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Research Article

THE INFLUENCE OF CERTIFIED TEACHERS ON EDUCATORS GRADUATES OF STATE HIGH SCHOOL SOCIAL SCIENCES MAJORS IN JAMBI CITY: PANEL DATA APPROACH

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Abstract

The quality of educational output is a crucial indicator of successful human resource development, but the effectiveness of teacher certification policies in improving student academic achievement remains a matter of debate in the educational management literature. This study aims to empirically analyze the influence of certified teachers on the graduation rate of social studies students at public high schools in Jambi City. Using a quantitative approach, this study analyzed panel data covering 11 schools during the 2017–2019 period. The selected estimation method through formal testing is *the Fixed Effect Model* (FEM). The results revealed that the presence of certified teachers has a positive and significant effect on student graduation rates ($p = 0.0099 < 0.05$), with a regression coefficient of 1.518. The *Adjusted R-squared value* of 0.7209 indicates that teacher professionalism contributes dominantly to the variation in student academic achievement, amounting to 72.09%. The novelty of this study lies in the application of panel data analysis to evaluate the impact of education policies at the local level, which is able to capture specific characteristics between schools that are not observed in conventional cross-sectional studies. Theoretically, these findings strengthen *Human Capital Theory* by proving that standardizing teacher competencies through certification is a strategic investment that improves internal school efficiency. The implications of this research emphasize the importance for policymakers to improve the quality of post-certification training to ensure the sustainability of its positive impact on graduate quality. This study contributes to the literature on educational effectiveness in developing countries by empirically demonstrating the crucial role of teachers as the primary cognitive agents in the school system.

Keywords: Teacher Certification, Student Graduation, Panel Data, Education Management, Graduate Quality.

INTRODUCTION

Education is a fundamental pillar in the development of national civilization that cannot be separated from the dynamics of individual life and global society. In the current era of disruption, a country's progress is largely determined by the effectiveness of its education system, from elementary school to university (Kizilhan, 2016) . Globally, improving the quality of human resources through formal channels is a key agenda in achieving the fourth point *of the Sustainable Development Goals* (SDGs), namely quality education. One indicator of the success of this system is the quality of educational *output* , which in the context of schooling is often projected through student graduation rates. Graduation is not merely a formality, but rather a representation of accumulated competencies that include knowledge, attitudes, and skills that have been standardized internationally and nationally (OECD, 2019) . Therefore, examining the factors that influence the success of graduates is crucial because competent graduates reflect the success of teachers in carrying out their pedagogical and professional functions.

From an educational management perspective, educational *output* is the concrete result of a systemic process that is greatly influenced by the quality of input and instructional management. (Kuswanto, 2019) . The better the quality of the education system that is built, the better the quality *of the output* produced. (Sagala, 2013) . Theoretically, the determinants of educational outcomes can be categorized into two main sides: the demand side, *which* includes student characteristics and family background; and the supply side , which includes school characteristics and the quality of teaching staff (Zulkarmain, 2021) . Among the various inputs on the supply side, the presence of professional teachers with teaching certificates occupies a central position. Based on Law No. 14 of 2005 concerning Teachers and Lecturers, certification is formal evidence of state recognition of teachers as professionals. Certified teachers are expected to possess four main competencies. pedagogical, personality, social, and professional which collectively contribute to improving students' academic achievement (Darling-Hammond et al., 2005) .

Ideally, the increase in the number of certified teachers should be directly proportional to the increase in the quality of educational *output* . (Sari et al., 2024) . However, the reality on the ground shows a significant phenomenological gap. In Jambi City, the certification policy has improved the welfare and formal status of teachers, but the hope that this would be followed by a consistent increase in student achievement has not been fully realized. Data on the average National Examination (UN) scores in social studies at Jambi City Public Senior High Schools for the 2017-2019 period show strange fluctuations. Although the number of certified teachers has increased, the average UN score in economics has actually decreased in certain schools (Ministry of Education and Culture, 2019) . This phenomenon raises a major question for policymakers: is certification merely an instrument for improving teachers' financial welfare without having a real impact on the effectiveness of classroom learning? This gap between government investment in certification allowances and the stagnation of student learning outcomes is the core problem in this study.

