MANAZHIM
Jurnal Manajemen dan Ilmu Pendidikan

p-ISSN : 2656-5374
e-ISSN : 2656-0216

Terindeks : SINTA 4, DOAJ, Dimensions, Scilit, Lens Crossref, Garuda, Google, etc.

https://doi.org/10.36088/manazhim.v7i2.5821

The Effect of Peer Interaction on Students'Learning Outcomes in a Digital Environment Mediated with Computer Self-Efficacy

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Abstract

This study was conducted in response to inconsistent findings in previous research regarding the impact of peer interaction on student learning outcomes. It aims to examine the effect of peer interaction on learning outcomes within a digital learning environment, with computer self-efficacy serving as a mediating variable. Utilizing a causal-associative design and a quantitative approach, the study employed purposive sampling to select 248 student participants. Data were collected through questionnaires and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 3 software. The results revealed that: (1) peer interaction has a significant and positive effect on learning outcomes; (2) peer interaction significantly and positively influences computer self-efficacy; (3) computer self-efficacy has a significant but negative effect on learning outcomes; and (4) the indirect effect analysis indicates that peer interaction significantly and negatively influences learning outcomes when mediated by computer self-efficacy. These findings underscore the importance of fostering supportive peer environments to enhance students'confidence in digital tool usage and to optimize learning outcomes.

Keywords: Peer Interaction; Learning Outcomes; Computer Self-Efficacy; Digital Learning; PLS-SEM

INTRODUCTION

Humans have been profoundly impacted by the existence of advancement of technology, especially in the educational sector. Education is very important to help individuals achieve their potential and become a useful resource to produce high-quality human resources (Mantiri, 2019).

Despite the fact that technology is becoming an essential part of education, data from the World Top 20 Education Poll 2024 indicates that Indonesia's education quality ranks 67th out of 203 countries globally (Weforum.org, 2025). This suggests that the quality of education in Indonesia remains relatively low, particularly in comparison to other ASEAN nations. For example, Singapore which is ranked 11th and Vietnam which is ranked 53rd. Therefore, the standard of education in Indonesia is still considered inadequate and requires attention so that education in Indonesia can be better in terms of quality and results.

Learning outcomes are a key factor in determining academic performance and serve as a standard by which to measure how well the teaching and learning process is working. According to Zahroh & Hilmiyati (2024), one indicator of the success of achieving learning objectives is reflected in student learning outcomes during the educational process. Changes in behavior, attitudes, better knowledge, skills and understanding are the outcomes of the results learning after carrying out the learning process (Syamsi, 2022). Data on learning outcomes for subjects Computer Applications lecture for students from the 2021, 2022, and 2023 intakes totaling 650, 282 students showed an "A" category grade and there were 6 students who were declared to have failed with a grade below "C-". This shows that there are still many students who have not achieve maximum results, so that student learning outcomes need to be improved.

According to Siregar (2024), Both internal and external influences influence learning results. Internal factors encompass elements such as interest, motivation, attention to learning, readiness, talent, learning methods, intelligence, perseverance, attitude, study habits, and physical health. In contrast, external factors originate from outside the student, including teaching methods, classroom facilities, friends, school environment, school culture, family environment, curriculum etc. The increase in students'academic achievement can be caused by the frequency of interactions carried out by students in lectures. According to Agustin et al. (2023) the interactions that students often carry out

cannot be separated from campus activities such as working on assignments together, discussing together, and problem solving. This allows students to exchange ideas and deepen their understanding of material. However, on the other hand, education in Indonesia in the era of globalization has had many utilizing technology as a primary need to support the learning process (Permana et al., 2024).

This research focuses on the educational components of Computer Application courses within the Office Administration Education program at Surabaya State University. The Computer Applications course is taught using the case study learning method. In the case study learning method, students are given learning experiences that involves case analysis through direct practice. Practical learning places great emphasis on the use of computers in practical learning such as the use of typing master applications, Microsoft Office (Word, Excel, and Access).

