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THE EFFECT OF PEDAGOGICAL CONTENT KNOWLEDGE (PCK) LEARNING MANAGEMENT TOWARD LEARNING OUTCOMES THROUGH STUDENT LEARNING MOTIVATION IN PHYSICS

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ABSTRACT
Research on physics learning management has not been done much, especially regarding PCK and learning outcomes. Many studies that investigate the relationship between variables use the regression method. However, this study uses path analysis. The purpose of this study was to measure the direct effect, indirect effect, and total effect of PCK, learning motivation, and student physics learning outcomes using path analysis. The research method used in this research is a survey with a quantitative approach and data analysis techniques, namely path analysis. The data collection technique used a closed questionnaire. This study's sample was 43 teachers who gathered from 64 high school physics teachers in Indramayu Regency. The PCK learning management research results had no significant effect on student learning outcomes, learning motivation had a positive effect, and learning motivation had a positive effect on student learning outcomes. The implication of this study that the principal and the education office should continue to strive to improve the quality and smoothness of the teaching and learning process by providing provision to teachers to improve pedagogical content knowledge (PCK) learning management by participating in workshops and continuously improving techniques to motivate students for results student learning better.

1. INTRODUCTION

An educational process's success can be seen from students' learning outcomes (Sudjana, 2014). Therefore, it is essential to pay attention to student learning outcomes to improve education quality and quality. One of the phenomena of Indonesian education is the low quality and quality of education reflected in learning outcomes. The Program for International Student Assessment (PISA), under the Organization for Economic Cooperation and Development (OECD), the year 2015 conducted a survey in several countries on literacy achievement and published it in 2016. Of the 70 countries surveyed, Indonesia ranked Bottom 62 or 10 (OECD, 2016).

Based on the international survey results, one indicator is that Indonesia's quality of education is still far from what is expected. The quality of education, one of which saw from the literary achievements of reading, mathematics, and science, can be reflected in

students' learning outcomes in pursuing education. Based on the international survey above shows that student learning outcomes in Indonesia are still low.

Learning outcomes are indicators of success in the teaching and learning process pursued by students. Learning is said to be successful if it gets results at least the same as the Minimum Mastery Criteria (MMC) set by each school according to its conditions. The MMC is a limitation for students to achieve the desired learning outcomes. Students expected to get good learning outcomes by achieving or exceeding the specified MMC.

Many problems faced by the education unit. One of the problems most often faced is the low learning outcomes obtained by students. Not a few learning outcomes obtained by students are under the Minimum Mastery Criteria (MMC). This low learning outcome is an indicator of the quality of the learning process and students' quality. It is reinforced by the data on the average value of the National Examination results in Physics Subjects in Table 1.

Table 1 Average National Examination Results (UN) for High School Physics Subjects in Indramayu Regency in years 2016, 2017, 2018, 2019

Years	Average	Percentage
2016	60.47	-
2017	43.19	-28.6%
2018	41.69	-3.5%
2019	39.94	-4.2%

Source:puspendik.kemendikbud.go.id

Based on the average value of the national exam results (UN) in table 1, it can say that from 2016 to 2018, there was a decline in the average value of the national exam results, the most significant drop occurred in 2017, which was -28.6% from the previous year. Furthermore, in 2019 there was a decrease in the average value of national examination results in physics subjects by -4.2% from the previous year. These results indicate that learning outcomes are still low and become a problem that must be considered. It is reinforced by the average value of the Final Semester Assessment results (PAS) in physics subjects at SMA Negeri 1 Lohbener, Indramayu Regency, odd semester 2019/2020, as shown in Table 2.

Table 2. Average Final Semester Assessment Results (PAS) in Physics Subjects at SMA Negeri 1 Lohbener, Indramayu Regency

School	Average Value	Category MMC (75)
SMA 1 Lohbener	53.17	Under MMC
	60.00	Under MMC
Average	**55.07**	**Under MMC**

Source: Physics teacher assessment, (data processed) 2019/2020 Academic Year

Students' learning outcomes are very closely related to the formulation of instructional goals planned by the teacher beforehand, grouped into three categories (realms): cognitive, affective, and psychomotor domains (Jihad & Haris, 2013).

