback. Effective students or learners regulate themselves, monitor & understand their learning environment, identify the end-objectives, and make the right choice/alterations, or present something new to hit the goals (Ashraf, Najam, & Nusrat, 2020; Bolu, Gündoğmuş, Öznur, & Çelik, 2020; Hensley, Iaconelli, & Wolters, 2021b; Lu, Penney, & Kang, 2021). Effective learners or students must check the level of progress in learning with the completion of the actions decided in learning strategy, manage their emotions to avoid distraction, and ensure concentration while making alterations for ultimate learning success. Self-regulating students must keep on questioning, taking notes, and using their time and equipment in such a manner as they themselves can successfully administer their learning. Through the application of inductive learning, students' self-regulated learning can be developed. Inductive learning is most often described as a discovery-oriented learning process. It refers to process of learning where students do not blindly follow rules but observe or study practical examples to prove or uncover certain principles or rules (Carpenter, Endres, & Hui, 2020; Haq, 2020; Matsuyama, Nakaya, Okazaki, Lebowitz et al., 2019; Mukama, 2020). Inductive teaching is a method of instructing students on how to manage and classify facts including subject matter of the class, skills, and ability to understand. It is utilized when professors wish to go deeper into the principles that support the subject matter of learning and want students to learn how they can attain knowledge relevant to context (Araka, Maina, Gitonga, & Oboko, 2020; Gudalov & Treshchenkov, 2020; Özigci, 2020; Peel, 2019). There are five different models of inductive learning such as like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning. The inductive learning processes do not force students to digest the facts or learning material, rather a learning environment is created which develops critical thinking, skills, habits, and behaviors among the students who can self-regulate learning and become able to overcome real-life problems, issues, and complex situations (Ainscough, Stewart, Colthorpe, & Zimbardi, 2018; Albert & Gómez-Fernández, 2020; Araka, Maina, Gitonga, & Oboko, 2019; Corrás-Arias, 2020).

The focus of our study is on analysis of the impacts of inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning for the educational sector of. Indonesia is one of the emerging economies of the world, and the largest one in Southeast Asia. Indonesia is an upper-middle-income economy and a member of the G20 countries (Barabadi, Robatjazi, & Bayat, 2020; Çağatay & Erten, 2020; Fadhil & Sabic-El-Rayess, 2021; Pelikan, Lüftenegger, Holzer, Korlat et al., 2021). As per the nominal gross domestic product (GDP), it is the 15th largest economy in the world, and as per GDP (PPP), it is the 7th largest economy in the world. The estimated nominal GDP of Indonesia is $ 1.16 trillion, and GPD (PPP) will be $3.51 trillion in 2021 (Fitriani, Zubaidah, Susilo, & Al Muhdhar, 2020; Girgin, 2020; Muwonge, Ssenyonga, Kibedi, & Schiefele, 2020; Sparrow, Dartanto, & Hartwig, 2020). According to the Regulation of the Minister of Higher Education, Technology, and Research of Indonesia Number 51, 2018 is concerned with the Establishment, Amendment, Revocation of Private Higher Education, and Establishment, Amendment, and Discontinuation of State Higher Education. In Indonesia, the higher education system offers professional degrees, academic degrees, and vocational degrees. In Indonesia, the government provides funds for Public higher education institutions. These are self-managed institutions. Nowadays, there are 122 public higher education institutions comprised

of 63 public universities, 43 Polytechnics, 12 Institutes, and 4 Community Colleges (Akanle & Shadare, 2020; Bryan, 2020; Cervin-Ellqvist, Larsson, Adawi, Stöhr et al., 2020; Sumartono, Urumsah, & Hamdani, 2020). Some of the best public universities in Indonesia are University of Indonesia, Gadjah Mada University, University of Andalas, Univesity of Hasanuddin, University of North Sumatra, Lambung Mangkurat, Mulawarman University, Cenderawasih University, Sunan Kalijaga State Islamic University, Pattimura University, and Tanjungpura Univerity etc. (Aguirre & Goméz, 2020; Breetzke, Pearson, Tao, & Zhang, 2020; Martha, Junus, Santoso, & Suhartanto, 2021).

Indonesia is a fast emerging economy with a large population that needs education for social reformation and economic progress. Although, in addition to the government, private individuals or institutions government also provide funds for the education sector, many educational institutions do not provide the required quality or learning to their students. Thus, education development rate is low. That is why the number of higher educational institutions such as universities is limited in Indonesia (Govender & Govender, 2020; Hotar, 2020; Li, Zheng, Lajoie, & Wiseman, 2021; Pambudi & Harjanto, 2020). Indonesia is one of the largest countries in the world with respect to population. The need for educational facilities increases with an increase in the population. Though Indonesia has a large education system and the government itself is providing funds for public education institutions which are operating in all regions of the world, the performance of all the public educational institutions is not satisfactory (Alvi & Gillies, 2021; Asha & Makalela, 2020; Chilimba, Dunga, & Mafini, 2020; Dinsmore, 2017). Students' self-regulated learning has become an essential part of student's success or accomplishments in the education sector and therefore, needs the attention of policymakers and academics (Abulela & Harwell, 2020; Barr & Askell-Williams, 2020; Dong, Wu, Dong, & Tang, 2020; Thomas, Muls, Backer, & Lombaerts, 2021). Thus, the current study investigates into the role of different learning styles such as just-in-time learning, case-based learning, inquiry learning, project-based learning and problem-based learning vis-à-vis students' self-regulated learning in public sector universities in Indonesia. There was a need to focus on the quality of learning imparted to the students. Considering this need, our study focuses on students' self-regulated learning. The aim of our study is to analyze the influences of inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning. Until now, though the role of inductive learning in developing the capacity of student for self-regulated learning has been explored by researchers and academics, the processes or models have not been studied in-depth.

