The impact of human resource management, learning, and academic infrastructure in pre-service teachers on pedagogical competence: A multifaceted analysis

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ABSTRACT

This study investigated the influence of the learning process, human resources, and infrastructure on the pre-service teachers' competencies, particularly their pedagogical competence as future professional teachers. This study employed survey research, a type of quantitative investigation. The study's population consisted of all 182 Pre-Service Teachers from the Indonesian Language and Literature Education Department, Mathematics, and English Education Department of the Teacher Professional Education Program, Faculty of Teacher Training and Education, Universitas Islam Malang. Primary and secondary data were the two data types used in this investigation: questionnaires and documentation. The main source of information was the assessment of the lecture process in Batches 1 and 2 of the Pre-Service Teacher of Teacher Professional Education Program. The course grades from LMS courses taken by pre-service PPG students made up the secondary data. Based on the results and discussion, it can be concluded that the learning process and human resources positively influenced the pre-service teacher's competence, especially in the pre-service teacher professional education program. Meanwhile, the data showed that academic infrastructure did not impact pre-service teacher competence.

1. Introduction

The Teacher Professional Education Program (PPG) issue has received critical national attention in Indonesia. The teacher professional education program (PPG) is an educational program organized to prepare non-educational S1 and S1 / D-IV graduates who have the talent and interest to become teachers to master teacher competencies as a whole following national education standards and other standards so that they can obtain professional educator certificates in early childhood, primary, and secondary education [1]. This teacher professional education program is expected to answer various educational problems such as *low competence*, *under qualification*, *mismatched*, and academic challenges such as the development of science, technology, and community dynamics and meet the needs of teachers in schools/*madrasahs* nationally. To meet the urgency of teacher needs in Indonesia, in 2002, the government issued Government Regulation No. 74 of 2008 concerning Teachers mandating prospective teachers with a bachelor's degree (S-1 or D-4) to take part in the pre-service teacher professional Education (PPG) program to achieve the required competencies and educator certificates. The Pre-service PPG program is held at the Educational Institution appointed by the Ministry of Education and Culture. The teacher professional education program is held after the undergraduate or applied undergraduate program for bachelor and diploma IV graduates, both from education and non-education, for prospective teachers to obtain an educator certificate in early

childhood education, elementary education, and secondary education. The teacher professional education program is a higher education program carried out after the undergraduate program to prepare students for jobs requiring special skills. The teacher professional education program is one of the efforts to produce experienced teachers [2].

The teacher professional education program has a tremendous influence in improving and developing a teacher's professional competence, proven by increased insight and teacher knowledge [3]. The teacher professional education program is one of the solutions to improving the professional competence of teachers; through teacher professional education programs, teachers can improve their ability to choose and master teaching materials, plan, develop, and actualize processes appropriate and productive teaching and learning with professional competency standards teacher [4]. Implementing this teacher professional education program is integral to learning activities on campus/school/madrasah in forming profiles of prospective teachers who excel in pedagogic, personality, professional, social, and leadership competencies. For this reason, implementing a pre-service teacher professional education program requires operational technical guidelines as a reference for Educational Institutions and Education Personnel. The implementation of a teacher professional education program is expected to improve teacher professionalism in teaching, starting from designing, implementing, and evaluating learning. It is hoped that increasing teacher professionalism in teaching will impact the quality of education in Indonesia so that it will be able to create high-quality and develop pre-service teacher competence [5]. In general, the pre-service of teacher professional education program aims to produce professional teachers who have pedagogic, personality, social, and professional competencies under the provisions of laws and regulations for prospective students who do not have a teacher professional certificate, have not become permanent teachers of educational institutions, and or permanent teachers who do not participate in the in-service teacher professional education program.

To achieve the goals and develop pre-service teachers' competencies, the learning process in the professional education program is carried out through classical lectures, workshops, and practices in schools/madrasahs, both online and offline, or blended learning. These activities can be carried out on campuses, schools/madrasahs/Islamic boarding schools, or dormitories. Classical lectures are intended for activities to deepen pedagogical material and deepen material in the field of study/skills that will be taught. Meanwhile, workshops are carried out with learning media courses, and practical lectures are carried out concerning practical courses in peer learning, internship, and classroom action research. The distinctiveness of pre-service teacher professional education program can be measured from several aspects, including; (1) Spiritual aspects, namely emphasizing wholeness in being, knowledge, and practice of the religion they believe in; (2) Material aspects, focused on studies based on comparative approaches and development in the scientific field; (3) Pedagogic aspects, combining Islamic pedagogics with existing pedagogics; (4) Aspects of teacher soft skills development, through spiritual, emotional, and adversity quotients development; moderate, tolerant, dexterous, caring for each other, independence, discipline, leadership, and adaptive; and love of the motherland; (5) Aspects of developing higher-order thinking, through growth mindset, computational thinking, critical thinking, problem-solving, creative thinking, reflective thinking, and communication; (6) Technological aspects, able to apply Technological Pedagogical and Content Knowledge (TPACK) and produce technology-based learning tools on teaching materials, student sheets, teaching media, and other learning resources; (7) Aspects of leadership (instructional leadership), able to transform, create and innovate in learning in line with social dynamics and the development of science and technology.

However, the implementation of a pre-service teacher professional education program to produce graduates of professional teachers and have superior pedagogic competence will not be optimal if it is not supported by human resource management, learning, and adequate facilities and infrastructure in processing the quality improvement of educational institutions, namely human resources filled by professional and reliable people in their fields. This follows that human resource performance is an organizational criterion for achieving its goals [6]. Human resource management in educational institutions will form an organization that is very influential in improving the quality of institutions. The learning outcomes of the teacher professional education program are translated from four teacher competencies and refer to level 7 of the Indonesian National Qualifications Framework; (1) Teaching skills (Pedagogic Competence) include, lesson planning, learning implementation, assessing and evaluating learning; (2) Personality competence: behaving by religious standards, legal standards, social standards, ethics, and cultural values; (3) Social competence: able to communicate, interact and

adapt effectively with students, other teachers, parents/guardians, and the surrounding community; and (4) Professional Competence; have a broad and in-depth understanding of the subject matter, master and explore relevant scientific, technological or artistic concepts, approaches, techniques and methods. With the learning outcomes of the teacher professional education program, it is hoped that teacher professional education program graduates can help the government develop professional human resources and meet the limited number of teachers [7].

To achieve these learning objectives, the teacher professional education program carries out learning evaluations that aim to monitor the development of student learning processes, especially pedagogical competence, and check the fulfilment of learning outcomes. However, the assessment results of students' pedagogical abilities are certainly not only influenced by the student's academic skills, the competence of lecturers and the infrastructure used to support the learning process are also factors that influence student learning outcomes. The pre-service teacher competence can also be seen from the results of assessments. Assessment is an effort to obtain information about students' overall learning gains, knowledge, concepts, attitudes, values, and process skills [8]. Learning experiences, assessments, and competencies are mutually sustainable in the learning process. Learning processes are intended to achieve goals (mastering specific competencies). The assessment is designed to see how far competencies students have mastered in the form of learning outcomes shown after they have gone through a learning experience [9]. Pre-service teacher competence is reflected in data and information about students' learning capacities, evaluates the program's effectiveness, and determines whether the educational goals and scientific development process have been followed correctly. Assessment continuously supports the process, advancement, and development of students' learning outcomes. It also helps to identify students' strengths and weaknesses in a particular subject of study and can inform parents/guardians of participants' class standing or graduation status [10].