Based on survey data from the Indonesian Internet Service Providers Association (APJII) in 2017-2024 shows that the use of information technology devices based on undergraduate/diploma education level recorded the use of computers and laptops at 2.30%, mobile phones or tablets at 60.58%, and a combination of both at 37.12% (Survei.apjii.or.id, 2024). The data indicates that the utilization of technology among students is quite high. So the importance of understanding and mastery of technology skills among students, because these skills not only support the teaching and learning process, but also prepare to compete in a technology-dependent workplace.

To enhance the development of knowledge and skills in mastering computer technology, students must have a positive attitude towards computers, develop high computer self-efficacy, and eliminate learning anxiety (Rezai & Ph, 2022). According to Wei et al. (2022) also stated that a positive attitude towards using technology tends to increase a person's self-efficacy. Students who having good self-efficacy tends to have confidence in facing and completing various tasks and challenges associated with using computer technology in education. In line with the research of Bunyamin & Sauda (2019) stated that computer self-efficacy has an influence on students academic achievement. However, this is different from the research of Abdullah & Mustafa (2019) Studies found no statistically significant correlation between computer self-efficacy and academic achievement.

In addition, peer interaction also plays an important role in forming positive attitudes towards technology. According to Mensah et al. (2024) One factor that can affect computer self-efficacy is the social support received from peers. And according to Li et al. (2020) enhanced self-efficacy can increase the impact of peer relationships on learning. Technology-supported learning environments tend to create closer relationships between peers, which can increase motivation and encouragement for students to learn better (An & Guo, 2024). If the study group is formed from peers who have a positive influence, then when students having difficulty understanding learning materials, peers will play a role in helping to solve problems (Bayu, 2021). However, if the study group is formed from peers who have a negative influence, it can hinder the learning process and reduce learning outcomes, such as giving bad study habits, cheating, not doing assignments, or not being serious about studying, and can cause a loss of motivation in achieving optimal learning outcomes (Wurdaningrum et al., 2025). This will cause the dynamics of learning activities to be less productive and hinder students'academic and social development. ccording to research by Sayekti et al. (2020) peer support significantly and favorably affects student learning outcomes. However, in contrast to the research by Kumalasari & Kasidi (2021) Learning achievement is not significantly influenced by the peer environment.

In general, the fendings of research on the relationship between peer interaction and learning outcomes are different from previous studies. There are studies that show significant results, indicating that the research influences learning outcomes, but there are also studies that show insignificant results, meaning that the research does not influence learning outcomes. Few researchers have performed more detailed investigations into whether the computer self-efficacy variable there is peer relationships and learning outcomes. This adds a fresh perspective on computer self-efficacy in relation to learning objectives in the digital world. Thus, This study's objective is to investigate how peer interaction influences student learning outcomes in a digital setting, mediated by computer self-efficacy.

METHODS

This study combines a causal associative strategy with a quantitative approach. The aim of using a quantitative approach is to test the established hypothesis, and the availability of a causal associative technique to demonstrate how two or more variables are

causally related (Sugiyono, 2019). From January to May 2025, this study was carried out at the State University of Surabaya. The 650 students in the Office Administration Education undergraduate study program from the classes of 2021, 2022, and 2023 made up the study's population. The sampling process made use of purposeful sampling. Sugiyono (2019) asserts that purposeful sampling is a data source collection technique based on certain considerations or criteria that are in accordance with the research objectives. So the sample used in this study was 248 students. The data collection technique for learning outcome variables using UTS and UAS scores, while peer interaction variables and computer self-efficacy using a questionnaires distributed via google form. Path analysis is used to analyze data using SmartPLS software. The outer model test, which measures validity and reliability, is the first step in the analysis stage, then there is internal model testing and hypothesis.