In addition, our study overcomes this literary gap by dividing inductive learning into five processes or models such as inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning for the analysis of the students' self-regulated learning. Several authors have discussed the influences of inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning. However, mostly, the authors have dealt with one or two inductive learning models for the analysis of students' self-regulated learning in their individual studies. Our study is a significant contribution to existing literature as it gives simultaneous descriptions of all the inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning to determine the students' self-regulated learning. For the analysis of the nexus among the aforementioned inductive learning models and students' self-regulated learning, the public higher education sector of Indonesia has been selected, which in itself is a significant contribution to literature, as no past study has addressed this issue in the context of the public higher education sector of Indonesia.

This paper is comprised of several parts. The 2nd part throws light on the views and opinions of different authors presented in past literature concerning the nexus among inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning. The 3rd part describes how quantitative data about the impact of inquiry-based learning, problem-based learning, project-based

learning, case-based learning, and just-in-time learning on students' self-regulated learning has been collected and analyzed. Subsequently, the results of the study, which are based on the data collected, are compared with and supported by findings from past studies. Following this, the study conclusions and implications are given in the last portion.

Literature Review

The education sector of a country has vital importance in terms of the growth and development o its economy, society, and politics. This is because education trains actors like social reformers, thinkers, philosophers, leaders, artists, scientists, doctors, and businessmen. The performance of educational institutions is dependent on the effective performance of students (Álvarez, González-Peño, & Coterón, 2020; Carolina-Paludo, Nunes-Rabelo, Maciel-Batista, Rúbila-Maciel et al., 2020; Michalsky & Schechter, 2018). With the development of self-regulated learning, which is a cyclical process consisting of planning for tasks, monitoring their own performance, and reflection upon the outcomes, student performance can be improved. Students with more effective self-regulated learning can perform well both in exams and in practical life (Hajjar, 2020; Hensley, Iaconelli, & Wolters, 2021a; Joffroy, 2020). Students' self-regulated learning can be developed and improved with the use of effective learning processes for students such as inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning which can determine students' self-regulated learning and their performance. Within the existing literature, several authors have presented their views on the nexus among inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning, and students' self-regulated learning. Our study postulated specific hypotheses in light of these arguments.

In traditional classrooms or learning environments, where the students are given a set of learning material to digest as it is, the students feel bored, and they are unengaged. Consequently, they are unable to effectively learn or understand the material or subjects being taught and fail to make their learning permanent. In inquiry-based learning, the role of students is more emphasized than the role of a teacher in the learning process. Inquiry-based learning is an effective step to students' self-regulated learning because, in this process of learning, teachers do not tell students what they must know; rather, the student is encouraged or motivated to explore the topic, ask questions, and share ideas among themselves (Moote, 2019). Moote (2019) focus on the relationship between inquiry-based learning and students' self-regulated learning. This study analyzes the influences of students' participation in the CREativity in Science and Technology (CREST) program on student self-regulated processes and related motivations. A rigorous quasi-experimental research design was applied. Data were collected through pen and paper form questionnaires from students of 2nd year of secondary school (aged 12 or 13 years) who participated in the CREST program. The results showed that the inquiry-based learning program motivates the students to focus on the task, contemplate upon it, ask questions, share ideas, and in cooperation with others, make strategies, and implement them to fulfil the task. A study by Taub, Sawyer, Lester, and Azevedo (2020), investigates the association between inquiry-based learning and students' self-regulated learning. Taub et al. (2020), argues that in the inquiry-based learning process, small groups of students are designed, facts and education material are not to be memorized but students, but mutual discussions, creativity, and sharing of ideas are encouraged. This increases the students' knowledge, awareness, broadens their scope of thinking, enables them to do the planning, and follow through it. Based on the above discussion, we put the following hypothesis:

H1: Inquiry-based learning has positive impacts on students' self-regulated learning.

Problem-based learning refers to the process of teaching which motivates students to become the determiner of the level of their learning education. In the problem-based learning process, complicated real-life issues are shown to students as the subject matter for the class in order to

encourage students to develop problem-solving skills and abilities needed to properly learn concepts instead of just absorbing or memorizing the facts. This process of learning can be employed in any subject, from social literature to science and mathematics. A study was conducted by Demirören, Turan, and Teker (2020) to investigate the determinants of students' self-regulated learning. The focus of this study is on the role of problem-based learning in developing students' self-regulated learning. This is a cross-sectional study based on data collected from 257 3rd-year medical students and analyzed by correlation coefficient and standard multiple regression analysis. The study implies that in the problem- based learning process, students are challenged to deeply understand the classroom subject matter by themselves, motivating them to make decisions to defend, compare current course objectives with previous ones and knowledge, and form groups to solve complicated issues and find solutions. In this way, it prepares students to regulate their own learning by effectively planning, solving issues, and achieving study objectives. A study by Darmawan, Syahputra, and Fauzi (2020), analyzes problem-based learning and students' self-regulated learning. The study states that in problem-based learning, students are demanded not to sit back, just listen to, and take notes, but are encouraged to take the driver's seat. Students are pushed to take the initiative and responsibility for their own learning. They are to be alert, use critical thinking skills, and think broadly to solve issues. This leads students to self-regulate their own learning process or goals in an effective manner. Similarly, research conducted by Istiningrum (2017), throws light on the relationship of problem-based learning with self-regulated learning. According to this study, problem-based learning creates teamwork abilities, more engagement, develops transformable skills, and encourages intrinsic rewards, which prove to be critical elements to develop self-regulated learning skills. The above-mentioned arguments lead the author to postulate the following hypothesis:

H2: Problem-based learning has positive impacts on students' self-regulated learning.