According to Purwanto (2017), the success or failure of learning depends on various factors. The factors are divided into two, namely individual factors (internal) and social factors (external). Included in individual factors include maturity/growth, intelligence, exercise, motivation, and personal factors. In contrast, those included in social factors include family/ household conditions, teachers and how to teach them, tools used in learning, environmental and social motivation. Other than that, the learning process's success affects the skills possessed by the teacher, such as pedagogic skills, content skills, and knowledge skills (Hadi et al., 2019).

Based on the statement above, it is clear that learning is an essential process in determining learning outcomes and influenced by students' internal and external factors. So it can be said that these factors influence learning outcomes. Student internal factors that influence learning outcomes are their motivation in learning. Furthermore, external factors that can affect students are a teacher. An external factor influencing student learning outcomes, in this case, is a teacher. A teacher's role as a manager in learning management reflected in every ability related to the learning process. In "managing" or managing learning, managers, in this case, the teacher, carry out various activities ranging from teaching and learning plan, organizing learning, directing, and evaluating learning. Understanding such learning management can be interpreted broadly in encompassing the whole activity of how to teach students from teaching and learning plan to learning assessment. Another opinion states that learner management can interpret as a management process that includes planning, organizing, controlling, and evaluating activities related to learning the learner by including various factors in it to achieve learning objectives (Sagala, 2013).

Learning management that can improve student learning outcomes is a management activity carried out by the teacher starting from planning learning, organizing learning, directing, and evaluating learning done by applying pedagogical content knowledge (PCK) in the learning process.

The concept of PCK has attracted much attention (Doyle et al., 2018). Science teachers' PCK has researched in many studies, including the Relating Teacher PCK and Teacher Practice Using Classroom Observation (Barendsen, 2017), application of PCK frameworks to design and technology (D&T) education, through an analysis of the nature of the discipline from an ontological and epistemological perspective and contemporary perspectives on the construct of PCK (Doyle, 2018), concurrently examine self-regulated learning processes (SRL) and learning outcomes of three teachers in professional development (PD) on argumentation in science to assess the relationship between types of learning processes employed by teachers and corresponding learning outcomes (Erin, 2020), how teachers learn to teach a new topic and the role played by their developing content

knowledge as they teach (Rollnick, 2016), and The Impact of Physics Teachers' Pedagogical ContentKnowledge and Motivation on Students' Achievement and Interest (Keller, 2017).

The research that the above researchers have conducted has not tested the effect of PCK on learning outcomes through learning motivation in physics, but the effect is tested jointly with PCK. It can happen that PCK does not have a direct effect on learning outcomes but through learning motivation. For this reason, this study will examine the effect of PCK learning management both directly and indirectly on learning outcomes through motivation to learn physics. It will clarify the effect of each independent variable on the dependent variable. The bias will reduce.

2. METHODS

2.1. Design

This study uses an abductive approach with quantitative methods that underlying positivism philosophy. This type of research is correlational research, to be precise path analysis. The research constellation can see in Figure 1.

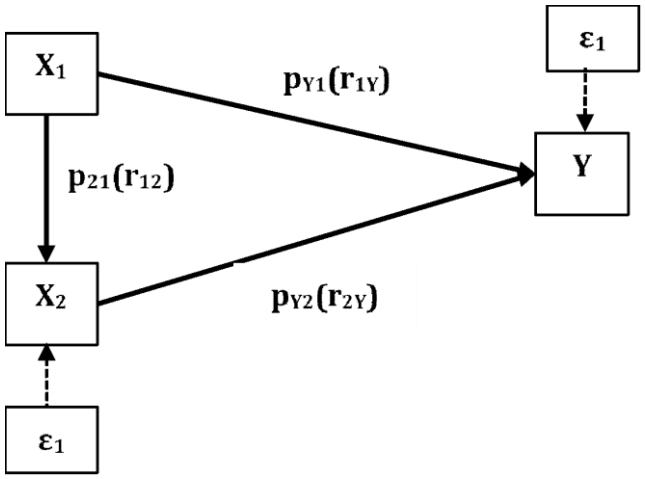

Figure 1. Medium Path Model (Senjaya, 2018)

The primary data to be collected is data about physics learning outcome variables (Y), pedagogical content knowledge learning management variables PCK (X_1), and student learning motivation variables (X_2). To collect the data, each uses an instrument in the form of a questionnaire. The instrument quality criteria are sufficient to meet the criteria (a) the items are valid and (b) the instrument is reliable (Senjaya, 2018: 17). Test the validity of instrument items using the Product Moment formula and test instrument items' reliability using the Alfa Cronbach formula. To test the validity and reliability used statistical calculation tools through the 2019.02 PESTRIPS program.