The main problem identified is the inconsistency in the graduation trends and academic scores of social studies students amidst the massive teacher certification program. Determinantly, student success is influenced by how teachers manage the classroom and adapt the curriculum (Hattie, 2008) . Professional teachers should be able to create a conducive and innovative learning climate. However, initial identification indicates the presence of inhibiting factors, such as the high administrative burden on teachers after certification, which actually distorts their focus on developing teaching quality. In addition, external factors such as school infrastructure support and family environment also play a role, but the position of teachers as the main determining variable (*key determinant*) remains a focus that needs to be tested empirically for its significance in Jambi City.

Numerous studies have been conducted on the influence of teacher professionalism, but they have yielded mixed results. (Astuti & Jailani, 2020) In their study in Central Bangka, they found that teacher competency tests contributed 9.4% to national exam scores, a significant but not dominant figure. On the other hand, (Maullidina et al., 2023) National studies have found a strong positive correlation between professional teachers and graduation rates. However, these studies often ignore temporal dynamics and specific differences between schools within a region. This research fills this gap . This study not only examines aggregate influences but also uses a panel data approach to examine the interaction between the temporal dimension (2017-2019) and spatial dimensions (state

senior high schools throughout Jambi City), resulting in a more comprehensive picture than previous studies, which used simple *cross-sectional methods.*

The novelty of this study lies in the application of econometric methodology through panel data analysis with a *Fixed Effect Model* (FEM) to evaluate the impact of education policies at the local level. The use of FEM allows this study to control for unobserved variables (unobserved *heterogeneity*) unique to each school, such as school culture or principal leadership, which are usually ignored in standard linear regression (Wooldridge, 2010) . The scientific contribution of this study is the provision of empirical evidence regarding the effectiveness of teacher certification in improving learning outcomes in the social sciences (IPS) cluster, which often receives less attention than the sciences cluster in the educational efficiency literature in Indonesia.

Based on this background, this study aims to analyze in depth the influence of certified teachers on the graduation rate of social studies students in Jambi City over the past three years. Furthermore, this study aims to map the effectiveness of certification in changing pedagogical behavior that leads to academic achievement. The results of this study are expected to serve as a reference for the Jambi Provincial Education Office in formulating more targeted policies for continuous professional development, so that the large budget allocated for certification can contribute significantly to improving graduate quality at the regional level.

RESEARCH METHODS

2.1 Research Design

This study uses a quantitative approach with an associative research design that aims to determine the relationship or influence between variables. The data used is secondary data analyzed using a panel *data regression approach* , namely a combination of time series data *and* cross *-section data* . This study was conducted in Jambi City with a focus on public high schools. The observation period (research time) covers a period of three years, namely from 2017 to 2019, to observe the dynamics of change and consistency of the influence of the independent variables on the dependent.

2.2 Research Target/Subject

The population in this study was all state high schools in Jambi City that have a Social Sciences (IPS) major. The sampling technique used was *purposive sampling* , or saturated sampling, in which all members of the population were sampled to ensure accurate data representation. The sample consisted of 11 public high schools in Jambi City (SMAN 1 to SMAN 11) that had complete data on the number of certified teachers and student graduation rates in social studies majors during the observation period.

2.3 Research Procedures

The research procedure begins with the problem identification stage and data collection through relevant agencies. After the data was collected, it was organized into a panel data format. The analysis procedure began by estimating panel data regression models using three approaches: *the Common Effect Model* (CEM), *the Fixed Effect Model* (FEM), and *the Random Effect Model* (REM). To determine the best model, a series of formal tests were conducted, namely the Chow Test (to choose between CEM and FEM) and the Hausman Test (to choose between FEM and REM). After the best model was selected, classical assumption tests were conducted, including tests for normality, multicollinearity, heteroscedasticity, and autocorrelation to ensure the model met the *Best Linear Unbiased Estimator* (BLUE) criteria.