In project-based learning, students are given a particular task or project on which the students work for a long period of time (approximately a week or a semester) and in this time, they get in the process of solving real-life issues or answering a complicated question. In this way, they can develop and represent their knowledge and abilities by creating a new product or for a real-life audience. In the words of Lin (2018), project-based learning is a way of teaching students in a way that helps them attain knowledge and skills (cognitive and physical skills) by working on a single task for a long period of time, investigating the possible aspects of the task and responding to a real, engaging, and complicated question, challenge, or problem. Project-based learning prepares students for self-regulated learning as it helps students achieve in-depth content knowledge along with critical thinking skills, communication skills, collaboration, cooperation, and creativity. Project-based learning creates prolonged, creative, and innovative energy in the form of talents among teachers and students, which enable the students to set the goals of their learning, plan strategies to achieve these goals and evaluate their performance (Kamtini, Ray, Simatupang, Tanjung et al., 2020). A study was conducted by Yilmaz, Yilmaz, and Keser (2020), to investigate the interrelationship of online project-based learning, motivation, group collaboration, and self-regulated learning skills. The research was carried out as per the factorial experimental design (2 by 2), and the mixed-method was applied. A research survey was conducted on 41 teachers with a random sampling technique. The study implies that project-based learning develops concentration, critical thinking skills, teamwork and collaboration, improves invention and sharing of ideas, problem-solving ability, and resilience, which creates motivation in the students and helps them in self-regulated learning, which requires abilities like goal-setting, self-monitoring, self-instruction, and self-reinforcement. A study by Mou (2020), focuses on the association among project-based learning, problem-solving skills, and students' self-regulated learning. The study highlights that project-based learning encourages teamwork, communication skills, cooperation, and creativity in students, enabling them to develop the problem-solving skills needed to handle complex issues. This improves the knowledge and abilities of students for effective self-regulated learning. In light of this, the current study hypothesizes the following:

H3: Project-based learning has positive impacts on students' self-regulated learning.

Case-based learning can be defined as two-fold. First, through the cases themselves and secondly, through a discussion of them. A case has a plot, a tale, or a series of events that take place over time in a specific location (Susilowaty, 2020). The content of cases have been written in narrative form and to describe the specificity and contextualization of cases. Only giving contents of cases in written form is not enough for effective case-based learning as the key to case-based learning is discussion. Discussion must be integrated into student learning processes. Case-based learning processes encourage students and develops creative ability in them to adopt self-regulated learning process as case-based learning encourages students' engagement in discussion and provides them with an opportunity to analyze, ponder on the situation, propose solutions to complex issues under discussion, evaluate potential solutions, or decision making. The study conducted by Lyons and Bandura (2020), demonstrates the relationship between case-based instruction and improvement in self-regulated learning. Information pertaining case-based learning and self-regulated learning was acquired through a literature review as well as databases like Education Research Complete, Science Direct, and Psych Info. Activities like critical analysis, concentration, sorting out issues, presenting ideas, finding solutions, evaluating solutions, and final decision making enables the students to play an active role in the learning process and in doing so, develop stamina for self-regulation in the learning process. The research was made by Willems, Gonzalez-DeHass, Powers, and Musgrove (2021), to integrate the relationship between authentic case-based learning and teachers' self-regulated learning. An empirical survey was conducted on 107 undergraduate distance learning students from educational psychology courses from the region of the United States. During this experiment, short narrative authentic case studies from published literature (based on the text ranging 3–5 pages in length) were employed. Over the semester, students took part in problem-solving real-life situations online through asynchronous discussion boards. The study showed that case-based learning, which is comprised of learning from the content of cases and discussion about these cases, improves teachers' critical thinking along with communication and problem-solving skills and helps them in developing skills like goal setting, strategies, self-monitoring, self-instruction, evaluation, and self-reinforcement. Based on the above discussion, it can be hypothesized:

H4: Case-based learning has positive impacts on students' self-regulated learning

Just-in-time learning is an approach to organizational or individual learning and development. It is helpful for students in terms of helping develop self-regulated learning skills. Just-in-time learning promotes need-oriented training, which must be available at the time when needed and in the way it is required for learning. Though atrategic, planned, and structured training and development, which are provided at the decided time, are also effective in students' learning, just-in-time learning, which is an extension to traditional training or development, is preferable as it meets the sudden needs of students' learning. It enhances the students' ability to self-regulate their learning during class or semester (Wolters, Won, & Hussain, 2017). The study conducted by Yen, Bozkurt, Tu, Sujo-Montes et al. (2019), identifies the relationship between just-in-time learning and students' self-regulated learning. The study implies that just-in-time learning focuses on the fulfilment of the learner's need when it occurs, rather than the traditional or structured training, which occurs irrespective of the immediacy or scope of the needs. This helps the students in terms of planning, evaluation, and reinforcement as they need some knowledge, or must develop skills immediately for effective self-regulated learning. Hence, just-in-time learning improves students' self-regulated learning. Empirical research by Onah, Pang, and Sinclair (2020) focuses on the role of moment-by-moment learning or just-in-time learning in getting high-level students' self-regulated learning. The study implies that during the four stages of the cyclic process of self-regulated learning, that is goal setting, strategies, self-monitoring, self-instruction, evaluation, and self-reinforcement, students may need up-to-date information or communication which are more likely to be made possible *with* the use of innovative technology. This need for immediate knowledge through digital technology can be met effectively if students have the facility of just-in-time learning in the institution. Based on the above discussion, it can be hypothesized:

H5: Just-in-time learning has positive impacts on students' self-regulated learning.

Research Methods

The article examines the role of just-in-time learning, case-based learning, inquiry learning, project-based learning and problem-based learning on students' self-regulated learning in public sector universities in Indonesia. Questionnaires were used by the researchers to gather pertinent or relevant data from the target respondents. The questionnaires are based on a "five-point Likert scale" in which 1 denotes strongly disagree, and 5 denotes strongly agree. The purposive sampling was used to identify and select the students as respondents because only those students were selected who had spent at least two years in the university using math journaling. Thus, 1065 surveys were forwarded to the selected students, but only 760 surveys were returned, indicating a 71.36 per cent response rate.

The researchers also executed the PLS-SEM for the purpose of analysis and tested the validity, reliability and relationships among variables. This study has used five predictors such as just-in-time learning (JITL) with three items, case-based learning (CBL) with four items, inquiry learning (IL) with five items, project-based learning (PRBL) with eight items and problem-based learning (PBL) with ten items. In addition, the researchers used students' self-regulated learning (SSRL) as the dependent variable with twelve items. These variables along with their linkages or relationships are illustrated in Figure 1.
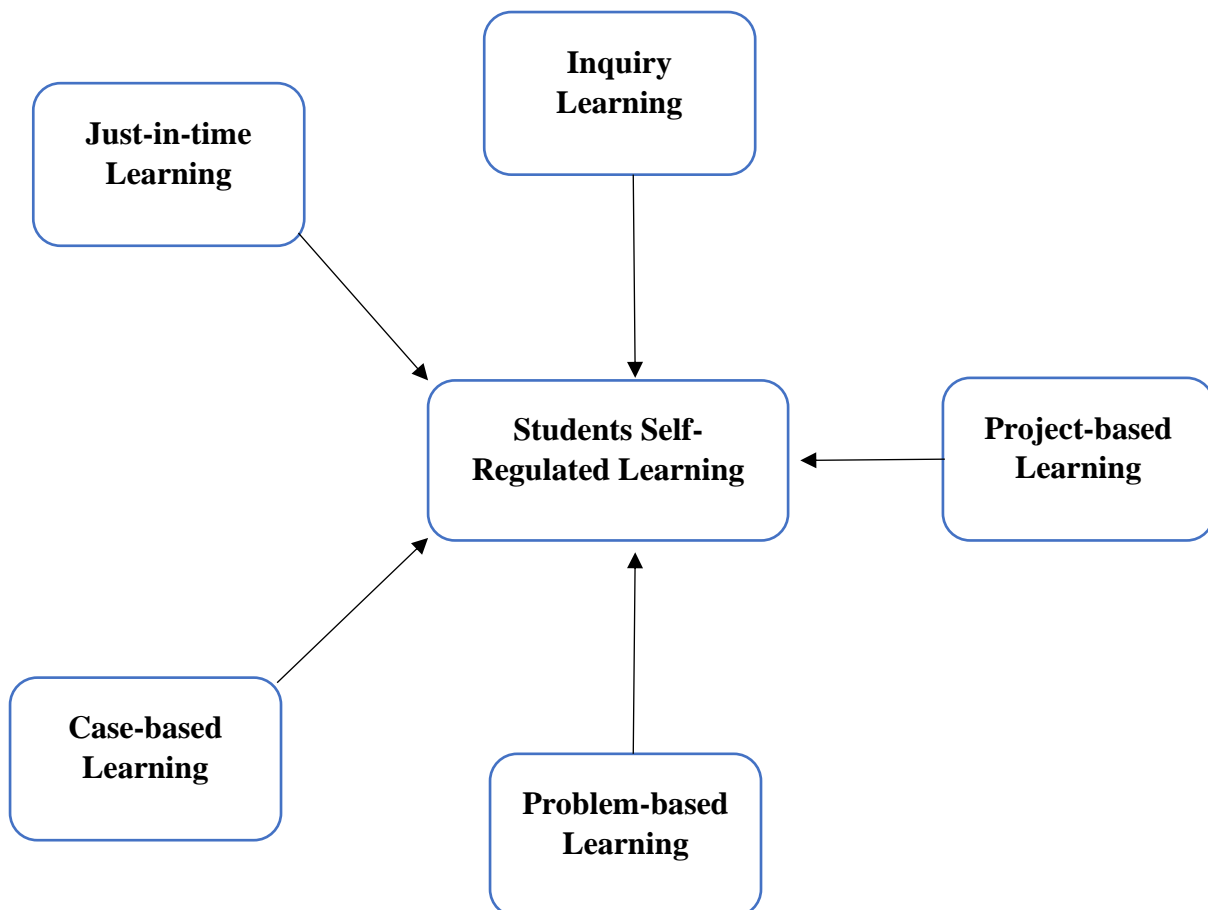

Figure 1: Theoretical Framework

Research Findings

The findings show the factor loadings which indicate the nexus among items of the constructs. The statistics have shown that all the items understudy have factor loadings more than 0.50, while the items with less than 0.50 factor loading were eliminated from the study. These factor loadings are presented in Table 1.