Instrument Student learning outcomes

Studen's learning outcomes instrument consists of 26 Likert scale items. After the test, two items dropped, so only 24 items were used. The item validity correlation coefficient

ranged from 0.25 to 0.79. As for calculating the reliability coefficient using Cronbach's alpha coefficient and obtained a reliability coefficient of 0.93.

2.2. PCK instrument

It consists of 45 statement items with a Likert scale. After being tested, there were four invalid items. Thus, 41 items used to collect data with a correlation coefficient ranging from 0.31 to 0.80. The reliability coefficient is 0.94.

2.3. Learning motivation instrument

It consists of 25 items questionnaire with a Likert scale, and after being tested for validity, there are only 24 items with a correlation coefficient ranging from 0.30 to 0.78. consists of 25 Items questionnaire with a Likert scale, and after being tested for validity, there are only 24 items with a correlation coefficient ranging from 0.30 to 0.78. The coefficient, using Cronbach's alpha coefficient, is 0.93.

2.4. Data analysis

The population of this research is high school physics teachers in Indramayu Regency. The Research strategy is a survey and instrument of data collection techniques administered to 43 physics teachers as samples from 64 physics teachers. The sample size was determined using the table from Krejcie & Morgan (Krejcie, 1970). Statistical calculation aids using LISREL 8.80 software and PESTRIPS 2019.02 (Senjaya, 2018).

Based on Figure 1, the model to be tested is as follows:

$X_1 = p_{21}$

$X_2 = p_{21}. X_1 + \varepsilon_1$

$Y = p_{Y1}. X_1 + p_{Y2}. . X_2 + \varepsilon_2$

Notes:

Y: Learning Outcomes Variable

X_1: PCK Management Variable

X_2: Learning Motivation Variable

p: path coefficient

r: correlation coefficient

ε: residual or error

The model above can analyze by using the Path Analysis method. Path analysis is one of the analyses that applied with correlational analysis. Path analysis is a statistical technique to illustrate the directed engagement between several variables. The path diagram and the research hypothesis into an empirical data correlation equation and its structural equation, Senjaya (2018).

Correlation equation:

$r_{12} = p_{21}$

$r_{1Y} = p_{Y1} + p_{Y2.r12}$

$r_{2Y} = p_{Y1.r12} + p_{Y2}$

Structural equation:

$X_1 = p_{21}$

$X_2 = p_{21}. X_1 + \varepsilon_1$

$Y = p_{Y1}. X_1 + p_{Y2.X2} + \varepsilon_2$

3. RESULTS AND DISCUSSION

RESULTS

3.1. Effect of PCK Learning Management towards Learning Outcomes Motivation.

To measure PCK Learning Management's path coefficient (X_1) towards Learning Motivation (X_2) used GAMMA output from the LISREL 8.80 program. GAMMA output is LISREL output in the form of an influence matrix between exogenous variables (X_1 and X_2) to endogenous variables (Y).

GAMMA

	X_1
X_2	0.86
Y	0.21

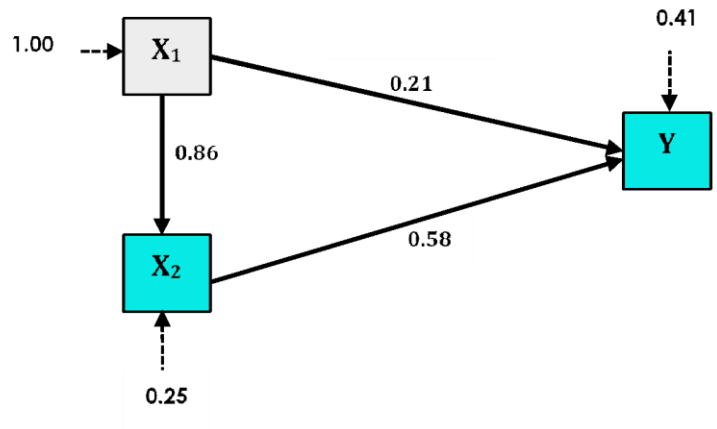

Figure 2. The effect of PCK student learning outcomes through Learning Motivation

Based on the Gamma output and Figure 2 above, the path coefficient value of the influence between PCK (X_1) and Learning Motivation (X_2) is 0.86 (p_{12} = 0.86). The direct influence of Learning Management Pedagogical Content Knowledge (PCK) on Learning Motivation of 0.86. To test the significance or insignificance of the influence of PCK (X_1) on Learning Motivation (X_2) by t-test, pay attention to the t-test output (T-Value) of the LISREL program in Figure 3.

Based on Figure 3, the T-Value output, the relationship between PCK Learning Management (X_1) and Learning Motivation (X_2) is significant because the value of t > critical t value (t = 11.02 > t critical = 1.96). Meaning: Management of pedagogical content knowledge learning has a positive effect on learning motivation. The influence of pedagogical content knowledge management learning on learning motivation is 0.86 (p_{12} = 0.86).

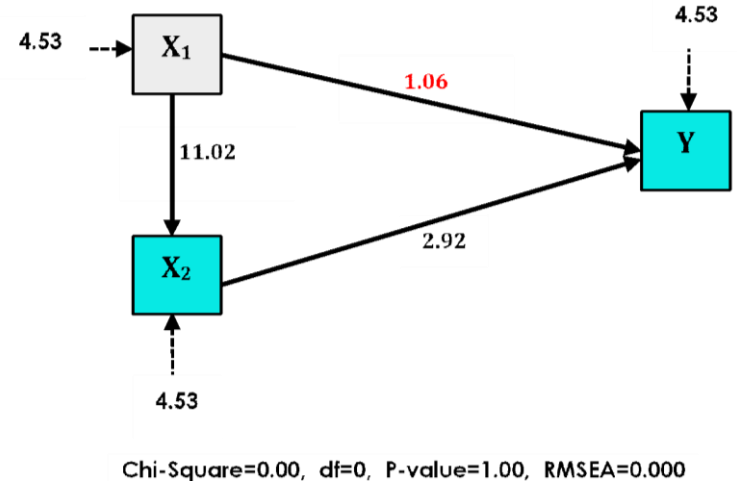

Figure 3. The effect of PCK student learning outcomes through Learning Motivation T-Test

The influence of other variables (besides learning motivation) can saw from the residual coefficient of the following LISREL program output:

PSI

Note: This matrix is diagonal

X_2	Y
0.25	0.41

PSI output displays output regarding measurement error only for endogenous variables (X_2 and Y), where standardized error X_2 has measurement error (ε = 0.25). It means that the influence of other variables (besides learning motivation) affects 25%.

3.2. The Effect of PCK Learning Management Variables (X_1) on Student Learning Outcomes (Y)

This path analysis was conducted to determine the effect of PCK on student learning outcomes. To measure PCK Learning Management's path coefficient (X_1) on student learning outcomes (Y), then look at GAMMA output from the LISREL 8.80 program above.

GAMMA output is LISREL output in the form of an influence matrix between exogenous variables (X_1 and X_2) to endogenous variables (Y). Based on the GAMMA output, the path coefficient between the PCK (X_1) learning outcomes towards student learning outcomes (Y) is 0.21 (p_{Y1} = 0.21). PCK (X_1) Learning Management's direct effect on student learning outcomes (Y) is 0.21.

While the indirect effect obtained with the following LISREL output.

Standardized Total and Indirect Effects

Standardized Total of X on Y

	X_1
.....	
X_2	0.86
Y	0.71

Standardized Indirects Effects of X on Y

	X_1
.....	
X_2	.....
Y	0.50

Standardized Total Effects of Y on Y

	X_2	Y
.....	.....	.....
X_2	.....	.....
Y	0.58	.....

Based on the LISREL output above the indirect effects X_1 to Y of 0.50. So that the total impact of X_1 on Y is 0.71, pay attention to the LISREL output above. To test the significance or insignificance of the influence of Pedagogical Content Knowledge Learning Management (PCK) (X_1) on student learning outcomes (Y) by t-test, pay attention to the t-test output (T-Value) of the LISREL program. Based on the T-Value output, the relationship of PCK) Learning Management (X_1) to student learning outcomes (Y) is not significant because the value of t < t value is critical (t = 1.05 < t critical = 1.96). Meaning: Management of pedagogical content knowledge learning has not a significant direct effect on student learning outcomes. However, it has effects indirectly on learning outcomes through learning motivation.