RESULTS

1. Testing the Validity of the Construct on the Outer Model

Considering the results of the analysis of the evaluation of the validity and reliability of the outer model test conducted using SmartPLS software. The result of the outer model, which is described in Figure 1 below, is as follows:

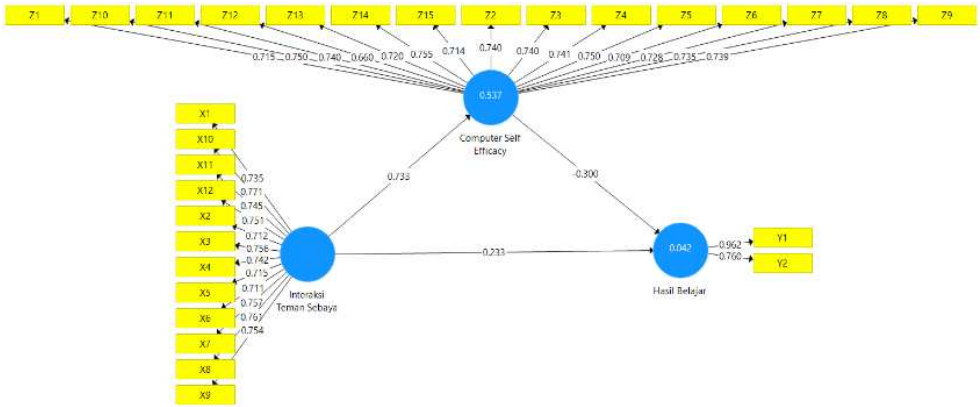

Figure 1. Results Of The Outer Model Convergent Validity Test

Convergent Validity, has the aim of assessing the relationship between each indicator and construct or latent variable. Hair Jr et al. (2021) state the *loading* value *factor* with a value range of 0.40- 0.70 means it can be considered with an AVE value > 0.5, which can be concluded to have met convergent validity.

Table 1. Loading Factor Test Results

Variables	Code	Loading	Description	AVE	Description
Peer Interaction (X)	X1	0.735	Valid	0.552	Valid
	X2	0,712	Valid		
	X3	0.756	Valid		
	X4	0.742	Valid		
	X5	0.715	Valid		
	X6	0.711	Valid		
	X7	0.757	Valid		
	X8	0.761	Valid		
	X9	0.754	Valid		
	X10	0.771	Valid		
	X11	0.745	Valid		
	X12	0.751	Valid		
Learning Outcome (Y)	Y1	0.962	Valid	0.751	Valid
	Y2	0.760	Valid		
Computer Self Efficacy (Z)	Z1	0.715	Valid	0.532	Valid
	Z2	0.740	Valid		
	Z3	0.740	Valid		
	Z4	0.741	Valid		
	Z5	0.750	Valid		
	Z6	0.709	Valid		
	Z7	0.728	Valid		
	Z8	0.735	Valid		
	Z9	0.739	Valid		
	Z10	0.740	Valid		
	Z11	0.740	Valid		
	Z12	0.660	Valid		
	Z13	0.720	Valid		
	Z14	0.755	Valid		
	Z15	0.714	Valid		

The test results in table 1, the Average Variance Extracted values (AVE) and loading factor for the variables of computer self-efficacy, learning outcomes, and peer interaction meet the requirements for validity testing.

Discriminant Validity, aims to assess how far a empirically constructs have differences from other constructs according to standards measurement. The testing criteria can be seen through the Heterotrait-Monotrait Ratio of Correlation (HTMT) with the provision of a value < 0.90.

Table 2. HTMT Test Results

Variable	HTMT
ITS <-> HB	0.064
ITS <-> CSE	0.780
CSE <-> HB	0.142

The test results in table 2, the variables pertaining to peer interaction on learning outcomes has a value of 0.064 < 0.90, the peer interaction variable on computer self-efficacy has a value of 0.780 < 0.90, and the computer self-efficacy variable on learning outcomes has value 0.142 < 0.90. Thus, the value HTMT can be considered fulfilled or valid, which is the basis for discriminant validity.