2.4 Data Collection Instruments and Techniques

The type of data used in this study is quantitative secondary data. Data collection techniques are carried out through documentation studies (documentary). The research instrument is a data tabulation table sourced from the official report of the Jambi Provincial Education Office and the respective school databases. The variables collected include: (1) Independent Variable (GSP), namely the number of teachers who have a teacher certificate; and (2) Dependent Variable (KL), namely the graduation

rate of social studies students as measured by the results of the National Examination (UN) in the subject of Economics as a representation of academic achievement.

2.5 Data analysis techniques

The data were analyzed using panel data regression techniques with the aid of EViews software. The basic functional model in this study is stated as follows:

$$KL_{it} = \beta_0 + \beta_1 GSP_{it} + e_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where KL is graduation, GSP is certified teacher, i denotes school entity, and t denotes time period. Data interpretation is carried out by looking at the regression coefficient value to determine the direction of influence, as well as hypothesis testing through the t-test (partially) and F-test (simultaneously) at a significance level (alpha) of 5%. In addition, the Determination Coefficient ($R2^{)}$ was analyzed to see the extent to which the certified teacher variable was able to explain the variations in the rise and fall of student graduation rates at Jambi City State Senior High Schools. Interpretation of the results is carried out by linking the statistical findings with educational management theory and applicable teacher certification regulations.

RESULTS AND DISCUSSION

3.1 Research result

1. Description of Research Data

This study involved 11 public senior high schools in Jambi City as observation units with a time period from 2017 to 2019, resulting in a total of 33 panel data observations as shown in the following Figure:

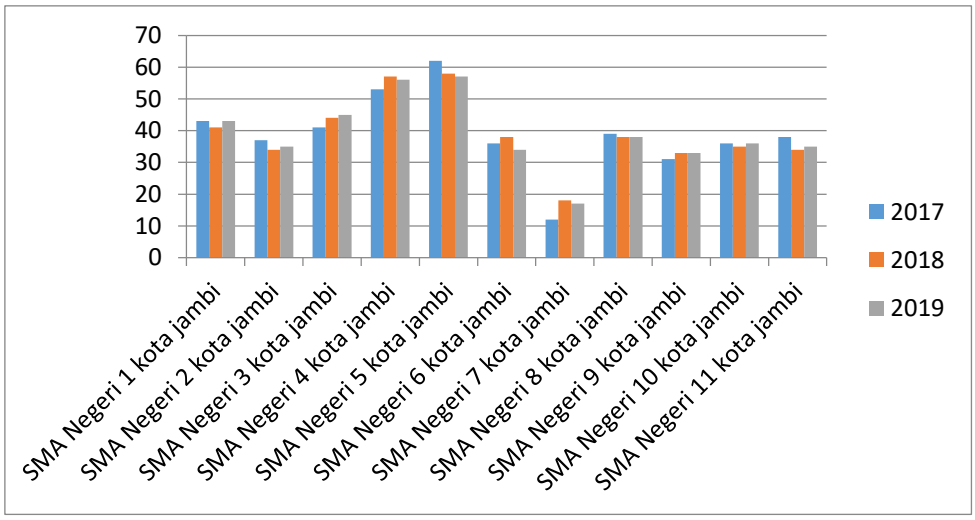

Figure 1. Number of Certified Teachers in Jambi City State Senior High Schools 2017-2019

Based on Figure 1, the independent variable (X), namely the number of certified teachers, shows a varied distribution across schools. Large schools such as SMAN 1, SMAN 2, and SMAN 3 tend to have a more stable and higher proportion of certified teachers than other schools.

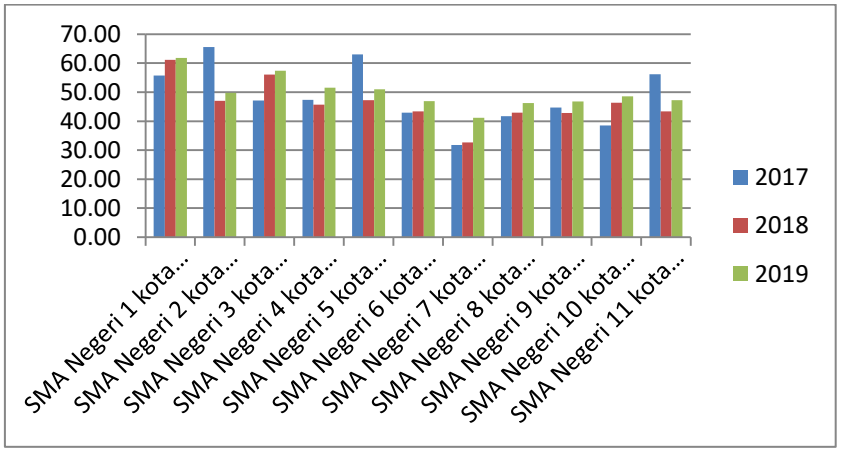

Figure 2. Average National Examination Scores for Social Sciences Majors at Jambi City State Senior High Schools in 2017-2019

Meanwhile, the pass rate, represented by the average National Examination (UN) score for the Social Studies major, shows a fluctuating trend, as shown in Figure 2. Although the formal pass rate is nearly 100%, the quality of UN scores has experienced significant dynamics, with a range of scores indicating a disparity in quality between schools in Jambi City.

2. Prerequisite Analysis Test Results

Before model estimation was carried out, the data had gone through a series of classical assumption tests to ensure the validity of the regression results.

Table 1. Results of the Analysis Prerequisite Test

No	Prerequisite Analysis Test Form	Criteria	Test Results	Conclusion
1	Normality	Jarque-Bera probability > 0.05	0.62	Normal
2	Heteroscedasticity	Probability (Obs*R-Squared) > 0.05	0.76	There is no heteroscedasticity
3	Autocorrelation	DW (du < d < 4-du)	2.96	No autocorrelation occurs

Based on the results of the normality test (Jarque-Bera) in Table 1, the data are normally distributed with a significance value above 0.05 . The multicollinearity test shows no correlation between the independent variables, considering that this study uses a single variable. Next, heteroscedasticity and autocorrelation tests were conducted to ensure the model met *the Best Linear Unbiased Estimator* (BLUE) criteria. The test results show that the model is free from non-constant variance disturbances and inter-error correlations, so it is suitable for use in further estimation.

3. Model Selection Test Results

In panel data regression, there are three stages in model selection. First, **the Chow Test** is used to compare *the Common Effects Model* (CEM) with *the Fixed Effects Model* (FEM).

Table 2. Model Selection Test Results

No	Model Selection Test Form	Criteria	Test Results	Conclusion
1	Chow Test	Cross-section probability (Prob.) F < 0.05; Fixed Effect Model (FEM) is better than Common Effect Model (CEM)	0.0001	FEM
2	Hausman test	Probability (Prob.) Cross-section Random < 0.05; Fixed Effect Model (FEM) is better than Random Effect Model (REM)	0.0032	FEM

Based on Table 2, it shows the *Cross-section F probability value* of 0.0001 (<0.05), which means FEM is better than CEM. Second, **the Hausman Test was conducted** to compare FEM with *the Random Effect Model* (REM). The results of the Hausman Test showed a probability value of 0.0032 (<0.05), which confirms that **the Fixed Effect Model (FEM)** is the most appropriate and consistent model to be used in this study. The selection of FEM indicates the existence of specific characteristics among Public Senior High Schools in Jambi City (such as internal management and school culture) that have a fixed influence on the dependent variable.

4. Panel Data Regression Analysis Results

After a series of model selection tests (Chow and Hausman tests), the Fixed Effects Model (FEM) was determined to be the best model for estimating the influence of certified teachers on student graduation rates. This model was chosen because it is able to capture the inter-school heterogeneity in Jambi City that remains constant throughout the observation period. The results of the panel data regression parameter estimation are presented in detail in the following table:

Table 3. Results of Panel Data Regression Analysis (Fixed Effect Model)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.99	20.90	-0.53	0.60
GSP?	1.52	0.54	2.84	0.01
Fixed Effects (Cross)				
_SMAN1—C	6.24			
_SMAN2—C	11.45			
_SMAN3—C	-1.30			
_SMAN4—C	-24.83			
_SMAN5—C	-24.83			
_SMAN6—C	0.70			
_SMAN7—C	22.40			
_SMAN8—C	-3.56			
_SMAN9—C	6.66			
_SMAN10—C	1.31			
_SMAN11—C	5.76			
R-squared	0.76	Mean dependent var		48.23
Adjusted R-squared	0.64	SD dependent var		7.96
F-statistic	6.12	Durbin-Watson stat		2.97
Prob(F-statistic)	0.00			

Mathematically it can be formulated as the following equation:

$$KL_{it} = -10.99 + 1.5\ 2GSP_{it} + e_{it}$$

Based on the results of data processing using the *Fixed Effect Model method* in Table 3 above, the following interpretations can be made:

a) Regression Coefficient Analysis (Partial/t Test)

The Certified Teacher Educator (GSP) variable has a coefficient value of 1.52 . This positive value indicates a unidirectional relationship between teacher certification and graduation rates (KL) . Statistically, the GSP variable has a t-statistic value of 2.84 with a probability of 0.01 . Since the probability value (0.01) is smaller than the significance level of 0.05, it can be concluded that Certified Teacher Educators have a positive and significant effect on the graduation rate of students majoring in social studies in Jambi City. Each additional certified teacher unit is predicted to increase the average graduation rate by 1.52 points, assuming other variables remain constant.

b) Fixed Effects Analysis

The use of *the Fixed Effect Model* shows differences in *the intercept constant* across schools. Positive *fixed effect values* (such as those for SMAN 1, SMAN 2, SMAN 7, SMAN 9, SMAN 10, and SMAN 11) indicate that these schools have internal factors that drive graduation rates above the model average. Conversely, negative values for several other schools indicate unique characteristics within those schools (such as the environment or infrastructure) that cause their graduation rates to fall below the baseline model's average constant.

5. Model Quality Test Results (Coefficient of Determination)

The quality and strength of the model in explaining the graduation phenomenon can be seen from the coefficient of determination ($R2^{)}$. Based on the results of data processing using the Fixed Effect model (FEM), the R-squared value was obtained at 0.8169 (81.69%) and the Adjusted R-squared value was 0.7209 (72.09%). The Adjusted R-squared value of 0.7209 indicates that the variation in the increase and decrease in the graduation rate (UN score) of social studies students in Jambi City Public Senior High Schools can be explained by the certified teacher variable of 72.09%. Meanwhile, the remaining 27.91% is influenced by other variables outside this research model, such as school infrastructure, student learning motivation, parents' socio-economic background, and the effectiveness of school management. This figure above 70% indicates that the model built has a very strong level of goodness of fit, so that the teacher certification variable is a very crucial predictor in determining the quality of graduation in Jambi City.

3.2 Discussion

The results of the panel data regression analysis in this study provide strong empirical evidence that the presence of certified teachers has a positive and significant influence on the graduation rate of students majoring in social studies at public high schools in Jambi City. This finding is demonstrated by a regression coefficient of 1.518, indicating that every increase in the number of professional teachers will be followed by an increase in student academic quality as represented by national exam scores. This statistical significance confirms that the certification policy in Jambi City is not merely an administrative formality to improve teacher welfare, but has become a strategic instrument in improving the quality of educational *output* . In the context of economics subjects, certified teachers are assumed to have mature pedagogical and professional competencies, thus being able to transform complex instructional materials into more meaningful learning for students.

Theoretically, these findings reinforce *Human Capital Theory* , which states that investing in quality teaching staff will yield returns in the form of improved academic achievement. Professional teachers act as crucial human capital *in* the school ecosystem. In line with the educational input-output management theory proposed by (Zulkarmain, 2021) , the quality of graduates is highly dependent on the quality of the inputs they manage. Certification is a form of quality assurance *that* ensures teachers possess the minimum competency standards to effectively manage classrooms. The increase in pass rates at Jambi City Public Senior High Schools indicates that the certification process has successfully encouraged teachers to maintain their qualification standards, which directly impacts the effectiveness of knowledge transfer in the classroom.

This discussion is reinforced by a global study conducted by (Darling-Hammond et al., 2005) In *the Education Policy Analysis Archives* , which reports that across countries, teachers with formal certification consistently produce higher student learning outcomes than uncertified teachers. This demonstrates that teacher professionalism is a universal variable determining educational success. In Indonesia, this finding aligns with research (Maullidina et al., 2023). which states that professional teachers have a positive correlation with national exam scores. While several other national studies have often found mixed results regarding the effectiveness of professional allowances, this research in Jambi City offers an optimistic perspective that at the regional education unit level, the impact of certification remains evident on student learning outcomes.

Furthermore, this study supports the argument (Guerriero, 2017) in an OECD publication emphasized that the core of professionalism is in-depth pedagogical knowledge. Certified teachers in Jambi City's public high schools tend to have better access to continuing professional development programs, enabling them to adopt innovative learning methods. As found by (Baeva et al., 2020) , teacher professionalism in social sciences is crucial because subjects like economics require high

levels of critical analysis, not just memorization. The presence of certified teachers in Jambi City schools has been shown to provide the cognitive stimulation students need to achieve nationally set graduation standards.

From a methodological perspective, the use of *the Fixed Effects* (FEM) model in this study provides a sharper depth of analysis compared to previous studies. The coefficient of determination (*Adjusted R-squared*) value of 72.09% indicates that the certified teacher variable has a very dominant predictive power on graduation in Jambi City. This implies that educational policy interventions at the regional level must continue to focus on increasing the proportion of certified teachers. Although there are other external factors amounting to 27.91% , such as school facilities, family support, and student motivation as revealed in the study (Ladd & Sorensen, 2017) , the role of teachers remains the main determinant factor that cannot be replaced in ensuring the quality of graduates at the senior high school level.

CONCLUSION

This study provides an empirical conclusion that teacher certification policy has a determinant role in improving the quality of graduates at public high schools majoring in social studies in Jambi City. Based on the results of panel data regression analysis with the *Fixed Effects* (FEM) model, it was found that the certified teacher variable has a positive and significant effect on student graduation rates. This is evidenced by a probability value of 0.0099, which is far below the 0.05 significance level, and a regression coefficient value of 1.518. These findings confirm that an increase in the proportion of educators with formal professional recognition is linearly correlated with student academic achievement in economics subjects in the study area.

Theoretically, the results of this study validate the urgency of quality input of educational personnel in the education management cycle. Teacher certification is proven not only an instrument to improve welfare through professional allowances, but also functions as a quality assurance mechanism that encourages the effectiveness of the teaching and learning process. The pedagogical and professional capacity inherent in certified teachers makes a real contribution of 72.09 % to the variation in graduation rates, which indicates that teachers are a key factor in the success of secondary education in Jambi City.

The policy implications of this study emphasize the need for the Regional Government and the Jambi Provincial Education Office to continue to strengthen the continuous professional development program for teachers. The policy focus should not only stop at granting certificates, but should also be directed at monitoring post-certification performance to ensure competency standards are maintained. In addition, it is necessary to equalize the distribution of certified teachers across all public high schools to minimize disparities in the quality of graduates between schools.

Despite making important contributions, this study has limitations in the scope of variables that only focus on teacher certification and the relatively short observation period. Therefore, it is recommended for future researchers to expand the analysis model by including other moderating variables such as the availability of educational technology facilities, the effectiveness of the principal's leadership, and the socio-economic background of students. The use of mixed methods *is* also recommended to explore more deeply how certified teachers' pedagogical practices in the classroom qualitatively influence students' motivation and learning outcomes holistically.

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AUTHOR CONTRIBUTION

Conceptualization, AF and VPS; Methodology, AF; Software, AF; Validation, AF and VPS; Formal Analysis, AF; Investigation, AF; Resources, AF; Data Curation, AF; Writing – Original Draft,

AF; Writing – Review & Editing, VPS; Visualization, AF; Supervision, VPS; Project Administration, VPS All authors have read and approved the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest, either financial or personal, that could affect the objectivity or integrity of this research. The entire research process, data analysis, and manuscript preparation were conducted independently without any influence from external parties or specific sponsors with an interest in the findings of this article.

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