Student competency can be influenced by several factors, namely the presence of quality teachers, which can be seen from the achievement of key indicators of educational staff standards. Apart from that, student competency can also be influenced by other factors, namely school facilities and infrastructure. To achieve maximum competency, students need complete learning facilities. Complete learning facilities will essentially make things easier, faster, and deeper for pupils or students in the learning process [11]. Test results can be used to monitor developments in the quality of education. In the learning process, all elements involved, starting from teachers, students, principals, supervisors, and parents, must be aware that any process that occurs in the classroom must be carried out in the context of achieving standard competence. In the institution, service products are accepted by customers when interactions occur between lecturers with service recipients (students), so lecturers should have valuable competence and quality. Service quality in higher education has an impact on an institution's overall performance. Higher education service products include teaching, research, and service in society, which is formed when interactions occur between lecturers and student customers, so the role of lecturer competence is determined by the superiority of the product and service produced to influence satisfaction among student customers [12]. The results obtained in this research are in line with the theory and results of previous research. According to The main activity is to achieve results superior products are input, product delivery process, marketing, and service. The learning process is the main activity part of the chain Porter's value is the process of delivering teaching and service services [13].

The learning or training process given to students with attention to teacher competence, effective learning processes, and a supportive learning environment will improve the quality of service products produced and impact student satisfaction [14]. Lecturer competency and the quality of the learning process simultaneously have a significant effect on student satisfaction in the study program at higher education, meaning that the synergy between lecturer competence and the quality of the learning process in higher education will be able to increase satisfaction among students in study programs [12]. Highly competent Lecturers will produce effective teaching and learning activities so that students feel satisfied because they can understand what the lecturer conveys, have enjoyable learning, and ultimately get good achievements, increasing the satisfaction value [15]. All in all, the effectiveness or ineffectiveness of teaching is closely related to lecturer competence [16]. Furthermore, education is inseparable from the role of facilities and infrastructure that are pretty dominant in supporting the smooth implementation of education. The success of learning in educational institutions is supported by utilizing all educational infrastructure facilities in schools effectively and efficiently. Management of facilities and infrastructure significantly influences the quality of education [6]. Infrastructure facilities in the pre-service teacher professional education

program also need to be considered and managed to create pleasant conditions for prospective teachers to support their competencies, especially pedagogic competencies. In addition, providing adequate learning facilities qualitatively and relevant to needs is very necessary. It can be utilized optimally to benefit the education and teaching process by lecturers and pre-service teacher professional education programs. Educational facilities are equipment and equipment that are directly used and support the educational process, especially the teaching and learning process. The educational infrastructure is a facility that indirectly supports the course of the teaching and learning process or teaching [17]. Meanwhile, the management of educational facilities and infrastructure is tasked with regulating and maintaining educational infrastructure to contribute optimally to the course of the educational process. These management activities include planning, procurement, supervision, inventory storage, and deletion and structuring activities. On the other hand, education is inseparable from the role of facilities and infrastructure that are quite dominant in supporting the smooth implementation of education. The success of learning in educational institutions is supported by the utilization of all educational infrastructure facilities in schools effectively and efficiently. Infrastructure facilities in the pre-service PPG program also need to be considered and managed to create pleasant conditions for prospective teachers to support their competencies, especially pedagogic competencies. In addition, it is essential to provide adequate learning facilities qualitatively, and quantitatively relevant to needs and can be utilized optimally for the benefit of the education and teaching process, both by lecturers and pre-service PPG students.

The educational infrastructure is a facility that indirectly supports the course of the teaching and learning process or teaching. Meanwhile, the management of educational facilities and infrastructure is tasked with regulating and maintaining educational infrastructure to contribute optimally to the course of the educational process. These management activities include planning, procurement, supervision, inventory storage, and deletion and structuring activities. School quality is related to effectively managing school resources. Good management of school resources can produce good output it can improve school quality [18]. Other research proved that facilities and infrastructure significantly influence the quality of education. Facilities and infrastructure are important factors in improving the quality of education. Facilities and infrastructure management is one of the domains of education quality improvement management where internally improving the quality of educational institutions [19]. Therefore, an institution's attention to the management of facilities and infrastructure is not can be ignored because, without adequate means and means, institutions will have difficulty supporting the professional competence of their teaching staff. The researchers conducted this study to investigate the Influence of learning, human resources, and infrastructure on student competencies in the Pre-service professional teacher education Program. However, after realizing the significance of the role of the learning process, lecturer competency, and infrastructure in developing pre-service teacher competency, there is still paucity considered in the findings of prior research regarding the magnitude of these three factors in developing student competency. Therefore, this current study investigates whether pre-service teachers' competence—particularly their pedagogical competence as future professional instructors—is influenced by the learning process, human resources, and infrastructure. Based on the context that has been described, the objectives of this research are as follows: (1) How does the learning process influence the competency of pre-service PPG students?; (2) What is the influence of human resources on the competency of pre-service PPG students?; (3) How does infrastructure affect the competency of pre-service PPG students?.

2. Method

This study employed a survey research design, a type of quantitative investigation. The post-positivism worldview considerations and assumptions underpinned this survey study, which was a quantitative research project [20]. Survey research used partial least squares structural equation modeling (PLS-SEM) to make predictions and provide explanations [21]. Despite the survey's social desirability and response biases, the data for the study was gathered by having participants complete an online questionnaire regarding the Pre-Service Teacher Professional Education Program lecture process batches 1 and 2 of 2022. This method allowed for a rapid evaluation of a large sample [22]. The study's population consisted of all 182 Pre-Service Teacher Professional Education Program Faculty of Teacher Training and Education at Universitas Islam Malang Batch 1 and 2 of 2022 students studying English, Mathematics, and Indonesian. Purposive sampling was the method of sampling employed in this investigation. Purposive sampling involves a sample with a specific goal in mind. All Pre-Service Teacher Professional Education Program students who completed the

questionnaire were included in the purposive sample technique used in this investigation [23]. Consequently, 134 students from the Faculty of Teacher Training and Education at Universitas Islam Malang Batch 1 and Batch 2 of 2022 who completed the lecture process evaluation questionnaire were sampled for the Pre-Service Teacher Professional Education Program. Primary and secondary data were the two data types used in this investigation: questionnaires and documentation. The primary source of information was the assessment of the lecture process in Batches 1 and 2 of the Pre-Service Teacher Professional Education Program in 2022. The grades from LMS courses taken by pre-service PPG students made up the secondary data.

The quality assurance standards for the Ministry of Education and Culture and Technology's Pre-service PPG Program are the source of the questionnaire used to assess Pre-service PPG lectures [24]. All Pre-Service Teacher Professional Education Program Batch 1 and Batch 2 students in Year 2022 received a closed platform to assess primary data, specifically evaluating the lecture process using four Likert scale choices. As the first exogenous variable, the human resources (X1) section of the Pre-Service Teacher Professional Education Program evaluation questionnaire consisted of five indicators for thirty items. Forty items in the learning process (X2) questionnaire for the second exogenous variable had five indications. There were 25 questions in the infrastructure questionnaire (X3) for the third exogenous variable, which had three indicators. Although the documentation technique obtained course score data from LMS, up to four-course scores—henceforth referred to as competence—for Pre-Service Teacher Professional Education Program students (Y) were endogenous variables (bound). SmartPLS software version 4 was used to analyze all of the data in this study, which employed partial least squares structural equation modeling (PLS-SEM) modeling. PLS-SEM was a multivariate statistic that might be used to investigate, predict, or create structural models by looking at some influences between variables that were evaluated simultaneously [25]. SmartPLS was utilized since the model was designed for limited samples. Extra information on SmartPLS 4 was as follows: (1) Since SmartPLS leverages random duplication or bootstrapping techniques, data used in smartPLS analysis did not need a normal distribution. PLS did, therefore, not have any issues with the assumption of normalcy. Consequently, PLS did not have problems with the assumption of normality. Apart from its connection to data normalcy, bootstrapping did not necessitate a minimum quantity of samples; (2) Reflective SEM models with distinct indicator measurement scales within a single model can be tested using SmartPLS. One model can test any scale (category ratio, Likert, *etc*.) [26].

The assessment of the PLS-SEM model comprised three components: the assessment of the reflective measurement model, which verified the validity and reliability of the instrument; the assessment of the structural model, which examined the relationship model between variables (path analysis); and the assessment of the goodness and fit, or compatibility, or good of fit, of the model, which yielded a model appropriate for predesign [27]. Where is the reflecting measurement model evaluation that uses an outer model analysis to verify the instrument's validity and reliability? the analysis was an external model used to make sure the measurement was appropriate for measurement (valid and reliable) [26]. The analysis involved multiple calculations: the value of loading factors on latent variables using indicators was known as convergent validity (a). >0.7 is the anticipated value. b. The value of cross-loading factors that help determine if the construct has sufficient discriminants is known as discriminant validity. This was achieved by comparing the construct's value, which must be greater than the values of other constructs. c. Composite reliability measure's reliability values greater than 0.7, indicating substantial dependability in the built value. d. The average of variances at least 0.5 is called Average Variance Extracted, or AVE. A Cronbach's alpha calculation demonstrated composite dependability results when the minimum magnitude was 0.6.

Regarding the assessment of structural models, route analysis involved analyzing the inner model and verifying the model of links between variables. This model's analysis aimed to investigate the connections between its latent constructs. The analysis involved multiple calculations: (1) The coefficient of determination for the endogenous construct is known as R Square. "The criteria for limiting the value of R square is in three classifications, namely 0.67 as substantial; 0.33 as moderate; and 0.19 as weak," [26], [27]; (2) Effect size (F square) to determine the model's goodness of fit. At the structural level, an F square value of 0.02 has minimal impact, 0.15 has a moderate effect, and 0.35 has a significant influence. Prediction relevance, also referred to as Stone-Geisser's (Q square). This test aimed to evaluate the predictive power of the value-generation process. If 0.02 (small), 0.15 (mid), and 0.35 (big) were the results obtained. Only endogenous constructs with reflected indicators can be used in this way. Researchers demonstrated hypothesis testing by examining his work's t-statistical and probability values. Using statistical values for hypothesis testing, the t-statistical value

for alpha 5% is 1.96 [28]. Therefore, when the t-statistic > 1.96, the hypothesis was considered accepted (Ha) and rejected (H0). Ha was accepted if the p-value was less than 0.05 to use probability to reject or accept a hypothesis. Fig. 1 of the following path analysis model depicts the study's hypothesis.

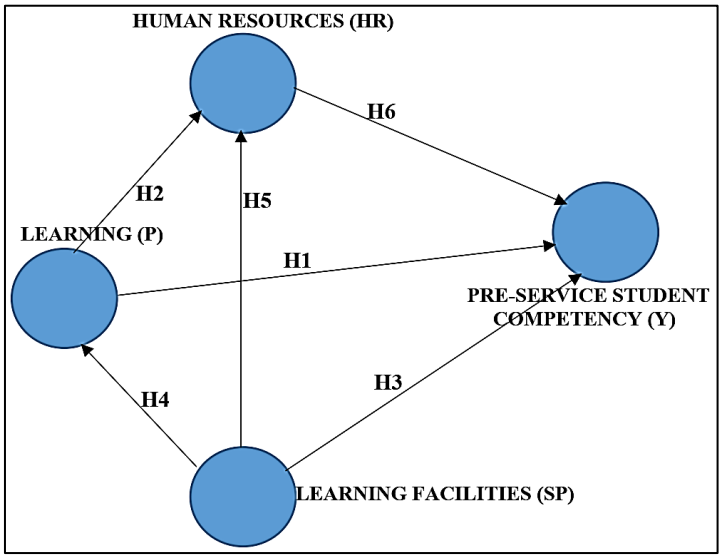

Fig. 1. Path Analysis Model

The hypotheses proposed in this study are as follows:

Direct Influence

- Hypothesis 1 (H1): There is a positive influence between the learning process of the Pre-Service Teacher Professional Education Program on the competence of Pre-service students.
- Hypothesis 2 (H2): There is a positive influence between the learning process of the Pre-Service Teacher Professional Education Program on the quality of human resources.
- Hypothesis 3 (H3): There is a positive influence between Pre-Service Teacher Professional Education Program infrastructure facilities on the competence of Pre-Service Teacher Professional Education Program students.
- Hypothesis 4 (H4): There is a positive influence between Pre-Service Teacher Professional Education Program infrastructure on the learning process.
- Hypothesis 5 (H5): There is a positive influence between the Pre-Service Teacher Professional Education Program's infrastructure on the quality of human resources.
- Hypothesis 6 (H6): There is a positive influence between human resources on the competence of Pre-Service Teacher Professional Education Program students.

Indirect Influence

- Hypothesis 7 (H7): There is an indirect influence between infrastructure facilities on human resources through the learning process.
- Hypothesis 8 (H8): There is an indirect influence between the learning process on the competence of Pre-Service Teacher Professional Education Program students through human resources.
- Hypothesis 9 (H9): There is an indirect influence between infrastructure facilities on the competence of Pre-Service Teacher Professional Education Program students through human resources.
- Hypothesis 10 (H10): There is an indirect influence between infrastructure facilities on the competence of Pre-Service Teacher Professional Education Program students through the learning process.

- Hypothesis 11 (H11): There is an indirect influence between learning infrastructure on the competence of Pre-Service Teacher Professional Education Program students through the learning process and human resources.

3. Results and Discussion

In this study, primary data collection is an independent (exogenous) variable that includes Human Resources (HR), Learning (PB), and Learning Facilities (SP). Online questionnaires were distributed to 134 respondents between July 5, 2023, and July 31, 2023. The value of the student courses in the Pre-Service Teacher Professional Education Program (student competence), which is determined by value documentation from the LMS, is an example of an endogenous variable in secondary data. Validity and hypothesis testing will be done on the data obtained from the distribution of the questionnaires and data taken documents in the analysis using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach utilizing SmartPLS 4 software. According to Table 1, the respondents are Pre-service Teacher Professional Education Program Batch 1 and 2 of 2022 students studying three subjects: English, mathematics, and Indonesian.

Table 1. Respondent by Pre-service PPG Study Program

Field of Study	Sum	Percentage (%)
Indonesian	36	26.87
Mathematics	69	51.49
English	29	21.64
Sum	134	100.00

3.1. Evaluation of the Measurement Model (*Outer* Model)

Through assessing Convergent Validity, Discriminant Validity, Indicator Reliability, and Internal Consistency Reliability, this evaluation seeks to confirm that the instruments employed in this study fulfill the standards and pass the validity and reliability tests [29]. The main model diagram of the PLS output algorithm results from the SmartPLS 4 software in the form of measurement model diagrams (outer models) are displayed in Fig. 2, and Table 2 displays the full outer loadings data of measurement items. These results demonstrate the validity and reliability of testing.

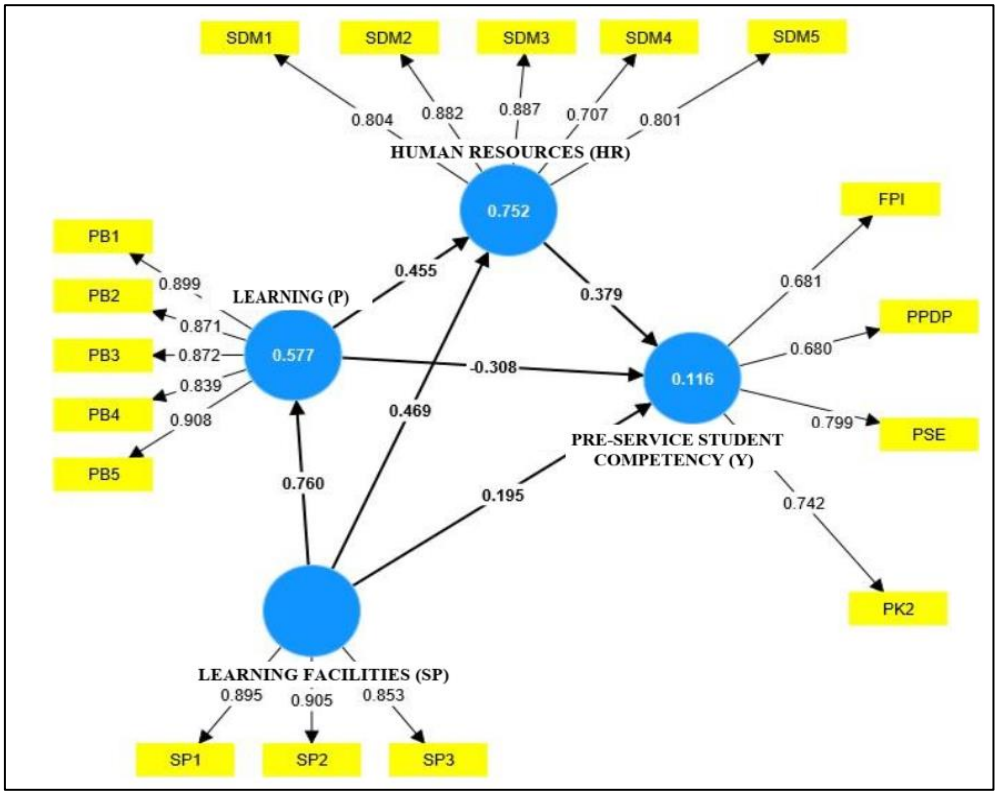

Fig. 2. Key Model Diagram *Output Results* PLS *Algorithm Outer* Model

Determining the validity of each link between indicators and their latent constructs or variables is the first step in verifying convergent validity. This study's proof comes from the PLS Output Algorithm's main model diagram, displayed in Fig. 2 as an outer model. All measurement items have met the Convergent Validity test, and the diagram in Fig. 2 indicates that all measurement items for each variable have passed the validity test [28], [30]. This is because all of the Louding Factor (LF) values in the diagram are more significant than 0.70, and there are two measurement items with LF values greater than 0.60. Another way to perform a validation test is by looking at the outer Loading values in Table 2.

Table 2. Outer Loadings, Cronbach Alpha Composite Reliability, and Average Variance Extracted

Variable	Measurement Items	*Outer Loadings > 0.70*	Description	*Cronbach's Alpha > 0.70*	*Composite Reliability > 0.70*	*AVE > 0.50*	Description
Human Resources (HR)	SDM1	0.804	Valid	0.875	0.910	0.671	Reliable
	SDM2	0.882	Valid				
	SDM3	0.887	Valid				
	SDM4	0.707	Valid				
	SDM5	0.801	Valid				
Learning (PB)	PB1	0.899	Valid	0.926	0.944	0.771	Reliable
	PB2	0.871	Valid				
	PB3	0.872	Valid				
	PB4	0.839	Valid				
	PB5	0.908	Valid				
Learning Facilities (SP)	SP1	0.895	Valid	0.861	0.915	0.783	Reliable
	SP2	0.905	Valid				
	SP3	0.853	Valid				
Pre-service Student Competenc y (Y)	FPI	0.681	Valid	0.710	0.817	0.529	Reliable
	PPDP	0.680	Valid				
	WHY	0.799	Valid				
	PK2	0.742	Valid				

The one-tailed 95% percentile confidence intervals (5%, 95%) of the reliability and validity statistics have been given. AVE stands for Average Variance Extracted; CR is for Composite Reliability [29]. Table 2 indicates that all measurement items have a Loading Factor (LF) or outer loading value of greater than 0.70. Additionally, two measurement items, the FPI and PPDP, have been deemed to have met the Convergent Validity test because their LF values are greater than 0.60 [30]. The LF value of > 0.70 and the AVE value of > 0.50 indicate that the measurement items for all variables have passed a satisfactory Convergent Validity test. Similarly, the AVE value is > 0.50 for each variable. Additionally, each variable's indicator reliability and internal consistency reliability are measured and tested using an instrument. Table 2's high Composite Reliability (CR) rating, which displays the consistency value of each indicator in assessing its construct, makes internal consistency reliability testing visible. Value > 0.70 for Composite Reliability (CR). The Reliability Indicator is tested using Cronbach's Alpha. The dependability of each indication in the model is reflected in this value. Cronbach's Alpha > 0.70 indicates a significant value quantity [29]. According to the analysis's results, the reliability indicator and internal consistency reliability of the measurement variable have either met the level criteria test reliability or all constructs have good reliability, demonstrating that all Composite Reliability (CR) and Cronbach's Alpha values are > 0.70. Discriminant validity testing is the last stage, verifying that each latent model notion is distinct from other variables. Assessing the values of Cross Loadings and Heterotrait-Monotrait (HTMT) [21], [29], [31] allows for discriminant validity testing. HTMT confidence interval limit smaller than 0.85 or 0.90 in this case. When comparing cross-loadings, the construct's value needs to be higher than the values of the other constructs. Tables 3 and Table 4 show the outcomes of the cross-loadings and HTMT values.

Table 3. Discriminant Validity Based on Heterotrait-Monotrait (HTMT) Values

Variable	Pre-service student competency (y)	Learning (PB)	Learning Facilities (SP)	Human Resources (HR)
Pre-service student competency (Y)				
Learning (PB)	0.182			
Learning Facilities (SP)	0.323	0.847		
Human Resources (HR)	0.344	0.802	0.837	

Based on Table 3, showing that the HTMT value for all variable pairs of HTMT values < 0.90, it can be concluded that the variable pairs meet good discriminant validity. Discriminant validity testing is performed based on each manifest variable's cross-loading value in Table 4 against its corresponding latent variable more significant than the cross-loading value for other latent variables. As a result, the main model satisfies the requirement of discriminant validity. The assessment of the measurement model compared to the main model Fig. 2 leads to the conclusion that it has passed the good validity and reliability test, allowing for additional study. Additionally, a multi-stage structural model evaluation test was conducted.

Table 4. Cross Loadings

Measurement Items	Competency Value Pre-service student (Y)	Learning (PB)	Learning Facilities (SP)	Human Resources (HR)
PB1	0.160	0.899	0.706	0.724
PB2	0.124	0.871	0.670	0.699
PB3	0.135	0.872	0.693	0.776
PB4	0.067	0.839	0.603	0.671
PB5	0.154	0.908	0.655	0.684
FPI	0.681	0.054	0.084	0.177
PK2	0.742	0.100	0.239	0.223
PPDP	0.680	0.058	0.133	0.134
WHY	0.799	0.183	0.273	0.270
SDM1	0.257	0.624	0.724	0.804
SDM2	0.241	0.698	0.659	0.882
SDM3	0.287	0.705	0.657	0.887
SDM4	0.114	0.618	0.577	0.707
SDM5	0.258	0.674	0.709	0.801
SP1	0.253	0.625	0.895	0.740
SP2	0.275	0.738	0.905	0.751
SP3	0.182	0.648	0.853	0.669

3.2. Structural Model Evaluation (*Inner* Model)

Evaluation of the structural model is an assessment of the hypothesis testing. The path coefficient displays the influence of the factors. As per the findings of [28], [29] testing for structural model assessment entails; (1) assessing collinearity between exogenous constructs by employing inner VIF values less than 5, which indicates no collinearity; (2) P testing, connected to hypothesis testing in PLS-SEM and done using the bootstrapping approach, determines the significance and relevance of the coefficient path. A statistical t-table value of 1.96 or a p-value of 0.05 indicates a substantial influence between variables. Finding the lowest and maximum influence values between the resultant variables is achieved by testing the 95% path coefficient confidence interval, which is a measure or value of the confidence interval of the size of influence (path coefficient) between variables; (3) F. Square test, which explains the structural level variable category of direct influence. Hair et al. (2021) state that low (F.Square = 0.02), medium (F.Square = 0.15), and high (F.Square = 0.35) influences should be taken into consideration when interpreting F. Square values. In the meanwhile, to view the low mediation influence (0.01), medium mediation influence (0.075), and high mediation influence (0.175) categories of indirect influence as reported by Lachowicz *et al*. (2018), which were obtained by squaring the mediation coefficient (Upsilon V). Testing the collinearity of latent variables is the first step. There is no collinearity in structural models, according to Table 5's collinearity test findings, which display the Inner VIF values of all combinations of exogenous and endogenous latent variables less than 5.

Table 5. Collinearity Statistics (VIP)-Inner Model

Construction of Exogenous and Endogenous Variables	VIF
Learning (PB) → Pre-service Student Competency (Y)	3.199
Learning (PB) → Human Resources (HR)	2.364
Learning Facilities (SP) → Pre-service Student Competency (Y)	3.251
Learning Facilities (SP) → Learning (PB)	1.000
Learning Facilities (SP) → Human Resources (HR)	2.364
Human Resources (HR) → Pre-service Student Competency (Y)	4.029

Additionally, the significant value of the path coefficient for each path that connects latent variables using the Bootstrapping technique will be studied in order to test the hypothesis. The results are displayed in Table 6.

Table 6. Testing the Direct Influence Hypothesis (Path Coefficient and P-Values)

Path Model	*Path Coefficient*	*T Statistics*	*P-Values*	95% Confidence Interval *Path Coefficient*		*F Square*	Description
				Lower limit	*Upper Limit*		
H1: PB Y→	-0.308	2.038	0.042	-0.582	0.017	0.034	Accepted/ Negative
H2: PB SDM→	0.455	5.694	0.000	0.298	0.611	0.353	Accepted
H3: SP Y→	0.195	1.153	0.249	-0.144	0.514	0.013	Rejected
H4: SP PB→	0.760	19.006	0.000	0.678	0.834	1.364	Accepted
H5: SP → SDM	0.469	6.026	0.000	0.312	0.619	0.375	Accepted
H6: SDM Y→	0.379	2.151	0.032	0.008	0.703	0.040	Accepted

Table 6 presents data analysis findings using the Bootstrapping process, which looked at the direct influence to create a hypothesis testing table. Path Coefficient and P-Values results with a significance threshold of 5% are included. The following is the interpretation of Table 6's results.

- **The first hypothesis (H1) is accepted**. There is a significant but negative learning effect (PB) on the competence of Pre-Service Teacher students (Y) with *a path coefficient* value of (, *t statistic* $(-0.308)2.038 > 1.96$), and *p-value* ($0.042 < 0.05$). This indicates that, with a low influence category (f square = 0.034), any increase in learning has the potential to lower the competence of pre-service teacher students and vice versa.
- **The second hypothesis (H2) is accepted.** There is a significant positive impact of learning (PB) on human resources (HR) with *path coefficient* values of (0.455), *t statistics* ($5.694 > 1.96$), and *p-value* ($0.000 < 0.05$). This implies that as learning improves, human resources will get better every time. The influence of learning on raising the caliber of human resources is found in the 95% confidence interval between 0.298 and 0.611, with a strong influence category having a f square value of 0.353.
- **The third hypothesis (H3) was rejected.** There was no impact on infrastructure facilities (SP) on the competence of Pre-Service Teacher students (Y) with *path coefficient* values of (0.195), *t statistics* ($1.153 < 1.96$), and *p-value* ($0.249 > 0.05$). This indicates that pre-service teachers' competency is not directly impacted by infrastructure.
- **The fourth hypothesis (H4) is accepted**. There is a significant positive impact on infrastructure facilities (SP) on learning (PB) with *path coefficient* values of (0.760), *t statistics* ($19.006 > 1.96$), and *p-value* ($0.000 < 0.05$). This implies that learning will be of higher quality each time there is an infrastructure update. The influence of infrastructure facilities on raising learning quality falls into a strong influence category with a f square value of 1.364 and a 95% confidence interval between 0.678 and 0.834.
- **The fifth hypothesis (H5) is accepted**. There is a significant positive impact on infrastructure facilities (SP) on human resources (HR) with *path coefficient* values of (0.469), *t statistics* ($6.026 > 1.96$), and *p-value* ($0.000 < 0.05$). This implies that human resources will be of higher caliber once infrastructure is altered. Infrastructure facilities have a strong effect category (f square value = 0.375) and a 95% confidence interval (0.312 to 0.619) for their impact on improving the quality of human resources.
- **The sixth hypothesis (H6) is accepted**. There is a significant positive impact on human resources (HR) on the competence of Pre-Service Teacher students (Y) with *path coefficient* values of (0.379), *t statistics* ($2.151 > 1.96$), and *p-value* ($0.032 < 0.05$). This implies that the quality of human resources will increase with each infrastructure modification. With a f square value of 0.004, the low influence group represents the 95% confidence interval in which infrastructure facilities' impact on enhancing human resource quality falls between 0.008 and 0.703.

The variable with the highest level of significance, H4, where there is a significant impact with a high category between infrastructure facilities (SP) and learning (PB), can be shown based on the results of the hypothesis test on the direct influence. However, only in H6, i.e., there is a considerable impact on the competence of Pre-Service Teacher students (Y), even with a low category between human resources (HR), are exogenous variables directly influencing endogenous variables. The Path Coefficient and P-Values models in Fig. 3 also clarify this.

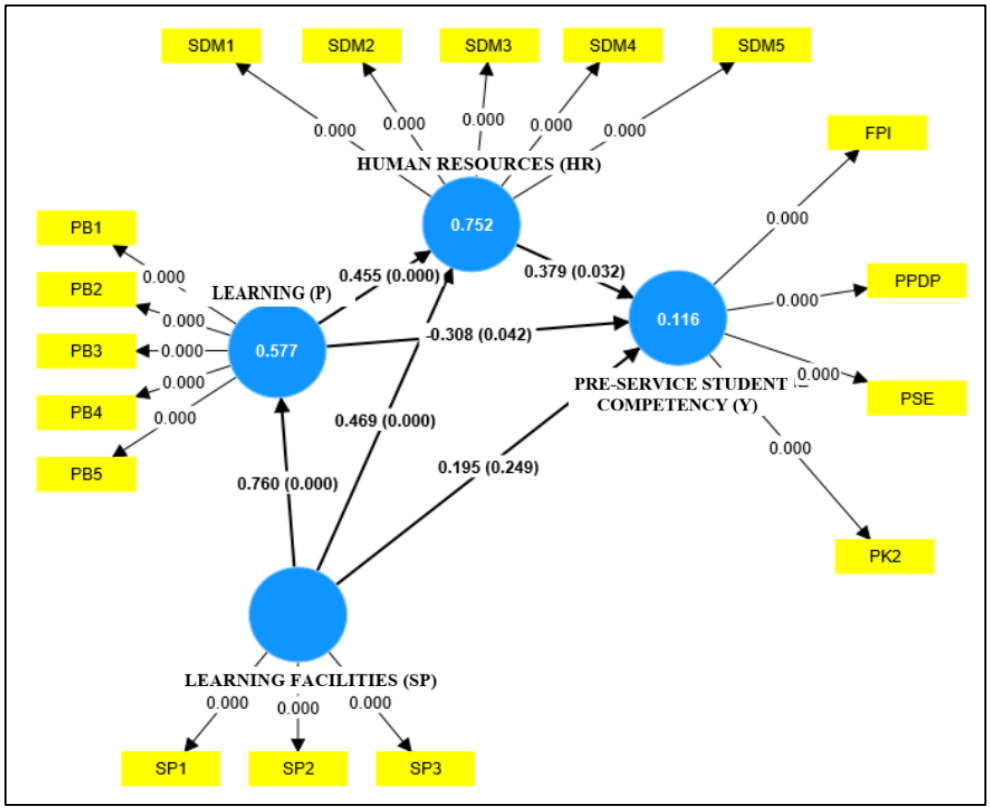

Fig. 3. Path Coefficient and P-Values Model

Meanwhile, the hypothesis of indirect influence between exogenous variables and endogenous variables can be seen in Table 7.

Table 7. Testing the Hypothesis of Indirect Influence (Path Coefficient and P-Values)

Path Model	*Path Coefficient*	*T Statistics*	*P-Values*	95% Confidence Interval *Path Coefficient*		*Upsilon V*	Description
				Lower Limit	*Upper Limit*		
H7: SP PB SDM→→	0.346	5.310	0.000	0.225	0.480	0.120	Accepted/ Partial Mediation
H8: PB→ SDM Y→	0.172	2.062	0.039	0.003	0.334	0.030	Accepted/Full Mediation
H9: SP SDM Y→→	0.178	1.973	0.045	0.003	0.369	0.032	Accepted/Full Mediation
H10: SP→ PB Y→	-0.234	2.005	0.045	-0.451	0.013	0.055	Accepted/Full Mediation/ Negative
H11: SP→ PB→ SDM Y→	0.131	2.037	0.042	0.003	0.258	0.017	Accepted/Full Mediation

Based on Table 7, the table tests the hypothesis of the indirect influence of *Path Coefficient* and *P Values* in the following results.

- **The seventh hypothesis (H7) is accepted,** where the indirect impact of infrastructure facilities on human resources can be mediated by learning, which has an α=5% mediation route

coefficient value of (0.346), a t statistic (5.31 0 > 1.96), and a p-value (0.000 < 0.05). With an Upsilon value of V = 0.120, the role of learning mediation falls into the category of high mediation influence at the structural level [32]. By increasing learning gains, this mediating role would rise to 0.480 within a 95% confidence interval.

- **The eighth hypothesis (H8) is accepted,** where learning and the α=5% competency of Pre-service students can be indirectly mediated by human resources, which are significantly defined as mediation variables. The mediation route coefficient values are 0.172, the t statistics are 2.062 > 1.96, and the p-value is 0.039 < 0.05. At the structural level, however, the mediation role of human resources falls into the low mediation influence group (with an Upsilon value of V = 0.030) [32]. As a result, human resources' mediating function needs to be strengthened. By enhancing human resources, this mediating role will rise to 0.334 within a 95% confidence interval.
- **The ninth hypothesis (H9) is accepted,** where the ability to mediate the indirect influence of infrastructure facilities on the competence of α=5% pre-service students is defined as a significant mediation variable for human resources, with a mediation path coefficient value of 0.178, significant t statistics (1.9 73 > 1.96), and a p-value (0.0 45 < 0.05). On the other hand, the role of human resource mediation falls into the moderate mediation influence category at the structural level (with an Upsilon value V = 0.055) [32]. As a result, human resources' mediating function needs to be strengthened. By strengthening human resources, this mediating role will rise to 0.369 with a 95% confidence interval.
- **The tenth hypothesis (H10) is accepted.** Regarding the indirect influence of infrastructure facilities on the competence of α=5% of pre-service students, learning can significantly not mediate as a mediation variable. This is demonstrated by the mediation path coefficient value of (-0.234), which is significant with t statistics (2.005 > 1.96) and p-value (0.045 < 0.05). Consequently, learning's function cannot act as a mediating factor.
- **The eleventh hypothesis (H11) is accepted,** where the ability to mediate the impact of infrastructure facilities on the α=5% competence of pre-service teacher students is defined as learning and human resources as mediation variables. This is demonstrated by a mediation path coefficient value of 0.131, which is significant with t statistics (2.037 > 1.96) and a p-value (0.042 < 0.05). At the structural level, however, the Upsilon value V = 0.017 of the roles of mediation, learning, and human resources places them in the category of low mediation influence [32]. As a result, learning and human resources must play a more effective mediating role. By strengthening human resources, this mediating role will rise to 0.258 with a 95% confidence interval

3.3. Model Quality and Fit Evaluation

Examining the model in its entirety, PLS-SEM is a variance-based SEM methodology designed to evaluate prediction study-focused model theory. As a result, the suggested model must pass several tests, such as R square testing, which quantifies the variation in endogenous variables that can be accounted for by other endogenous or exogenous variables in the model. The interpretation values of R square are 0.19 (low impact), 0.33 (mid effect), and 0.66 (great influence. The Q square test describes a measure of prediction accuracy or how effectively any change in exogenous/endogenous variables can predict endogenous variables [30]. Values of 0 (low influence), 0.25 (moderate influence), and 0.50 (high influence) are reported by [25]. The difference between the model estimate correlation matrix and the data correlation matrix is the model fit, and testing the value of SRMR (Standardized Root Mean Square Residual) indicates how well the model fits the data. SRMR values between 0.08 and 0.10 are still acceptable fit [33]. However [28] stated that SRMR values below 0.08 indicate a suitable fit model. Testing with PLS Predict [25]. Testing for the Goodness of Fit Index (GoF Index) [34] involves evaluating the full model, which includes structural and measurement models. *The GoF Index* is only calculated from the reflective measurement model, which is the root of geometric multiplication of the mean commonality with the mean *R square*. GoF Index values are 0.1 (low GoF), 0.25 (medium GoF), and 0.36 (high GoF) [27], [35]. The R square test indicates the extent to which exogenous factors or other endogenous variables in the model can account for the variation in endogenous variables. The interpretation values of R square are 0.19 (low impact), 0.33 (mid effect), and 0.66 (great influence), [30]. Table 8's R square results indicate that infrastructure, learning procedures, and human resources have an 11.6% (low influence) impact on pre-service teacher students' competency. On the other hand, infrastructure has a 57.7% (strong effect) impact on

the learning process. Similarly, the impact of learning procedures and infrastructure on human resources was 75.2% (strong influence).

Table 8. R Square and Q Square Table

Exogenous Variables	*R Square*	*Q Square*	Description
Pre-service Students Competence (Y)	0.116	0.050	Low Influence
Learning (PB)	0.577	0.569	High Influence
Human Resources (HR)	0.752	0.657	High Influence

The Q square test describes a measure of prediction accuracy or how effectively any change in exogenous/endogenous variables can predict endogenous variables. The values are 0.50 (great influence), 0.25 (moderate influence), and 0 (poor influence) [25]. Table 8 shows that the learning process has a Q square variable value of 0.569 (high prediction accuracy), the human resources have a Q square variable value of 0.657 (high prediction accuracy), and the pre-service teacher student competence results are 0.050 (low prediction accuracy). The difference between the model estimates correlation matrix and the data correlation matrix is the model fit, and testing the value of SRMR (Standardized Root Mean Square Residual) indicates how well the model fits the data [33]. SRMR values between 0.08 and 0.10 are still acceptable fit. However, SRMR values below 0.08 indicate a suitable fit model [28]. The SRMR model's predicted result of 0.069 indicates the fit model match where the relationship between the model's variables may be explained by actual evidence, Table 9.

Table 9. SRMR (Standardized Root Mean Square Residual)

Estimated model		Information
SRMR	0.069	< 0.08 = Model PLS *Path Coefficient* fit

Testing for the Goodness of Fit Index (GoF Index) [34] involves evaluating the full model, which includes structural and measurement models. Only the reflecting measuring model—the geometric multiplication of the mean commonality by the mean R square—is used to compute the GoF Index. [27], [35] state that the GoF Index values are 0.1 for low GoF, 0.25 for medium GoF, and 0.36 for high GoF. Table 10's computation results demonstrate that the GoF model's value is root $(0.689\ x\ 0.482) = 0.576$, which includes the high GoF Index category. This indicates that measurement models with a high match rate (0.689 x 0.482 = 0.576) can be explained by empirical data.

Table 10. Goodness of Fit Index (GoF Index)

Rerata Communality/AVE	Average R Square	GoF Index	Description
0.689	0.482	0.576	≥ 0.36 = GoF High Index

Researchers [25] who describe PLS Prediction testing, define PLS as an SEM analysis with a prediction purpose. Therefore, constructing a single model validation form is necessary to verify the suggested model's predictive power. The PLS prediction test's validity is checked using PLS prediction functions. To show that the PLS results have a good degree of predictive ability, one must compare them with the basic model, the linear regression (LM) model. The PLS model is deemed to have predictive potential when its mean absolute error (MAE) or root mean square error (RMSE) is lower than that of the linear regression model. There are 9 measurement items in the PLS model with RMSE and MAE values lower than the LM model (linear regression), according to Table 11, which displays the management outcomes of 14 observations of RMSE and MAE values. This demonstrates the strong predictive potential of the suggested PLS model. Based on the study's results, learning variables significantly but negatively affect learning competence. The hypothetical results found that learning negatively affects student competence (learning outcomes in the form of Pre-service Teacher Professional Education Program course scores), this is because the learning system in Pre-service Teacher Professional Education Program nationally uses LMS learning management, so that students have plenty of time to discuss with fellow friends outside of learning on campus and school. So, to do all course assignments online, students have more discussions with other friends outside of learning. This is reinforced by the advantages of LMS-based learning, including student learning time becoming flexible because it can be accessed at any time through electronic devices such as laptops or gadgets owned. In addition to helping teachers support the administration of student progress, learning management systems (LMS) give students interactive capabilities to access information resources, complete and submit learning activities, and connect with peers online [36]. On the other hand, learning also has a positive and significant effect on the competence of Pre-service Teacher Professional Education Program students through human resource mediation variables, which, if there

is an increase in the quality of learning, will be followed by the rise in human resources, which include Teacher Professional Education Program managers, course lecturers, instructors, shadow teachers, and Pre-service Teacher Professional Education Program education staff and affect student competence. This is reinforced by hypothesis 2, which shows that learning positively and significantly affects human resources. This is reinforced by the theory of Organizational learning (OL) helps organizations turn individual knowledge into organizational knowledge [37].

Table 11. PLS Predict

Indicator	PLS-SEM		LM	
	RMSE	***MAE***	***RMSE***	***MAE***
FPI	3.683	2.998	3.607	2.926
PK2	3.596	2.881	3.663	2.903
PPDP	3.307	2.874	3.353	2.917
WHY	3.281	2.653	3.336	2.714
PB1	3.420	2.702	3.366	2.624
PB2	2.347	1.837	2.374	1.821
PB3	2.121	1.606	2.108	1.563
PB4	2.828	2.287	2.834	2.292
PB5	2.852	2.096	2.828	2.105
SDM1	1.286	0.996	1.302	1.002
SDM2	2.978	2.137	2.927	2.217
SDM3	2.275	1.74	2.305	1.803
SDM4	3.238	2.464	3.184	2.388
SDM5	1.492	1.144	1.519	1.130

Furthermore, the third hypothesis demonstrates that Pre-service Teacher Professional Education Program students' competency is unaffected by infrastructure. Because Pre-service Teacher Professional Education Program learning is centred on using LMS, which students can access from anywhere, infrastructure has no bearing on the competency of Pre-service Teacher Professional Education Program students. Facilities and infrastructure have little bearing on Pre-service Teacher Professional Education Program students' competencies because most of them are acquired through LMS activities, where the necessary lecturers actively supervise LMS learning. This is out of line with the principle of self-determination. According to the self-determination theory, optimal levels of student engagement and accomplishment can only be attained when students have the perception that the classroom environment and university facilities satisfy their psychological requirements for relatedness, autonomy, and competence [38]. Furthermore, Campus facilities play a role in a classroom environment. In this manner, they influence the students' engagement and performance within it [39]. Matin and Nurhattati stated that facilities are tools that are the main support for the implementation of a process of teaching and learning activities. On the other hand, hypothesis 9 is contrary to hypothesis 3 where infrastructure facilities have a positive and significant effect on the competence of Pre-service Teacher Professional Education Program students if there is a mediating variable in the form of human resources. This is reinforced by hypothesis 6, where human resources positively and significantly influence the competence of Pre-service Teacher Professional Education Program students. Regarding learning, the quality of human resources, especially teachers and instructors in the Pre-service Teacher Professional Education Program, can affect the learning approach. Qualified instructors can provide guidance and in-depth knowledge to students. So, it can increase their understanding of learning material.

Lecturers as leaders and facilitators can model behaviours, guide discussions, and engage students in online course activities, supporting their attainment of positive learning experiences [40]. However, if the teacher's competence is low, the student's achievement is low, and vice versa [41]. Prior research also emphasized that the impact of teachers on students' academic success can be significant [42]. However, human resources' capacity to oversee classes and foster productive relationships with students can impact the learning environment. Student competency development will be aided by a favourable atmosphere. Elucidating that engaging instructors impact virtual exchanges by enhancing learners' engagement with course materials. Furthermore, hypothesis 4 states that infrastructure is closely related to the quality of learning because infrastructure is a supporting factor in improving the quality of learning. The better the infrastructure provided, the better the quality of learning. This is because good infrastructure creates a comfortable learning process so that it can increase productivity in the classroom. This is reinforced by previous research, which states that School infrastructure is all

components that indirectly support the teaching and learning process or all existing facilities before the existence of school facilities, such as roads leading to schools, yards, and others [43].

In addition to affecting learning, infrastructure also affects human resources through learning mediation variables. This is evidenced by the results of hypothesis 5, which states that infrastructure facilities positively and significantly influence human resources. Good infrastructure can be vital in forming productive, skilled, and competitive human resources. Any change in infrastructure is believed to improve the quality of human resources, and this result has positive implications. To get good learning outcomes, it is necessary to have a facility to help encourage students to achieve maximum achievement [44]. Moreover, [45] opined that quality education is determined by inputs such as curriculum content, instructional materials and equipment, school culture, teacher-pupil ratio, costs and guiding policies, quality assurance, learning duration, and above all the quality of the teachers and management functions [46]. On the other hand, the learning process will be negative if it is involved in the process of infrastructure facilities and student competencies. Thus, learning cannot be used as a mediation variable. This is reinforced by hypothesis 3, which states that infrastructure facilities positively and significantly influence the competence of Pre-service students. This is in line with research conducted by [39] who stated that facilities are tools that are the main support for the implementation of a process of teaching and learning activities. On the other hand, in hypothesis 11, infrastructure facilities will positively influence if there are mediating variables in the form of learning and human resource.

4. Conclusion

Based on the results and discussion, it can be concluded that although hypothesis 1 states that there is a negative influence of the learning process on the competence of pre-service teachers, especially in Pre-service Teacher Professional Education Program, hypothesis 8 shows that there is an indirect positive influence between learning process on the pre-service teacher competence through human resource mediation. The results of hypothesis 2 reinforce that the learning process has a positive and significant effect on human resources, showing that human resources as a mediating variable are robust as intermediaries for the influence of the learning process in teacher professional programs, especially on the pedagogical competencies obtained by pre-service teachers. Hypothesis 3 shows that infrastructure does not affect the competence of pre-service teachers. Similarly, hypothesis 9 contradicts hypothesis 3, which states that if human resources act as a mediating variable, infrastructure facilities positively and significantly impact pre-service teachers' competency. This is supported by hypothesis 6, which states that human resources positively and significantly impact pre-service teachers' competence. Hypothesis 4 posits a close relationship between infrastructure and learning process quality, as infrastructure is a supporting factor to enhance learning process quality. By meditating on the learning process, infrastructure influences learning and human resources. The results of hypothesis 5, which asserts that infrastructure facilities positively and considerably influence human resources, prove this. On the other hand, the learning process will be negative if it is involved in the infrastructure facilities and pre-service teacher competencies. Thus, the learning process cannot be used as a mediation variable. This is reinforced by hypothesis 3, which states that infrastructure facilities positively and significantly influence the pre-service teacher competence of teacher professional programs. This is evidenced by hypothesis 11 that infrastructure facilities have a positive impact when the mediating variables of the learning process and human resources are present.

The study's findings and comments provide important insights into the dynamics of pre-service teacher competency and the interactions of numerous factors within teacher professional programs. The findings emphasize the complexities of factors impacting pre-service teacher competency. While the learning process appears to have a detrimental impact on competence, human resources play a beneficial role, demonstrating that the relationship is multidimensional and context-dependent. Human resources appear as an important link between the learning process and pre-service teacher competency. This emphasizes the necessity of excellent teaching staff and support mechanisms in improving the quality of teacher education programs, particularly in developing pedagogical competencies in pre-service teachers. Contrary to predictions, infrastructure amenities have little effect on pre-service teacher competence. However, when paired with the mediation of human resources, infrastructure positively contributes to competence, implying that it has a supportive rather than direct function in creating educational outcomes. The study emphasizes the mutually beneficial relationship between infrastructure and the quality of the learning experience. Infrastructure acts as a facilitator for improving the learning environment, which improves the effectiveness of educational

activities and aids in the development of pre-service teachers' competencies. It is important to avoid confusing the responsibilities of infrastructure and the learning process since their overlap might harm pre-service teacher competency. This emphasizes the need to identify the individual contributions of various parts within teacher education programs to maximize their impact. The study highlights the complexities of mediation effects in the context of teacher professional programs. While certain variables may have a direct impact on outcomes, their impacts can be modified or exacerbated by other factors, underscoring the importance of understanding these interactions in program design and execution. These findings help policymakers, educational institutions, and program creators construct effective teacher education efforts. Emphasizing the importance of human resources, improving infrastructure support, and carefully balancing the components of the learning process can all help to improve the holistic development of pre-service teachers and the overall quality of teacher professional programs.

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Declarations

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