2. Reliability Test Results

The purpose of reliability testing is to assess how consistently a measuring instrument measures a concept or to assess the consistency of respondents when providing answers to statement items. In this study, the reliability test used 2 criteria testing, namely *Crombach's alpha* with a value of > 0.70 and *Composite reliability* > 0.70. The following reliability test results:

Table 3. Result of Reliability Test

Variable	***Crombach's Alpha***	***Composite Reability***
Peer Interaction	0.926	0.927
Learning Outcomes	0.712	0.856
Computer Self Efficacy	0.937	0.945

The test results in table 3, the Crombach's alpha value for the peer interaction variable. of 0.926, learning outcome variable of 0.712, and computer self-efficacy variable of 0.937. So it can be concluded that all of these variables can be said to be reliable because they meet the criteria of Crombach's alpha value and composite reliability > 0.70. So the questionnaire can be said to be consistent and accurate.

3. Uji Inner Model

Testing the inner model using SmartPLS software through R-Square, F-Square, and Goodness Of FIT tests. The following is the inner model output explained in Figure 2 below:

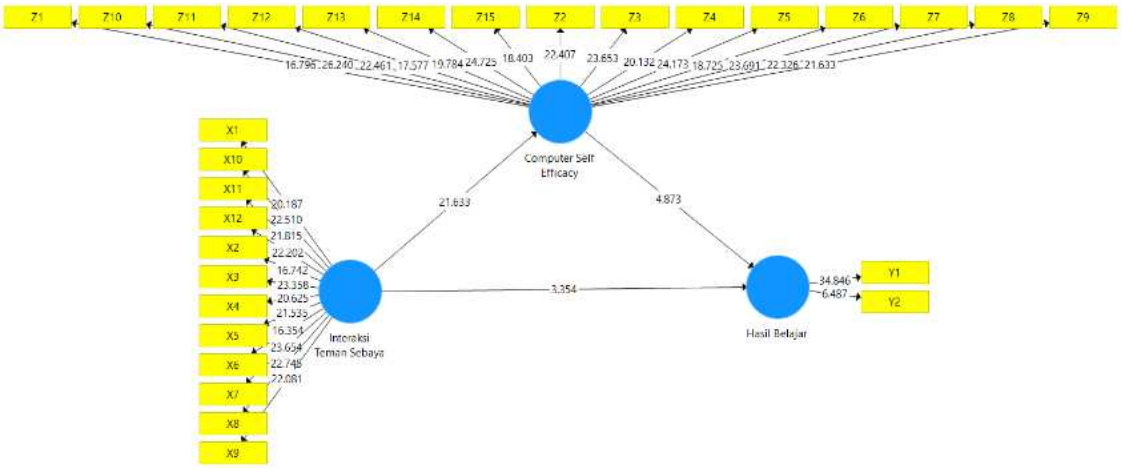

Figure 2. Inner Model Result

The coefficient of determination, commonly referred to as the R-Square (R^2) test is employed to calculate the proportion of endogenous variable variance that can be predicted or accounted for by exogenous variables. In this study, the R-Square (R^2) test has criteria if 0.25 inidcate weak, 0.50 inidcate moderate, and 0.75 indicate strong. The following are the results of the R-Square (R^2) test:

Table 4. R-Square Test Results

Variable	R-Square (R^2)
Learning Outcomes	0.042
Computer Self Efficacy	0.537

The test results in table 4, the learning outcome variables can be influenced by the peer interaction variable of 0.042 or 4.2%, including in the weak criteria. Then the computer self-efficacy variable can be influenced by the peer interaction variable is 0.537 or 53.7%, which is included in the moderate criteria.

Utilizing the F-Square (F2) test, one may assess the quality of the model and the influence of the value from exogenous variable to endogenous variable. The F-Square uses the following value criteria: 0.025 indicates high, 0.01 indicates medium, and 0.005 indicates low. The F-Square test yielded the following findings:

Table 5. F-Square Test Results

Variable	Peer Interaction	Learning Outcomes	Computer Self Efficacy (CSE)
Peer Interaction		0.026	1.161
Learning Outcomes			
Computer Self Efficacy		0.044	

Based on the F-Square (F^2) test table from table 5, it shows the peer interaction variable nfluence learning outcomes with high criteria with a score of 0.026. Then the peer interaction variable influences computer self-efficacy with the following criteria high with a score of 1,161, and the computer self-efficacy variable influences the variable learning outcomes with high criteria with a score of 0.044.

The Goodness of FIT test is used to test the predictability and feasibility of the exogenous variable model against the endogenous variable. The assessment criteria used in the Goodness of FIT is in the form of Standardized Root Mean Square Residual (SRMR) where the model will considered suitable or appropriate if the SRMR value < 0.08. The Goodness of Fit test yielded the following findings:

Table 6. Goodness of FIT (GOF) Test Results

	Saturated Model	Estimated Model
SRMR	0.057	0.057

The test results in table 6, the Goodness of FIT test show an SRMR value of 0.057 < 0.08, so it can be concluded that the model formed is appropriate or suitable, so that considered appropriate in modeling the relationship between variables.

4. Hypothesis Testing

Direct relationship testing in hypothesis testing is used to collect data on the presence or absence of a direct correlation between exogenous and endogenous variables. And the indirect influence test is aimed at finding information on the extent to which exogenous variables influence endogenous variables through mediator. The assessment criteria used in measuring direct and indirect effects tests using P-Value, where if the P-Value < 0.05 then it can be said has a significant effect, whereas if the P-Value is > 0.05 then it has no effect significant.

Table 7. Dirrect and Indirrect Effect Test Results

HP	Variable	*Original Sample*	*T Statistics*	*P Value*
1.	Peer Interaction-> Learning Outcomes	0.233	3.354	0.001
2.	Peer Interaction-> Computer Slef Efficacy	0.733	21.633	0.000
3.	Computer Slef Efficacy-> Learning Outcomes	-0.300	4.873	0.000
4.	Peer Interaction-> *Computer Self Efficacy*-> Learning Outcome	-0.220	4.593	0.000

The test results in table 4, Of the four hypotheses proposed in this study, the results of hypothesis testing show that four hypotheses can be accepted because they meet the requirements of P-Value < 0.05 and T statistic > 1.96. However, of the four hypotheses, there are two that have a negative correlation value because the original sample is <0.1.

DISCUSSION

1. Peer Interaction on Learning Outcome

The calculation results show the peer interaction variables on learning outcomes obtained a coefficient value of 0.233 > 0.1 which means positive, P-Value score 0.001 < 0.05 which means significant, and the T-Statistic score 3.354 > 1.96. So hypothesis 1 accepted, and the peer interaction variables on learning outcomes have a positive direction positive correlation and has a significant influence.

In this hypothesis, respondents have a peer environment in their learning activities. This statement is supported by the respondents'answers, one of which is the statement "discussion with friends can solve problems in the Computer Application course assignments faced", by showing the highest loading factor.

This finding shows that during practical activities in the computer laboratory students often discuss with their friends to exchange information and solve problems encountered while working on assignments. Discussions between students will form study groups that have a positive influence, so when students have difficulties in dealing with lesson material, peers from classmates will play a role in helping to solve problems together. Through discussion students can improve their understanding and will enhance the results of their learning.

According to Sayekti et al., (2020), peer support significantly and favorably affects student learning outcomes. This demonstrates that learning results improve with the quality of peer relationships. Also supported by (Agustin et al., 2023; Yu et al., 2023) who stated that peers play an important role in improving learning achievement.

2. Peer Interactions on Computer Self Efficacy

The calculation results show the peer interaction variable on computer self efficacy obtained a coefficient value of 0.733 > 0.1 which means positive, the P-Value score 0.000

< 0.05 which means significant, and the T-Statistic score 21.633 > 1.96. So hypothesis 2 accepted, and the peer interaction variable on computer self-efficacy has the direction of the correlation is positive and has a significant influence.

In this hypothesis, respondents have a peer environment in their learning activities that can increase students'confidence in the use of computer technology. This statement is supported by the respondents'answers, one of which is the statement " discussion with friends can solve problems in the Computer Application course assignments faced", by showing the highest loading factor. In addition, the respondent's answer with the statement " I am confident that I can learn various kinds of programs or software"by showing the highest loading factor.

These findings show that students exchange thoughts, ideas and diffrernt perspectives in learning by discussing with friends to deepen their knowledge them. That way students can be more motivated and not feel alone in dealing with the problems faced. To increase self-confidenc students in using computers, there needs to be motivation from lecturers or friends. Therefore, peer support is crucial for raising kids'self-confidence. Students can discuss with their friends, share knowledge, experience and provide positive encouragement, which in the end can increase self-confidence to try and learn to use computers in learning. This means that when students are involved in discussions with friends who having good computer skills, they tend to feel more confident.

This supports studies by Mensah et al., (2024) that indicated peer support boosts self-efficacy when it comes to using computers or the internet. The study shows that there is a need for efforts to building and maintaining social networks among students, both at the family level as well as among peers, to increase their self-confidence in using technology. By creating a collaborative environment, students are more may feel confident and motivated in using technology.

3. Computer Self Efficacy on Learning Outcomes

The calculation results show the computer self-efficacy variable on learning outcomes obtained a coefficient value of-0.300 < 0.1 which means negative, P-Value score 0.000 < 0.05 which means significant, and the T-Statistic score 4.873 > 1.96. So hypothesis 3 accepted, and the computer self efficacy variable on learning outcomes has a correlation direction negative and has a significant influence.

In this hypothesis, respondents have confidence in computers in their learning activities. This statement is supported by the respondents'answers, one of which is the statement " I am confident that I can learn various kinds of programs or software" with shows the highest loading factor.

This finding shows that students with a high tendency towards self-efficacy does not always guarantee that the learning outcomes are also high. Computer self-efficacy only reflects confidence in the ability to use a computer, if not supported by knowledge of the subject matter then the learning outcomes may be less than optimal even decreased. Mastery of technical skills in operating computers alone are not enough, but knowledge of the subject matter is also very important. Students tend to focus more on the technical aspects of operating a computer, without being balanced with a deep understanding of the subject matter. Therefore that if self-confidence increases, then understanding and ability of the subject matter must be improved.

Supported by Dewi & Roshayanti (2022) who stated that the low ability value can be influenced by overconfidence. Overconfidence can cause someone ignores what the teacher and other people say, belittles the material or the tasks given so that the learning outcomes are poor. Then according to Porto-bellini & Serpa (2025) stated that students who showed high levels of CSE does not always have better performance.

4. Peer Interactions on Computer Self Efficacy Mediated Learning Outome

The calculation results show the peer interaction variables on learning outcomes throught mediation computer self-efficacy obtains a coefficient value of-0.220 < 0.1 which means negative, P-Value score 0.000 < 0.05 which means significant, and the T-Statistic score 4.593 > 1.96. So hypothesis 4 accepted, and peer interaction variables on learning outcomes through mediation computer self-efficacy has a negative correlation direction and can mediate.

In this hypothesis, respondents have a peer environment in their learning activities to create self-confidence in using computer technology. This statement is supported by the respondents'answers, one of which is the statement "discussion with friends can solve problems in the Computer Application course assignments faced", by showing the highest loading factor. In addition, the respondents'answers with the statement "I am confident that I can learn various kinds of programs or software" by showing the highest loading factor.

These findings indicate that students tend to have high self-efficacy or overconfidence without being balanced by understanding the subject matter. According to Rusmana et al. (2020) overconfidence is not only limited to individual actions but can also occur in a group. During practical learning, students were able to create study groups from friendship circles. For students who have a less supportive friendship environment will make it difficult to engage in discussions learning. They tend to feel very confident in their technical abilities in operating computer software, even though understanding the material is a more important aspect. This condition can spread to other friends, causing them to have poor understanding and poor learning outcomes. If the study group formed from peers who have a negative influence, it can hinder learning process and reducing learning outcomes, such as providing learning habits bad behavior, cheating, not doing assignments, or not being serious about learning, and can cause a loss of motivation in achieving learning optimal outcomes (Wurdaningrum et al., 2025).

The variables and topics of this study found alignment with other similar studies, but in the research results obtained did not find previous studies that were in line. Thus, the findings of this study represent a new contribution compared to previous research. In contrast to the research conducted by An & Guo (2024) according to which peer support for deeper learning is totally mediated by computer self-efficacy. According to this, having supportive peer interactions will lessen their negative feelings, boost their confidence in their ability to use computers, and promote deeper learning. Then according to Pan et al. (2024) who refers to the digital environment, self-efficacy plays a role as a mediator in interactions between friends which show extraordinary effects and significantly and favorably impact learning results.

Theoretical and practical implications

Theoretically, this study explores the relationship between peer interaction and learning outcomes among students in learning using computer technology. The findings of this study add variables that may influence how well students learn in the classroom. This finding can strengthen the social cognitive theory put forward by Bandura. According to Bandura (1986), social cognitive theory highlights that there are three variables that influence each other, which are better known as traditional reciprocity. The third variable is

behavior, and cognitive and personal factors, and the environment. In addition, there are two sets of expectations, the first relating to results, and the second relating to self-efficacy. so that the results of the present study can offer unique insight into how peer interaction relationships affect the learning outcomes of students. In addition, computer self-efficacy plays an important role in the relationship. Consequently, these results offer important information for creating a classroom environment that promotes improved learning results.

Practically, the findings of this study indicate the need for peer support in learning using computer technology. For educators, in order to design learning strategies that involve interaction between students and to be able to balance practical and theoretical learning. This needs to be done to prevent the emergence of student doubts in using computers in learning activities. To improve student abilities, lecturers must create as many opportunities as possible for interaction and even cooperation between students in the classroom. Furthermore, lecturers must encourage students to be able to discuss with all friends without discrimination. This is to avoid the creation of circles between students. In addition to paying attention to peer factors, lecturers must also be able to divide learning and practice equally to avoid being overconfident.

Research Limitations

There are several limitations in this study: first, the object of the study is only focused on the Computer Application course, which is one of several other courses that utilize computer technology in the learning process. Second, data collection in this study used purposive sampling, which made us unable to reach the entire population because it was hampered by certain criteria in the study.

CONCLUSION

The following conclusions can be made in light of the findings of the analysis and hypothesis testing conducted in this study:

1. Peer interaction significantly and favorably impacted learning outcomes, because students have peers in their study groups who provide a positive influence, such as when there are difficulties in understanding learning materials, peers help solve problems through discussion.

2. Peer interaction significantly and favorably impacted computer self-efficacy, because students have peers in their study groups so that students can discuss with their friends, share knowledge, experiences and provide positive encouragement which can ultimately increase self-confidence to try and learn to use computers in learning.
3. Computer self-efficacy significantly and negatively impacted learning outcomes, due to the existence of an attitude of computer self-efficacy that is too high or overconfidence, without being balanced by knowledge of the subject matter.
4. The indirect effect test revealed that peer interaction significantly and negatively impacted learning outcomes, mediated by computer self-efficacy, because if peers in a study group have a negative influence and have an attitude of computer self-efficacy that is too high or overconfident without being balanced by knowledge of the subject matter, then this condition can spread to other friends, which results in them having less understanding and poor learning outcomes.

The study's findings aid the field of education by showing that peer support is one factor that can enhance learning outcomes. Because of the restrictions in the research objects of this study, it is anticipated that future researchers will be able to increase the research objects in order to achieve more thorough results. In addition, there are also limitations in data collection techniques using purposive sampling, therefore further research should use proportional random sampling techniques to ensure that each group in the population is well represented. Another recommendation regarding peers which is one of the external factors in improving learning outcomes, it is hoped that further researchers can modify the new model by using other variables to find out other factors that can affect learning outcomes.

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