The influence of other variables (which the authors did not examine) can be seen from the residual coefficient of the following LISREL program PSI output above. PSI output displays output regarding measurement error only for endogenous variables (X2 and Y) where the error is standardized Y has measurement error (ε = 0.41). That means that the influence of other variables not examined the effect of 41%.

3.3. The Effect of Learning Motivation Variables (X_2) on Student Learning Outcomes (Y).

The path analysis used to determine Learning Motivation (X_2) on Student Learning Outcomes (Y). To measure the path coefficient of the variable Learning Motivation (X_2) on Student Learning Outcomes (Y), then see the BETA output from the LISREL 8.80 program. The BETA output is LISREL output in a relationship matrix between endogenous variables (X_2 and Y).

Standardized Solution

BETA

	X_2	Y
	.....	.....
X_2	...	...
Y	0.58	...

Based on the BETA output obtained by the value of the path coefficient of influence between variables Learning Motivation (X_2) on Student Learning Outcomes (Y) of 0.58 (p_{Y2} = 0.58). The variable Learning Motivation (X_2) 's direct effect on Student Learning Outcomes (Y) is 0.58. Table 4 shows the direct, indirect, and total influence between the dependent and independent variables.

Table 2 Decomposition of Influence Between Variables

Effect of Variables	Effect		Total
	direct	indirect	
X_1 □ X_2	0.86	-	0.86
X_1 □ X_2 □ Y	0.21	(0.86) (0.58) = 0.50	0.21 + 0.50 = 0.71
X_2 □ Y	0.58	-	0.58

Test the significance or insignificance of the influence of Learning Motivation (X_2) variables on Student Learning Outcomes (Y) by t-test paid attention to the t-test output (T-Value) of the LISREL program. Based on the T-Value output above that the relationship of Learning Motivation (X_2) to Student Learning Outcomes (Y) is significant because the value of t > critical t value (t = 2.92 > critical t = 1.96). Meaning: Learning motivation has a positive effect on student learning outcomes. The influence of learning motivation on student learning outcomes is 0.58 (p_{Y2} = 0.58).

3.4. The effect of the other variables known from the residual coefficient from the following LISREL program output.

PSI output (above) displays output regarding measurement error only for endogenous variables (X_2 and Y) where standardized error X_2 has a measurement error (ε = 0.25), and Y has a measurement error (ε = 0.41). Based on the LISREL output above, the influence of other variables (besides pedagogical content knowledge learning management and learning motivation) is 41% (Figure 2).

Furthermore, to determine the suitability of the research model or measurement model with empirical data. The path analysis model above was then tested for feasibility by looking at the probability value of P > 0.05 and the value of Root Mean Square Error of Approximation (RMSEA) < 0.05. From the LISREL output P values = 1.00 > 0.05 and RMSEA = 0.00 < 0.05. That means that the model is Fit. The following outputs are the model conclusions from LISREL.

Goodness of Fit Statistics
Degree of Freedom = 0
Minimum Fit Function Chi-Square = 0.0 (P = 1.00)
Normal Theory Weighted Least Squares Chi-Squares = 0.00 (P = 1.00)

The Model is Saturated, and the Fit is Perfect!

3.5. Direct Effect of Learning Management PCK on Physics Learning Outcomes

The problem that will answer in this research is that there is a direct and significant influence toward PCK learning on physics student learning outcomes in-state high schools in the Indramayu region. Empirically, the results of this study's learning management on student physics learning outcomes appear from the correlation coefficient (r_{1Y} = 0.71). However, the effect's magnitude was not significantly from the path coefficient's value (p_{Y1} = 0.21). Based on the t-test obtained value < critical t value (t = 1.05 < critical t = 1.96). Mean Management of pedagogical content knowledge learning has an insignificant effect on student learning outcomes—however, its effects indirectly through learning motivation.

3.6. Direct Effect of Learning Management PCK Against Learning Motivation.

Based on the results of this study, it found that there was a significant positive effect toward PCK of high school physics subjects in the Indramayu region on student motivation with a contribution of 75% (R^2 = 0.75), the rest influenced by other variables not examined in this study by 25% (ε = 0.25). Based on the description, the effectiveness of learning depends on teachers' ability to manage the class. Teachers who have good classroom management skills can maintain the teaching and learning conduciveness and vice versa. Related to classroom management, teachers need to understand the characteristics of students, that the attributes of students in-state high schools in Indramayu Regency that study physics are so varying, that teachers must determine precisely the ways and strategies for delivering subject matter. Variative learning strategies can eliminate students' boredom in the teaching and learning process; that determination of learning strategies differs from one teacher to another following the students' characteristics. This variation can increase students' fun and motivation in learning, support, and the teacher needs to appreciate each student's learning activities.

3.7. Direct Effect of Student Learning Motivation on Physics Learning Outcomes.

The problem to be answered in this study is that there is a positive and significant influence on learning motivation on students' learning outcomes in physics at state high schools in the Indramayu region. Based on empirical findings that indicate a significant influence of learning motivation on student learning outcomes, this study provides some information, including 1) an increase in learning motivation has a significant effect on student learning

outcomes in physics in school, 2) one way to improve student learning outcomes is to increase learning motivation, 3) the percentage of the effect of learning motivation is 59% (R^2 = 0.59), and the rest influenced by other variables namely pedagogical content knowledge learning management (PCK) and other variables not examined in this study.

3.8. The Effect of PCK learning management on Physics Learning Outcomes Through Learning Motivation

The results showed an indirect effect. It is evidenced by the output of LISREL (indirect effects) X_1 to Y by 0.50. Also (indirect effects of X on Y) or pedagogical content knowledge (PCK) learning management on student learning outcomes through learning motivation is significant. The value of P > 0.05 evidences it. It can conclude that learning motivation was influenced by PCK learning management and affects student learning outcomes. The higher the pedagogical content knowledge learning management (PCK), the higher the learning outcomes of students and the increase in learning motivation. The complete causal relationship diagram can be illustrated empirically from the test results in Figure 2.

Value of P = 1.00 > 0.05 and RMSEA = 0.00 < 0.05. Then the research model (hypothetical model) is in fits with empirical data. So Figures 2 becomes an empirical model of the relationship between pedagogical content knowledge learning management (PCK) (X_1), learning motivation (X_2), and student learning outcomes (Y).

DISCUSSION

Regarding the correlation between PCK and learning motivation, this study's results are in line with Maryani's (2015) research that studies correlation between Teacher's PCK (Pedagogical Content Knowledge and Student's Motivation in Primary School. However, not in line with Cheng's (2020) research examines the correlation between teachers' PCK (Pedagogical Content Knowledge) and Student's Motivation in Primary School.

The research results on the relationship between PCK and learning outcomes showed that the effect was not significant. This result is inconsistent with Creasy's (2012) research with microevolution material, Lange (2012), which states that teachers' PCK was significantly related to student achievement in elementary science after controlling for crucial students' teacher-level covariates. Likewise with Jasmina (2017), who researched The Effects of Professors 'Pedagogical Content Knowledge on Elementary Teacher Candidates' Attitude and Achievement Regarding Biology.

The results of research on the relationship between learning motivation and learning outcomes show a significant effect. These results align with Wu's (2016) research which discusses the Effects of Multimedia Information Technology Integrated Multi-Sensory Instruction on Students' Learning Motivation and Outcome. These results are also in line with

Rafiola's (2020) research which examines The Effect of Learning Motivation, Self-Efficacy, and Blended Learning on Students' Achievement in Industrial Revolution 4.0.

Learning motivation as a mediator for the achievement of learning outcomes in this study shows a significant indirect effect of PCK on learning outcomes through learning motivation. This result is in line with Gumelar's research (2019), in which one of his research findings states that learning styles affect learning outcomes through learning motivation. Likewise, this study's results are in line with the results of Copriady's (2014) study, which states that the results show that motivation is a significant variable as a mediator between the variables of readiness with the ICT application in teaching and learning science and social science.

The implication of this study that the principal and the education office should continue to strive to improve the quality and smoothness of the teaching and learning process by providing provision to teachers to improve pedagogical content knowledge (PCK) learning management by participating in workshops and continuously improving techniques to motivate students for results. Students are learning better.

4. CONCLUSION

Based on the research results and analysis of research data and discussion, the following conclusions obtained that Pedagogical content knowledge learning management (PCK) has no significant direct effect on student learning outcomes. PCK learning management has a positive effect on learning motivation (p_{12} = 0.86). The relative contribution of PCK) learning management to learning motivation is 75%. Learning motivation has a positive direct effect on student learning outcomes (p_{Y2} = 0.58). The relative contribution of learning motivation to student learning outcomes is 59%.

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