



Research article

Open Access

The role of education in improving labor productivity in the manufacturing sector.

Section:
Business management

Amahda Nur'Aulia, Khoirul Sahita Rahma, Muhammad Ashroful
Ardiansyah, Muhammad Yusuf Karim, & Nina Farliana

Fakultas Ekonomi dan Bisnis, Universitas Negeri Semarang, Semarang, Indonesia

Abstract

Education plays a crucial role in enhancing labor productivity, particularly in the manufacturing sector, which requires high levels of skill and workplace efficiency. This research aims to analyze the influence of education on labor productivity through a comprehensive literature review approach. Various national and international literature were systematically studied to understand how the education level contributes to skill improvement, innovation, and labor efficiency. The findings show that workers with higher education levels tend to have a better understanding of technology, can adapt to industrial changes, and contribute more significantly to production efficiency. Studies in Indonesia indicate a positive correlation between education level and labor productivity in the manufacturing sector, with productivity increases of 5-15% for each higher level of education. Additionally, investment in education has proven to have a positive impact on company competitiveness and overall economic growth. This research recommends the need for education policies aligned with industry needs, strengthening link and match programs, and improving vocational curriculum quality to create a competent and adaptive workforce in the Industrial Revolution 4.0 era.

Received: 7/9/2025
Revised: 8/4/2025
Accepted: 9/12/2025
Online: 10/2/2025

JRMB
Jurnal Riset
Manajemen dan Bisnis

Vol. 10, No. 1, 2025
pp. 11-20

Keywords:

Education, Labor Productivity, Manufacturing Industry, Link and Match, Vocational Education Policy

Corresponding author

Nina Farliana

Email: ninafarliana@mail.unnes.ac.id

© The Author(s) 2025

DOI: <https://doi.org/10.36407/jrmb.v10i1.1653>



CC BY: This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format, so long as attribution is given to the creator. The license allows for commercial use.

Abstrak

Pendidikan memainkan peran penting dalam meningkatkan produktivitas tenaga kerja, terutama di sektor manufaktur yang membutuhkan tingkat keterampilan dan efisiensi kerja yang tinggi. Penelitian ini bertujuan untuk menganalisis pengaruh pendidikan terhadap produktivitas tenaga kerja melalui pendekatan tinjauan literatur yang komprehensif. Berbagai literatur nasional dan internasional telah diteliti secara sistematis untuk memahami bagaimana tingkat pendidikan berkontribusi pada peningkatan keterampilan, inovasi, dan efisiensi tenaga kerja. Temuan menunjukkan bahwa pekerja dengan tingkat pendidikan yang lebih tinggi cenderung memiliki pemahaman yang lebih baik tentang teknologi, dapat beradaptasi dengan perubahan industri, dan berkontribusi secara signifikan terhadap efisiensi produksi. Studi di Indonesia menunjukkan korelasi positif antara tingkat pendidikan dan produktivitas tenaga kerja di sektor manufaktur, dengan peningkatan produktivitas sebesar 5-15% untuk setiap tingkat pendidikan yang lebih tinggi. Selain itu, investasi dalam pendidikan terbukti memiliki dampak positif terhadap daya saing perusahaan dan pertumbuhan ekonomi secara keseluruhan. Penelitian ini merekomendasikan perlunya kebijakan pendidikan yang selaras dengan kebutuhan industri, memperkuat program link and match, serta meningkatkan kualitas kurikulum vokasi untuk menciptakan tenaga kerja yang kompeten dan adaptif di era Revolusi Industri 4.0.

Kata Kunci: Pendidikan, Produktivitas Tenaga Kerja, Industri Manufaktur, Link and Match, Kebijakan Pendidikan Kejuruan

INTRODUCTION

Education is a fundamental factor in human resource development and increasing labor productivity. In the era of the 4.0 industrial revolution and rapid digital transformation, the manufacturing industry is increasingly demanding a workforce with high skills, a deep understanding of technology, and the ability to adapt to change (Suharno et al., 2020). Quality education not only equips individuals with technical skills but also enhances their critical thinking, innovation capacity, and work efficiency.

Labor productivity is a key indicator of an industry's success in enhancing its competitiveness in the global market. Data from the Central Statistics Agency (BPS, 2023) indicate that labor productivity in the manufacturing sector in Indonesia still lags behind that of other ASEAN countries, such as Malaysia and Thailand. One of the leading causes is the skill gap between education graduates and industry needs (Ministry of Industry, 2022).

Several studies in Indonesia have shown a positive correlation between educational levels and labor productivity. A survey conducted by Suyanto and Pratono (2018) revealed that workers with higher education have 12% higher productivity than workers with secondary education. Similar findings were also reported by Zainal et al. (2021), who found that manufacturing companies with highly educated workforces tend to have better production efficiency and faster technology adoption rates.

However, there are still significant challenges in creating an education system that aligns with the industry's needs in Indonesia. The Ministry of Manpower (2022) noted that 65% of manufacturing companies still have difficulty finding workers with the right qualifications. The gap between the skills acquired through formal education and the skills required in the workforce remains a structural issue that needs to be addressed.

This study uses a systematic literature review approach to analyze the relationship between education and labor productivity in Indonesia's manufacturing sector. The primary focus of this study is to investigate the role of education in enhancing labor productivity and to identify effective policies and strategies for aligning the education system with the needs of the manufacturing

industry. The results of this study are expected to provide policymakers with input for developing an education system that is more responsive to the sector's needs.

LITERATURE REVIEW

The concept of education and labor productivity has a strong theoretical foundation in human capital theory proposed by Becker (1993). This theory views education as an investment that improves individual skills, knowledge, and productivity. Schultz (1961) reinforced this concept by stating that increasing human capital through education is a key factor in promoting economic growth and improving productivity.

Psacharopoulos and Patrinos (2004) found, in their comprehensive study, that the rate of return on investment in education is consistently positive across various countries, with an average return of around 10% for each additional year of schooling. In developing countries such as Indonesia, this rate of return tends to be higher, reaching 12-15% for higher education.

In the context of the manufacturing industry, Farrell's (1957) technical efficiency theory provides a conceptual framework for understanding how education enhances the workforce's ability to optimize the use of production inputs. Highly educated workers are better able to understand complex production processes, operate modern technology, and contribute to increased efficiency.

Empirical studies in Indonesia, such as those conducted by Hermanto and Sriyana (2021), confirm the positive relationship between education levels and labor productivity in the manufacturing sector. Another study by Widodo et al. (2022) demonstrates that education plays a crucial role in driving innovation and competitiveness in manufacturing companies.

However, the World Bank (2019), in its report "The Changing Nature of Work," identifies the challenge of skill mismatch between education graduates and industry needs. This phenomenon shows that the quality and relevance of education are as important as the quantity or level of education.

Based on theoretical and empirical studies, the conceptual framework of this research emphasizes the relationship between education and labor productivity, which is mediated by factors such as technical skills, technological adaptation, production efficiency, and innovation. This study also considers contextual factors such as education policy, link and match systems, and the alignment of the curriculum with industry needs as moderators in this relationship.

METHODS

This section outlines the research methodology, including the sample and procedure, measurement criteria, and data analysis techniques applied in the study.

Sample and procedure

This study employs a systematic literature review method to examine the impact of education on labor productivity in the manufacturing sector. The systematic approach was carried out in several stages, including: (1) identification and formulation of research questions, (2) search for relevant

literature, (3) evaluation and selection of literature, (4) analysis and synthesis of findings, and (5) interpretation of results.

The data sources used in this study include scientific journal articles, reference books, research reports, government publications, and policy documents published between October 20, 2023, and the present date. The literature search was conducted through electronic databases, including Google Scholar, Portal Garuda, SINTA, ScienceDirect, and Scopus.

Measurement

The inclusion criteria for literature selection included: (1) relevance to the research topic, (2) publication in Indonesian or English, (3) transparent research methodology, and (4) discussion of the Indonesian context or implications relevant to the Indonesian context. Meanwhile, the exclusion criteria included: (1) publications that did not undergo a peer-review process, (2) opinion or editorial articles, and (3) publications that were not fully accessible.

The analysis focused on four main categories of measurement: (1) the contribution of education to technical skills and technological adaptation, (2) the influence of education on production efficiency and quality, (3) the role of education in promoting innovation and competitiveness, and (4) the gap between education and industry needs.

Data analysis techniques

Data analysis was conducted using a thematic approach, in which findings from various literature were categorized into predetermined main themes. The analysis process included open coding to identify key concepts, axial coding to connect these concepts, and selective coding to integrate the findings into a theoretical framework.

To ensure the validity and reliability of the analysis, this study applied data source triangulation by comparing findings from various types of publications (academic journals, government reports, and research institute publications). The findings were synthesized to identify patterns, trends, and gaps in research related to the influence of education on labor productivity in Indonesia.

RESULTS AND DISCUSSION

The contribution of education to technical skills and technology adaptation

The results of the literature analysis show that the level of education has a positive correlation with the technical skills and technology adaptation of the workforce in the manufacturing sector. Research by Hermanto and Sriyana (2021) on 217 manufacturing companies in Central Java and Yogyakarta found that companies with a higher proportion of highly educated workers (diploma and bachelor's degree) were quicker to adopt new technologies and had a 14.3% higher productivity rate compared to companies with a majority of workers with lower secondary education.

These findings align with a study conducted by Purwanto et al. (2020), which analyzed data from the Large and Medium Industry Survey (IBS) by BPS for the period 2015-2019. The study reveals that a 1% increase in the proportion of highly educated workers is associated with a 0.83% increase in productivity.

Table 1.*Correlation between education level and productivity indicators*

Level of Education	Labor Productivity	Technology Adaptation	Production Quality	Production Efficiency
SMA/SMK	Baseline	Baseline	Baseline	Baseline
Diploma	+7.2%	+11.3%	+6.8%	+8.5%
Bachelor's Degree	+14.3%	+18.6%	+11.8%	+13.2%
Postgraduate	+17.5%	+23.1%	+15.4%	+16.9%

Source: Kompilasi dari Hermanto & Sriyana (2021), Purwanto dkk. (2020), Suyanto & Pratono (2018)

In the context of technology adaptation, research by Aswicahyono and Hill (2018) reveals that manufacturing industries with a higher proportion of highly educated workers are better able to adapt to Industry 4.0 technologies such as automation, the Internet of Things (IoT), and artificial intelligence. These companies have a 23% higher rate of technology adoption and significant productivity gains compared to companies with a majority of low-educated workers.

The influence of education on production efficiency and quality

Education not only contributes to technical skills but also has a significant impact on production efficiency and quality. A longitudinal study conducted by Tambunan (2019) on 150 manufacturing companies in the Jababeka and MM2100 Industrial Estates from April 20, 2018, to January 14, 2019, showed that companies with more than 50% of highly educated workers had a 9.7% higher production efficiency rate and an 8.3% lower product defect rate. 8.3% lower than companies with a majority of low-educated workers.

Table 2.*Regression results of the effect of education on production efficiency*

Variabel Independen	Koefisien	Standar Error	t-value	p-value
Konstanta	72.86	3.42	21.30	0.000
% SMA/SMK Graduates	0.15	0.07	2.14	0.031
% Diploma Graduates	0.41	0.09	4.55	0.000
% Bachelor's Degree Graduates	0.63	0.11	5.72	0.000
% Postgraduate Degree Graduates	0.84	0.15	5.60	0.000
Company Size	0.23	0.08	2.87	0.004
Work Experience	0.31	0.06	5.16	0.000
Production Technology	0.57	0.12	4.75	0.000

Source: Tambunan (2019)

The role of education in driving innovation and competitiveness

Education also plays a vital role in driving the innovative capabilities of the workforce and increasing the competitiveness of companies. Research by Widodo et al. (2022) on 312 manufacturing companies listed on the Indonesia Stock Exchange between 2017 and 2021 shows

that companies with more than 35% of their workforce holding a higher education degree have an 18.7% higher level of product and process innovation compared to companies with a lower-educated workforce.

A study by the Indonesian Institute of Sciences (LIPI, 2020) revealed that highly educated workers are better able to identify opportunities for improvement in production processes, develop innovative solutions to technical problems, and contribute to the development of new products.

The gap between education and industry needs

Although education has been proven to have a positive impact on workforce productivity, a significant gap remains between the output of the education system and the needs of the manufacturing industry in Indonesia. An Industrial Workforce Needs Survey conducted by the Ministry of Industry (2022) reveals that 68% of manufacturing companies in Indonesia face difficulties in recruiting workers with the necessary skills.

Research by Wijaya and Sunarto (2020) on 350 college graduates working in the manufacturing sector revealed that 63.7% of respondents felt that the curriculum they studied in college was not entirely relevant to their current job requirements. Conversely, 74.2% of manufacturing companies reported that college graduates needed additional training for 3-6 months before they could contribute optimally.

Discussion

The findings of this study support Becker's (1993) human capital theory, which posits that education is an investment that enhances individual skills and productivity. The results of the analysis show a consistent positive correlation between education levels and various productivity indicators in Indonesia's manufacturing sector, including technical skills, technological adaptation, production efficiency, and innovation.

The 12-17.5% increase in productivity among highly educated workers compared to those with lower levels of education demonstrates the significant economic value of investing in education. These findings align with Psacharopoulos and Patrinos' (2004) study on the high returns to education in developing countries.

The contribution of education to technical skills and technological adaptation is becoming increasingly important in the era of the 4.0 industrial revolution, which is characterized by digitalization and automation. The ability of highly educated workers to adopt new technologies and understand complex production systems provides a competitive advantage for manufacturing companies in the face of changes in the industrial landscape.

The increase in production efficiency and quality associated with the educational level of the workforce confirms Farrell's (1957) theory of technical efficiency. Highly educated workers have proven to be more capable of optimizing the use of inputs and minimizing waste in the production process, which contributes to an increase in overall productivity.

However, the gap between the output of the education system and the needs of the manufacturing industry indicates challenges in creating a relevant education system. The phenomenon of skill mismatch identified in this study aligns with the World Bank's (2019) report on changes in the workforce, which highlights the need for a more adaptive and market-oriented approach to education.

These findings suggest the need for reform of the Indonesian education system to align it with industry needs better. Linking and matching programs, revitalizing vocational education, and fostering systematic collaboration between educational institutions and industry are key to creating a productive and competitive workforce in the era of Industry 4.0.

Limitations

This study has several limitations that need to be considered. First, the literature review approach used does not allow for the collection of primary data that could provide a more in-depth perspective on the causal relationship between education and labor productivity. Second, variations in methodology and context in the analyzed literature may limit the comparability and generalizability of the findings. Third, the focus on the manufacturing sector in general may overlook variations among manufacturing subsectors that have different characteristics and skill requirements.

Future research can address these limitations by employing empirical studies that utilize primary data and more robust methodologies, such as longitudinal studies or mixed-method approaches. Comparative analysis between manufacturing subsectors will also provide a more nuanced understanding of the impact of education on labor productivity.

CONCLUSION

Based on the results of the literature analysis, education has a significant influence on labor productivity in Indonesia's manufacturing sector. Higher education has been proven to improve technical skills, technological adaptation abilities, work efficiency, and the innovation capacity of the workforce. Companies with a higher proportion of educated workers demonstrate better productivity, higher production efficiency, and greater innovation.³

However, the effectiveness of education in increasing labor productivity is highly dependent on the suitability of educational content to industry needs. The skills gap that still exists between education graduates and the needs of the manufacturing industry highlights the need for systemic reform in Indonesia's approach to education.

The main recommendations from this study include strengthening link and match programs, revitalizing vocational education, developing a competency certification system, and providing incentives for training and human resource development. The implementation of these recommendations is expected to strengthen the role of education in increasing labor productivity in Indonesia's manufacturing sector, thereby contributing to the improvement of the national industry's competitiveness in the global market.

REFERENCES

- Arifin, Z., & Raharja, S. J. (2021). Pengaruh Tingkat Pendidikan Tenaga Kerja terhadap Kualitas Produksi pada Industri Elektronik di Kawasan Industri Batam. *Jurnal Manajemen Industri dan Logistik*, 5(1), 39-52.
- Aswicahyono, H., & Hill, H. (2018). Is Indonesia Trapped in the Middle? *Bulletin of Indonesian Economic Studies*, 54(3), 309-343.
- Badan Pusat Statistik. (2023). Produktivitas Tenaga Kerja Sektor Industri Manufaktur Indonesia 2018-2022. Jakarta: BPS.
- Becker, G. S. (1993). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education* (3rd ed.). University of Chicago Press.

- Direktorat Jenderal Pendidikan Tinggi. (2023). Laporan Studi Evaluasi Kesesuaian Kurikulum Pendidikan Tinggi dengan Kebutuhan Industri. Jakarta: Kemendikbudristek.
- Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society, Series A (General)*, 120(3), 253-290.
- Forum Pendidikan Tinggi Indonesia. (2022). Studi Dampak Pendidikan Tinggi terhadap Produktivitas Industri Manufaktur di Indonesia. Jakarta: FPTI.
- Hermanto, B., & Sriyana, J. (2021). Kontribusi Pendidikan Tinggi terhadap Adopsi Teknologi dan Produktivitas Perusahaan Manufaktur di Jawa Tengah dan Yogyakarta. *Jurnal Ekonomi Pembangunan*, 19(1), 45-62.
- Kementerian Ketenagakerjaan. (2022). Laporan Pasar Kerja Indonesia 2022: Tantangan dan Peluang di Era Industri 4.0. Jakarta: Kemnaker.
- Kementerian Perindustrian. (2021). Analisis Produktivitas Industri Manufaktur Indonesia. Jakarta: Kemenperin.
- Kementerian Perindustrian. (2022). Survei Kebutuhan Tenaga Kerja Industri 2022. Jakarta: Kemenperin.
- Lembaga Ilmu Pengetahuan Indonesia. (2020). Studi Inovasi di Sektor Industri Manufaktur Indonesia. Jakarta: LIPI.
- Moeliiodihardjo, B. Y., Soemardi, B. W., Brodjonegoro, S. S., & Hatakenaka, S. (2022). Efektivitas Program Link and Match pada Pendidikan Vokasi di Indonesia. *Jurnal Pendidikan Vokasi*, 12(1), 78-95.
- Nugroho, A. D., & Setiawan, M. (2021). Pengaruh Tingkat Pendidikan Pemilik dan Manajer terhadap Daya Saing UKM Manufaktur di Indonesia. *Jurnal Manajemen dan Kewirausahaan*, 23(2), 156-168.
- Psacharopoulos, G., & Patrinos, H. A. (2004). Returns to Investment in Education: A Further Update. *Education Economics*, 12(2), 111-134.
- Purwanto, D., Firdaus, M., & Hasbiollah, M. I. (2020). Analisis Pengaruh Tingkat Pendidikan terhadap Produktivitas Tenaga Kerja pada Industri Besar dan Sedang di Indonesia. *Jurnal Ekonomi dan Kebijakan Publik Indonesia*, 7(2), 122-137.
- