

Vocational Teacher Productivity in Palembang: Education Production Function

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Abstract

This study analyzed Education Production Function by using human capital inputs, namely education and skills as well as wages toward output (productivity). The probability sampling method with the proportional random sampling technique was used to collect the data. 301 vocational teachers in Palembang became the sample of this study. By using multiple analysis tools, it was obtained that (1) Wages and skills had a positive and significant effect on productivity. (2) There were differences in productivity based on education categories. (3) Input determinant of teachers' productivity was skill.

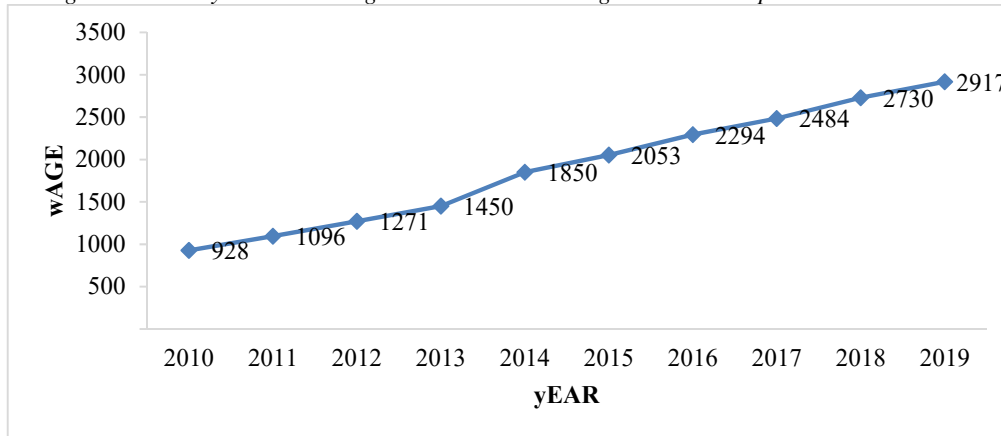
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1. Introduction

Education is one of industrial sector where direct estimates of worker productivity are available for the majority of the workforce. In recent years, educational economists have produced literature that examines productivity returns to work experience among teachers using predicted contributions to increase student test scores as a proxy for productivity (Papay & Kraft, 2015; Todd et al., 2003; McCaffrey et al., 2004). Substantial teacher productivity as input is the key in educational production function. This situation should be considered as a policy in increasing teacher productivity (Nagler et al., 2020; Hanushek & Rivkin, 2012). Increasing economic benefits become one of the policy recommendations that can be used as an effective strategy to increase teacher's productivity. In contrast, (Ree et al., 2018) found that increasing teacher wages without any conditions did not improve student achievement. These results provide recommendations for selection in teaching which influenced by changes in economic benefits. This condition is in line with empirical evidence which occurs in developing countries which was supported by field-experimental evidence from developing countries. In fact, according to (Ashraf et al., 2020) it was found that the selection of individuals under career incentives and not from social incentives leads to better results in the delivery of public services. The following figure shows teacher incentive policies which are related to the city minimum wage trends that occur in Palembang.

Figure no. 1. City Minimum Wage Trends in Palembang in 2010-2019 period



Source: Authors' contribution

Figure 1 shows that, the minimum wages increase significantly each year in general. This condition shows that wages have changed in all sectors. A person's productivity cannot be separated from wages, but what happens to an increase in wages is not accompanied by an increase in teacher wages (Hanushek, 2007). The production function of education shows that the role of wages is the main input to produce better education outcomes. Considering that, this linkage actually underlies aspects of human capital and skills, the two variables will produce a different focus which causes a varied perspective on the measurement of human capital implicitly and will describe the fundamental modeling of economic results (Hanushek, 2020).

There are many variations of literature that discuss the input of the education production function model that have similarities with this study. The similarities are related to human capital and wages. Some studies fail to identify in proving the statistical consistency of a significant relationship between teacher experience and student achievement (Blömeke et al., 2016; Gustafsson and Nilsen, 2016). In contrast with some studies that found there was a relationship between teacher experience and student achievement in secondary schools (Papay & Kraft, 2015; Ladd, 2017; Gerritsen, & Webbink, 2016). In addition to experience, education is also a major point in increasing teacher productivity (Britton & Vignoles, 2017)

2. Literature review

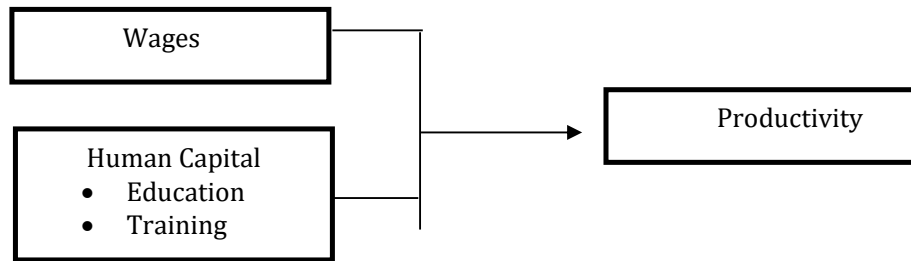
Teacher productivity in the labor economy is measured simply using the education production function model which discusses broadly the general inputs in education such as school resources, teacher quality, and family while the output is student achievement (Britton & Vignoles, 2017). The education production function has the following input variables, where (h) is the individual human capital i at the time t, which is determined by individual characteristics (X), a set of cumulative family inputs (F) and cumulative resource inputs from the education system (I).

$$h_{it} = f(h_{t-1}, X_{it}, F_{i\dots t}, I_{i1\dots t})$$

The application of the education function production model in this study uses resource inputs including wages, teacher education and training. Teacher productivity is explained mathematically as follows:

$$Y_i = f(W_i, Educ_i, Tr_i)$$

Y_i = Output (Productivity) and Input is W_i = wages , $Educ_i$ = Education and Tr_i = Teacher training. The model above builds a conceptual framework relating to the relationship between human capital input and wages with the teacher's productivity which is presented in Figure 1.



The conceptual framework illustrates the effect of inputs on output. The literature on the causal relationship between low family income and educational outcomes is discussed quite conclusively (Almond & Currie, 2011). However, income has also an impact on the accumulation of human capital. Almond & Currie (2011) concluded that an increase in income, especially cash transfer programs, was effective in improving educational outcomes, while for human capital inputs both skills and education impact positively on education output in overall (Papay & Kraft, 2015; Todd et al., 2003; McCaffrey et al., 2004). The results of the review of some literature can build a hypothesis about the relationship between input and output in the education production function model as follows:

Table no. 1. Hypothesis

No	Hypothesis	Literature
1	Wages have a positive and significant effect on teacher productivity	(Ashraf et al., 2020; Almond & Currie, 2011)
2	Human Capital: Education and skills have a positive and significant effect on Teacher Productivity, Skills have a positive and significant effect on Teacher Productivity	(Papay & Kraft, 2015; Todd et al., 2003; McCaffrey et al., 2004)

Source: Authors' contribution

3. Research methodology

Research on honorary teacher productivity which was measured using the use of instructional media, wages, level of education and training will affect the productivity of a teacher. Source of data used are primary data including data on the characteristics of respondents and the variables studied. The population in this study were honorary private vocational high schools teachers in Palembang. Meanwhile, 522 teachers became the sample in this study with the number of samples taken from the four highest districts above 100 teachers consisting of Sukarami, Kemuning, Ilir Timur I and Sebrang Ulu I. The method used in sampling is probability sampling, while the sampling technique used is proportional random sampling with the Slovin formula.

$$n = \frac{N}{1 + Ne^2}$$

They are explained as:

n = sample size

N = population size

e = error tolerance limit used by 5%

$$\frac{1385}{1 + 1385 \cdot 0,05^2} = 310$$

Table no. 2. Proportion of Respondents in the Study

Sub-district	Number of teachers	Proportion (%)	Calculation of Sample	Number of Samples
Sukarame	105	62	24	24
Kemuning	148	89	33	33
Iilir Timur I	167	99	37	37
Sebrang Ulu I	102	60	22	22
Total	522	310	116	116

Source: Authors' contribution

As presented in Table 2, number of samples that can be drawn from four sub-districts is 310 people, each from 24 people in Sukarame sub-district, 33 people in Kemuning sub-district, 37 people in Iilir Timur I sub-district and 22 people in Sebrang Ulu Sub-district I. Questionnaire was used as the instrument of data collection method as a tool in the interview. The analysis technique used is descriptive statistics and quantitative to illustrate the effect of the use of instructional media, wages, level of education and training on teacher productivity with multiple regression analysis tools. The research model is written as follows:

$$Y_i = \beta_0 + \beta_1 W_i + \beta_i Educ_i + \beta_3 Tr_i + e_1$$

They are explained as:

Y_i = Productivity (output); β_0 = Interception parameter; W_i = Wages; $Educ_i$ = Education (dummy); 1 = if they have professional certificate, 0 = if they don't have professional certificate; Tr_i = Training; $\beta_1 - \beta_3$ = Regression coefficients.

The estimation test using several test tools, namely Gauss Markov test covering normality, multicollinearity, and heteroscedasticity and hypothesis testing including F test, t test and coefficient of determination (Gujarati, 2004).

4. Results and discussion

4.1 Descriptive statistics

In general, it can be seen that none of the respondents' wages reached above average wages or reached the city minimum wage in Palembang. Respondents cannot receive wages above the city minimum wage because respondents can only teach in one school due to the specific area of expertise possessed by the teacher such as teachers who teach in vocational high schools majoring in nursing, pharmacy, motorcycle engineering, light vehicle engineering, audio video engineering, chemical industry, maintenance and repair of aircraft electronic instruments, motorcycles and aircraft frames, business travel, hospitality accommodation, mining geology and petroleum engineering. In addition, there were also respondents who teach in two schools got wages above the city minimum wage if the wages of the two schools where the respondent teaches are combined.

The results showed that the majority of respondents were undergraduate education with professional certificates. The distribution of respondents based on professional certificates is presented in table 3:

Table no. 3. Distribution of Respondents by Education

Education	Number of Respondents	Percentage (%)
S1 with professional certificates	162	52.25
S1 without professional certificates	148	47.75
Total	310	100.0

Source: Authors' contribution

As presented in table 3, it is known that the majority of respondents undertook tertiary education at undergraduate level with professional certificates were 162 people (52.25%) and 148 people (47.75%) without professional certificates. Respondents mentioned that having a professional certificate support them to work productively compared to them who only graduated in Strata 1 and not having a professional certificate.

The knowledge and skills possessed by a worker who comes from education and training will produce certain output products. The existence of training will help teachers improve their knowledge and skills, so that in the end the output produced is higher.

Table no. 4 Distribution of Respondents by the kind of the training

The number of training that was attended	Number of Respondents	Percentage (%)
1	108	34.84
2	112	36.13
3	60	19.36
4	30	9.67
Total	310	100
Average 2.03 be 2		

Source: Authors' contribution

As we presented in Table 4, Respondents who attended training above an average are 90 teachers (29.04%) and respondents who attended training below and equal to an average were 220 teachers (70.96%). Most of the respondents mostly attended 1 type of training, namely Subject Teacher Deliberative Training (MGMP), were 108 people (34.84%), while those who took part in two types of K13 training and Subject Teacher Deliberation (MGMP) were 112 people (36.13%), who attended three types of training courses (MGMP) and 112 people (36.13%) (PTK) were 60 people (19.36%) and those who attended four types of K13 training, Subject Teacher Deliberation (MGMP), Class Action Assessment (PTK) and learning models and media were 30 people (9.67%).

Table no. 5 Distribution of Respondent by the Productivity

Productivity	Media Rank	Number of Respondents	Percentage (%)
15 – 41	5, 4 dan 3	275	88.72
42 – 68	2	16	5.16
69 – 95	1	19	6.12
Total		310	100
Average	29		

Source: Authors' contribution

The estimation results shown in Table 5 explained that teacher productivity was quite low with the average result of 29%. Respondents with productivity below the average were 233 teachers (75.16%) and respondents with above average productivity were 77 teachers (24.84%). The respondents used 5 types of media learning or showed teacher productivity rank 1 by 19 teachers (6.12%) and using the media at most with 4 types of media or showing the teacher productivity rating at rank 2 were 16 teachers (5.16%) and the least using learning media with only one to three types of media or showing teacher productivity ratings at rank 3, 4, and 5 using instructional media were 275 teachers (88.72%). The table above also explained the productivity categories arranged in the form of ratings 1, 2, 3, 4, and 5. The more media used the higher rank that they got. It can be assumed that the higher the productivity of the teacher. The performance factors and the length of working hours were determined the high level of productivity produced by the teacher.

4.2 Discussion

A good econometric model must fill econometric and statistical criteria. Based on econometric criteria, the model must the classical assumption test, it means that it is free from multicollinearity symptoms, autocorrelation and heteroscedasticity. The suitability of the model with statistical criteria can be seen from the coefficient of determination (R^2), the F statistical test and the t statistical test (Gujarati, 2004).

Table no. 6. The estimation result of multiple linier regression in teacher productivity

Variable	Coefficient	t-calculate value	Std Error	Significancy
Wage	2,999	13,583	0,000	0,000
Education	- 2,397	1,602	1,598	0,010
Training	2,226	2,003	1,173	0,046
constanta	-8,068			
R-Square	= 0,659	D-W Hitung	= 1,841	
R-Square Adjusted	= 0,656	F-Statistic	= 197,051	

Source: Authors' contribution

The results of the calculation of the main model estimation of the multiple linear equations for male workers can be explained by the following equation:

$$\text{Productivity} = -8,068 + 2,999 W - 2,397 \text{ Educ} + 2,226 T$$

Simultaneous testing based on Table 8 shown that the value of F-Statistics > F-table (197.05 > 2.64) it meant that wages, education, and training simultaneously affect teacher productivity. Partially, it shown that wages, education, and training had a significant effect on teacher productivity based on the probability value <Significance level α . While the Adjusted R-squared test shows that wage variations, education, and training can explain the variation in teacher productivity by 65.6 percent. The Gauss Markov test shown that the classic assumptions are rejected statistically, the estimation result shown that the model was free from the assumptions of normality, multicollinearity and heteroscedasticity as presented in Table 7:

Table no. 7. Gauss Markov Test

Testing	Probability	Explanation
Normality Test histogram	Data distribution followed a straight line	Free from Normality Problems
Variance Inflation Factor (VIF) and Tolerance Test	VIF <10 Tolerance > 0,1	Free from Multicolinearity problem
Heteroskedasticity Test Histogram	The distribution of data points were not patterned	Free from heteroskedasticity problem

Source: Authors' contribution

The effect of wages on teacher productivity Private Vocational High Schools in Palembang City. Based on the results of the significance test, there was a probability value of 0.000 (0.000 < 0.05). This value could prove that wages had a statistically significant effect on productivity. If the wages received by a teacher are greater, the teacher's comfort in working would be guaranteed. The teacher would be able to prepare more, more varied and better learning media. The teacher would also be more focused in teaching in that area and the teacher would not find another place to teach. So that teachers would have enough time to prepare another learning media. When the teacher gave so many kinds of media, students would receive the transfer of knowledge more easily and would get good learning results. When the number of learning media was used more in every learning process, it would be able to increase the teacher's productivity. It could be concluded that wages had a positive significant effect on teacher productivity.

This result is also in line with the research conducted by Ashraf et al., 2020; Almond & Currie, 2011 with their research that there was a significant relationship between wages and employee productivity. The results of this study also supported that compensation has a significant effect on productivity. Furthermore, supported by research conducted by Torberg (2010), Sojourner (2013) and Sinungan (2005) with the variables of the Work Environment, student learning outcomes, and Wages, there was an influence on teacher productivity. This mean that the higher the wage, the higher the labor productivity.

The effect of education on teacher productivity in Palembang City Private Vocational High Schools. Education is the main requirement that must be taken by someone to be able to enter the job market. The level of education was a teacher had affect the mindset, attitude and action in dealing with problems that arise, especially in work problems. People who had a higher level of education generally cope faster with the problems they face than the people with a lower level of education. Education had a function to improve the qualifications of the workforce to be more productive (Hellerstein, 2018). This was similar with Kneller's theory which states that education was a conscious effort to prepare students through guidance, teaching and training activities for their role in the future and Borjas (2016) states that human capital investment in education would generate higher income because companies are interested. Workers had higher education (more productive) so they would offer higher wages. This is intended to increase labor productivity because education, both formal and non-formal, was expected to have the ability to better understand and adapt to changes in the work environment more quickly.

In line with research conducted by Salazar et al (2016), it shown that online professional learning communities could increase teacher work productivity, increase access and flexibility as well as a combination of work and education. Supported by research results, Afrooz et.al (2010) analyzed the effect of education, skills and working capital on labor productivity. The results of this study were education, skills and working capital had a positive and significant effect on work productivity. In line with Rehman and Mughal's (2013) research, it shown that skilled workers had a positive and significant effect. But unskilled workers had a negative and significant effect on labor productivity.

It was same in the case with the study with the result that wages had a positive and significant effect on labor productivity. In addition, it was also in line with the results of Syverson (2016) that in the recruitment of new workers, the personnel could determine the minimum formal education requirements that must be met by prospective applicants. With relatively high education, the knowledge and understanding of employees would be greater so they could quickly receive new input and could increase their work productivity. In this study, the results of the significance test shown that there was a probability value of 0.01 ($0.01 < 0.05$). This value could prove that education had a statistically significant effect on productivity. Education could increase teacher productivity through the output and input generated by the teacher through student learning outcomes and the use of learning media used by teachers in the learning process. Undergraduate education or teacher professional education in increasing teacher productivity was closely related to this study. Undergraduate education or teacher professional education would have a high enough contribution in increasing productivity.

Everyone could teach or transfer the knowledge to the students, but to make input on productivity in this research through the use of learning media. Not everyone could make good learning media, because they must have good teacher training and adequate skills. A teacher who takes undergraduate education in the field of teacher training or teacher professional education already has the knowledge in making good learning media that they got in the education process. Moreover, if the teacher had a professional certificate, the skills and knowledge that the teacher had will be much better and the teacher could certainly make various types of learning media in the teacher carrying out learning activities. When learning media was used in student learning activities, it would be more comfortable and easier to receive knowledge on the learning carried out by the teacher. From the description above, it could be concluded that formal good education would have a positive effect on increasing teacher work productivity.

The effect of training on teacher productivity on private vocational schools in Palembang City. Not only wage and education variables that could increase teacher productivity, training variables could also increase teacher productivity. The results of the significance test shown that

there was a probability value of 0.046 ($0.046 < 0.05$). This value could prove that teacher training had a statistically significant effect on productivity. Through training, technical knowledge and job skills could be used at the same time. School institutions tended to choose teachers who had attended training in the field of teacher training rather than those who had never attended training. Teachers who often followed training, they were more capable in carrying out teaching tasks. The fact shown that the longer the teacher works, the more training a teacher would take. With training, a person would be able to carry out their duties properly so that work productivity would be better too (Ismail, Rosa, Sulaiman : 2017)

There are various types of training that could support the input of productivity in this study, namely Subject Teacher Training (MGMP) training, Curriculum 13 and Learning Media. Because there were so many learning media available, the most supportive training was able to improve the knowledge and skills of teachers in creating and implementing learning media in detail and mandala. When the knowledge and skills of teachers in making learning media, variations in learning activities and students were easier to accept learning because of the variation in the learning process that teachers used more and the output produced by students over learning outcomes would be better. When many training activities are followed, the skills of teachers in making learning media improved student learning outcomes and teacher productivity.

The increase in the amount of training by a teacher was related to a person's tenure, the longer a teacher worked, the more teacher training would attend. We could compare it to new teachers. If a teacher had frequently attended training in a particular field, it would increase their teaching abilities and skills. Unconsciously they would learn so they had practical skills at work. With job training in the field of teacher training that each teacher had, each school institution hoped that achieving goals would be easier, as stated by Surahman (2018).

These results were in line with the teacher-specific research conducted by Haris (2018) based on the results of the study, it shown only two forms of teacher training that we studied affect productivity. First, content-focused teacher professional development is positively related to productivity in secondary and high school on mathematics lesson. Second, more experienced teachers appeared to be more effective at teaching basic and reading and secondary school on mathematics lesson. Furthermore, research conducted by Amron (2017) The period of a person's work was related to training, the longer a person worked in a field the more training the teacher participates in. If a teacher had frequently attended training in a particular field, it would increase their teaching abilities and skills. Training was also a skill or skill possessed by a workforce to do a job and could only be obtained through practice, both training and experience.

This result was also in line with research in general for workers who had training to support other workforce productivity as stated by Syverson, (2017) that schools were in an effort to increase work productivity, companies paid attention to teacher job training, with companies providing and conducting programs or tips. Special tips for providing input and direction as a useful reference for increasing work productivity in the company as a process of developing the company going forward.

5. Conclusions

The study analyzes the empirical evidence related to the education function production model based on human capital input, namely education, skills and wages on the productivity for vocational teachers. The results shown the wages and skills responded positively and significantly to productivity. These results also proved that there were significant differences in productivity based on education level. Meanwhile, empirically the determinant input in this model was skill, therefore skill development was needed through wider opportunities for teachers to participate in various kinds of training activities to support teacher productivity in teaching. Teachers were required to play an active role in finding information on various trainings for improve their ability to prepare media and transfer knowledge to students so that the output (learning outcomes) obtained by students was higher

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