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Table 1: Factor Loadings

Variables	Items	Factor Loadings				
Case-based Learning	CBL1	0.858				
	CBL3	0.744				
	CBL4	0.724				
Inquiry Learning	IL1		0.823			
	IL2		0.855			
	IL3		0.733			
	IL4		0.756			
	IL5		0.830			
Just-in-time Learning	JITL1			0.710		
	JITL2			0.814		
	JITL3			0.765		
Problem-based Learning	PBL1				0.696	
	PBL10				0.709	
	PBL2				0.718	
	PBL3				0.702	
	PBL4				0.704	
	PBL5				0.735	
	PBL6				0.740	
	PBL7				0.784	
	PBL8				0.783	
	PBL9				0.748	
Project-based Learning	PRBL1					0.743
	PRBL2					0.807
	PRBL3					0.788
	PRBL4					0.758
	PRBL5					0.570
	PRBL6					0.776
	PRBL7					0.780
	PRBL8					0.642
Student Self-regulated Learning	SSRL1					0.683
	SSRL10					0.767
	SSRL12					0.734
	SSRL2					0.725
	SSRL3					0.717
	SSRL4					0.756
	SSRL5					0.750
	SSRL7					0.753
	SSRL9					0.720

The findings also show the convergent validity that exposes the nexus among items of the constructs. The statistics have shown that average value extracted (AVE) values are not less than 0.50. In addition, the statistics have also shown that the composite reliability (CR) values are not lower than 0.70, and Alpha values are more than 0.70. The convergent validity results are presented in Table 2.

Table 2: Convergent Validity

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
CBL	0.675	0.820	0.604
IL	0.861	0.899	0.641
JITL	0.646	0.808	0.584
PBL	0.904	0.920	0.537
PRBL	0.877	0.904	0.543
SSRL	0.893	0.913	0.539

The findings indicate the discriminant validity which shows the nexus among the constructs. Discriminant validity has been tested using the Fornell Larcker. The statistics mentioned that the figures that indicated the association among constructs itself are not smaller than the figures that indicated the association among other constructs. The results of Fornell Larcker are presented in Table 3.

Table 3: Fornell Larcker

	CBL	IL	JITL	PBL	PRBL	SSRL
CBL	0.777					
IL	0.468	0.801				
JITL	0.274	0.298	0.764			
PBL	0.521	0.605	0.247	0.733		
PRBL	0.464	0.473	0.107	0.645	0.737	
SSRL	0.625	0.621	0.257	0.506	0.662	0.734

In addition, discriminant validity has also been tested using cross-loadings. The statistics show that the figures that indicated the association among items themselves are not smaller than the figures that indicated the association among other constructs' items. The figures of cross-loadings are presented in Table 4.

Table 4: Cross-loadings

	CBL	IL	JITL	PBL	PRBL	SSRL
CBL1	**0.858**	0.456	0.222	0.491	0.424	0.593
CBL3	**0.744**	0.311	0.268	0.304	0.290	0.392
CBL4	**0.724**	0.299	0.160	0.392	0.350	0.441
IL1	0.375	**0.823**	0.242	0.579	0.427	0.578
IL2	0.384	**0.855**	0.288	0.437	0.360	0.441
IL3	0.390	**0.733**	0.192	0.432	0.413	0.476
IL4	0.365	**0.756**	0.225	0.518	0.351	0.538
IL5	0.350	**0.830**	0.247	0.403	0.318	0.405
JITL1	0.194	0.177	**0.710**	0.171	0.137	0.218
JITL2	0.242	0.273	**0.814**	0.221	-0.009	0.200
JITL3	0.187	0.236	**0.765**	0.169	0.118	0.161
PBL1	0.396	0.543	0.200	**0.696**	0.494	0.654
PBL10	0.316	0.361	0.169	**0.709**	0.410	0.512
PBL2	0.332	0.354	0.098	**0.718**	0.497	0.527
PBL3	0.340	0.354	0.140	**0.702**	0.453	0.503
PBL4	0.294	0.379	0.110	**0.704**	0.459	0.522
PBL5	0.409	0.433	0.223	**0.735**	0.562	0.660
PBL6	0.419	0.507	0.205	**0.740**	0.439	0.573
PBL7	0.342	0.440	0.239	**0.784**	0.481	0.632
PBL8	0.483	0.491	0.197	**0.783**	0.450	0.637
PBL9	0.448	0.515	0.192	**0.748**	0.469	0.635
PRBL1	0.298	0.339	0.044	0.441	**0.743**	0.456
PRBL2	0.397	0.393	0.094	0.569	**0.807**	0.570

	CBL	IL	JITL	PBL	PRBL	SSRL
PRBL3	0.290	0.372	0.123	0.487	**0.788**	0.497
PRBL4	0.310	0.350	0.087	0.441	**0.758**	0.494
PRBL5	0.316	0.279	0.010	0.424	**0.570**	0.431
PRBL6	0.382	0.322	0.042	0.465	**0.776**	0.479
PRBL7	0.356	0.373	0.069	0.461	**0.780**	0.491
PRBL8	0.377	0.346	0.151	0.495	**0.642**	0.467
SSRL1	0.364	0.479	0.218	0.490	0.416	**0.683**
SSRL10	0.366	0.427	0.151	0.642	0.449	**0.767**
SSRL12	0.564	0.463	0.190	0.636	0.504	**0.734**
SSRL2	0.623	0.455	0.212	0.630	0.489	**0.725**
SSRL3	0.472	0.459	0.186	0.583	0.476	**0.717**
SSRL4	0.554	0.425	0.151	0.590	0.513	**0.756**
SSRL5	0.411	0.475	0.194	0.572	0.538	**0.750**
SSRL7	0.393	0.472	0.217	0.570	0.538	**0.753**
SSRL9	0.333	0.458	0.186	0.596	0.442	**0.720**

Moreover, the discriminant validity has been tested using Heterotrait Monotrait (HTMT) ratio. The statistics have shown that the figures of the HTMT ratios are not higher than 0.90. The figures of the HTMT ratio are shown in Table 5.

Table 5: Heterotrait Monotrait Ratio

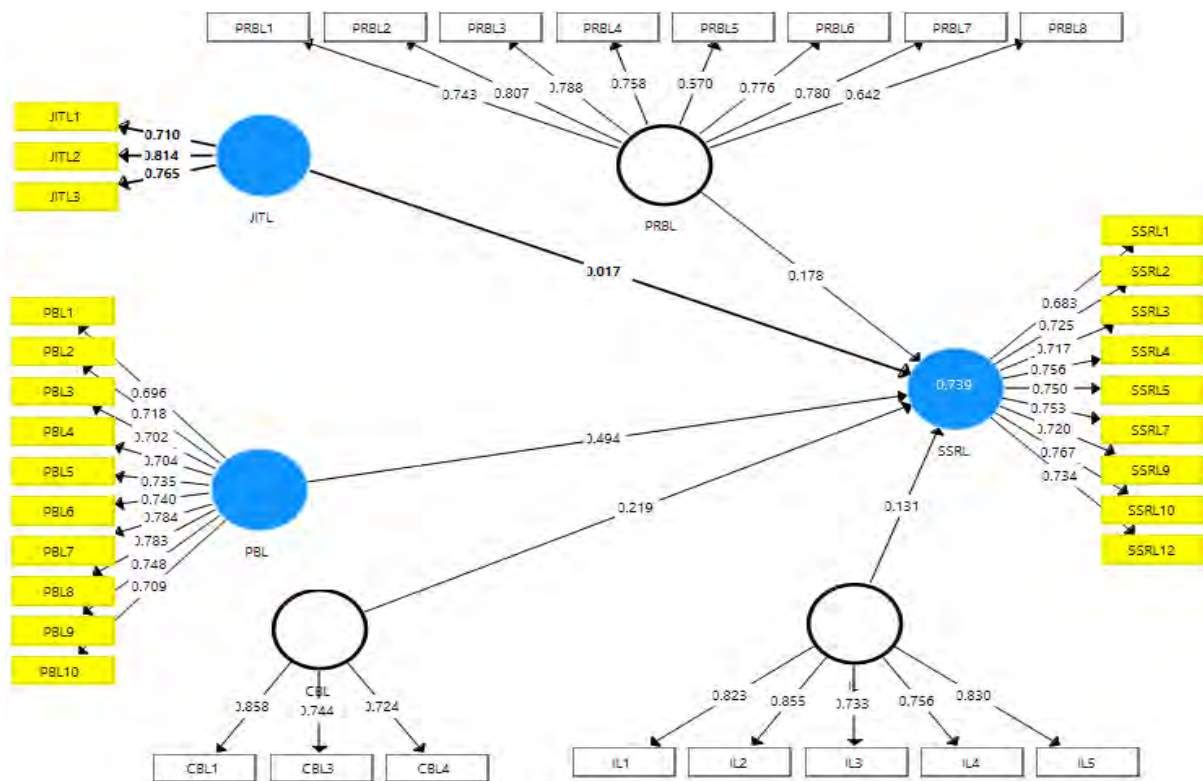|	CBL	IL	JITL	PBL	PRBL	SSRL
CBL						
IL	0.595					
JITL	0.417	0.402				
PBL	0.643	0.663	0.314			
PRBL	0.593	0.537	0.178	0.722		
SSRL	0.776	0.695	0.333	0.886	0.746	

Figure 2: Measurement Model Assessment

The path analysis results indicated that all the learning styles such as just-in-time learning, case-based learning, inquiry learning, project-based learning and problem-based learning have a positive nexus with students' self-regulated learning in public sector universities in Indonesia and therefore, the study accepts H1, H2, H3, H4 and H5. These links among the constructs are depicted in Table 5.

Table 6: Path Analysis

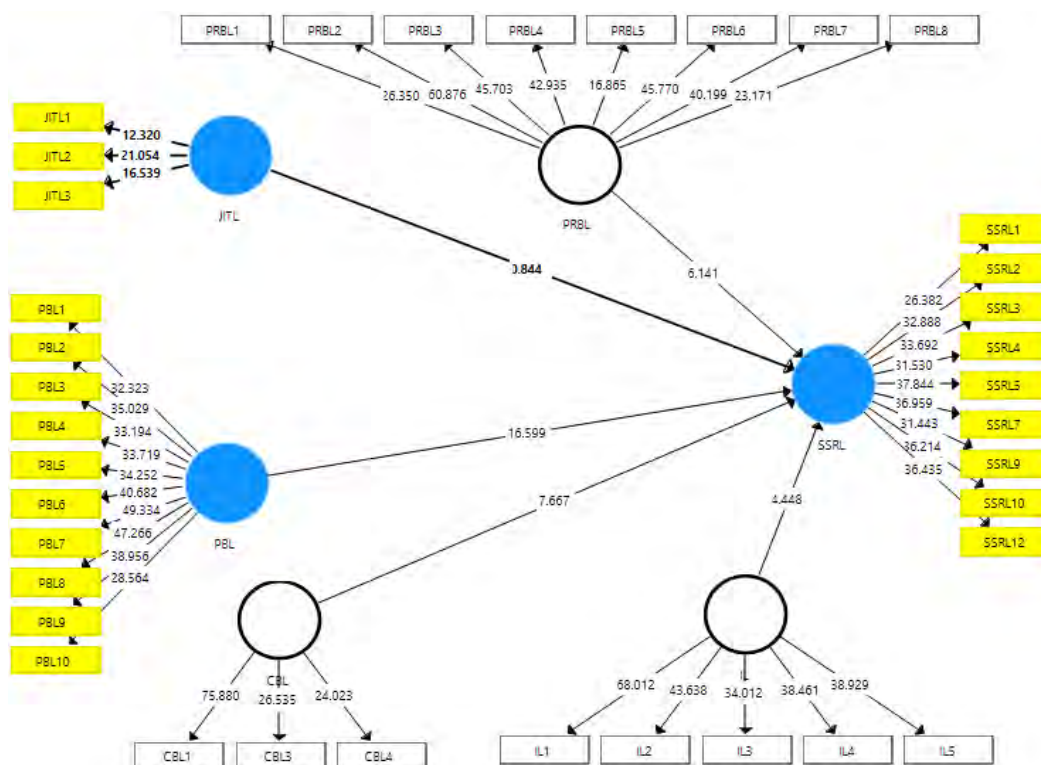| Relationships	Original Sample	Standard Deviation	T Statistics	P Values	Lower Limit	Upper Limit
CBL -> SSRL	0.219	0.029	7.667	0.000	0.156	0.272
IL -> SSRL	0.131	0.029	4.448	0.000	0.081	0.189
JITL -> SSRL	0.017	0.021	0.844	0.401	-0.031	0.053
PBL -> SSRL	0.494	0.030	16.599	0.000	0.430	0.549
PRBL -> SSRL	0.178	0.029	6.141	0.000	0.120	0.230

Figure 3: Structural Model Assessment

Discussion and Implications

The study results have indicated that inquiry-based learning (IL) has a positive association with students' self-regulated learning. These results are in line with the previous study of Lankveld, Maas, Wijchen, Visser et al. (2019), which analyzes the role of inquiry-based learning in improving students' self-regulated learning. The study implies that when, in the inquiry-based learning process, teachers do not force the students to absorb or digest the learning material or facts; but rather, motivate the students to understand the subject matter, ponder on the topic, conduct discussion among themselves and come up with questions to learn about the subject matter from all angles/perspectives. This learning process develops curiosity, open-mindedness, confidence, and facilitates the invention of ideas which help students in self-regulated learning at all stages. These results are also in line with the previous study of Lim and Baildon (2021), which suggests that during inquiry-based learning, students are not only forced to ask questions during lectures from teachers but also motivated to form teams and inquire questions from one another or find the answers to questions about the subject matter from outside sources like digital devices or Internet or searching through writing material. This stirs the mind of students, stimulates creativity, and enables them to plan and evaluate their performance.

The study results have indicated that problem-based learning (PRBL) has a positive association with students' self-regulated learning. These results are supported by the previous study of Efendi (2021), which analyzes problem-solving skills and their impact on students' self-regulated learning. This study emphasizes that in problem-based learning, teachers expose the problems or complex issues to students and challenge them to solve these problems. Teachers also encourage them to develop critical thinking to sense the problems, analyze the situation, and determines causes and ways to overcome or mitigate these problems. This develops self-efficacy in students, overcomes problems in implementing the strategies designed to achieve the goals, and re-enforces performance. These results are supported by the previous study of Maghfiroh, Subchan, and Iqbat (2017), which states that problem-based learning encourages collaboration, communication, teamwork, concentration, and decision-making skills, which are applied when handling complex situations. It also enables them to set the goals through their subject, analyze related factors, undertake planning consisting of steps to achieve the goals, act upon the plan and t evaluate their performance. The study results have indicated that project based-based (PBL) learning has a positive association with students' self-regulated learning. These results are supported by the past study of Wan, Lee, Yan, and Ko (2021), which highlights that in project-based learning, students are given a particular task to investigate during a specific period. The task may be in the form of some problem to solve, challenge to meet, or question to answer. The abilities or skills which the students develop by working for an extended period of time to fulfil the task are helpful in developing self-regulated learning. These results are also supported by the previous study of Wallin and Adawi (2018), which indicates that the use or application of the project-based learning process to teach the students develops the skills like effective communication, collaboration, critical thinking, and creativity in the students. These skills are effective in promoting students' self-regulated learning.

The study results have revealed that case-based learning (CBL) has a positive association with students' self-regulated learning. These results are in line with the past study of Fan, Matcha, Uzir, Wang et al. (2021), which highlights that in case-based learning, teachers teach their students through the use of a specific case, through the content of case itself and through discussion on the content of story. Such a learning environment is provided to the students that their interest is aroused, they are motivated to ponder on and critically analyze the story, characters, surrounding, actions, situation, problems, and end of the events, using the words of why, how, where, and when. This shapes the skills and habits of students which are favorable for self-regulated learning. The study results have revealed that just-in-time learning (JITL) has a positive association with students' self-regulated learning. These results are in line with the past study of Merrienboer and Bruin (2019), which shows that when an educational institution provides the facility of training, learning, and improvement to students when they need it, even before the exact date for training and development, then students have support and can use its knowledge, awareness, and abilities that are needed for self-regulated learning. Thus, just-in-time learning improves the skills, abilities, and behaviors to self-monitor, self-instruct, and self-reinforce which characterizes self-regulation learning.

The present study has a theoretical significance because of its vital contribution to the literature on education development. This study throws light on the role of different inductive learning models in developing students' self-regulated learning. The study analyzes the influences of inductive learning models like inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning. Mostly, long and in-depth research has been done on the role of different inductive learning models in developing the students' self-regulated learning, but its processes or models have less been differentiated in the literature. As our study discusses the impacts of inductive learning from different perspectives, it overcomes this literary gap. The influences of inquiry-based learning, problem-based learning, project-based learning, case-based learning, and just-in-time learning on students' self-regulated learning have been analyzed in many literary works but individually in different studies and at different times.

Thus, the simultaneous description of IL, PRBL, PBL, CBL, and JITL while analyzing the students' self-regulated learning is a valuable addition to the existing literature. Students' self-regulated learning has become an essential part of students' success in the education sector that needs the attention of policymakers and academics. This study offers guidance to policymakers regarding formulating new policies about student self-regulated learning. The current study has key significance in the practical educational sectors as it provides a guideline for the education ministry, guiding them on how to design their policies to promote education by improving the performance of students. This also holds relevance or significance for the management in educational institutions when formulating institutional policies, for teachers in terms of adopting effective processes to teach students, as well as for students in making decisions to achieve specific learning goals. This study guides stakeholders on how to enable students to develop self-regulation abilities in them. The study highlights that with the effective use and application of inductive learning models like IL, PRBL, PBL, CBL, and JITL on self-regulated learning, skills and abilities can be improved.

Conclusion and Limitations

Indonesia is one of the largest countries in the world with respect to population. The need for educational facilities increases with an increase in the population. Although Indonesia has a large education system, and the government itself is providing funds for the public education institutions which are operating, the performance of all the public educational institutions is not upto mark. Therefore, a large number of students produced by these institutions cannot perform well within the economy. There is a need to address this issue and find a solution. Considering this need, the current study has aimed to highlight ways to improve students' performance which is the ultimate product of educational institutions. The current study was conducted to explore the role of inductive learning models like IL, PRBL, PBL, CBL, and JITL in improving students' self-regulated learning. The study analyzed the impact of inductive learning models like IL, PRBL, PBL, CBL, and JITL on students' self-regulated learning among students of public universities in Indonesia. The results of the study are based on this empirical analysis. The results indicate that in the IL process, students do not absorb or digest facts; rather, they are motivated to ponder on the topic, try to understand it, conduct discussions if needed and pose questions to learn the subject matter from all aspects. This learning process helps foster and develop curiosity, open-mindedness, confidence, and creativity which aids the students in their self-regulated learning. The results indicate that in PRBL, teachers expose the problems or complex issues to students and challenge them to solve these problems. The abilities like initiatives, exploration, analysis, and creativity are developed in this manner, which is effective to self-regulated learning. As the work on a project during an extended period develops team performance, communication, analytical skills and creativity, it enables students to self-regulated learn. The study also inferred that in CBL, the students are taught through the contents of cases and the discussion on the cases, and in JITL, students are trained at the time of need which helps them develop or acquire skills needed for self-regulated learning.

The current study has certain limitations which must be fulfilled by other researchers or scholars in future studies in the extension to the new ones. The study analyzes the influences of only inductive learning models like IL, PRBL, PBL, CBL, and JITL on students' self-regulated learning. Factors like institutional policies, human resource management, and technology application, which have an impact on the students' self-regulated learning, have not been considered in the present study. As a result, the scope of the study is limited. Therefore, authors are recommended to focus on considering additional factors affecting self-regulated learning. Moreover, data for inductive learning models like IL, PRBL, PBL, CBL, and JITL and students' self-regulated learning have been collected from public universities of Indonesia. For this reason, the study results are not universally valid because they do not consider the nexus among the above-mentioned factors in the overall education sector and across the world education system. Therefore, authors must also analyze the influences of inductive learning models like IL, PRBL, PBL, CBL, and JITL on students' self-regulated learning in the overall education sector in different countries and regions of the world.

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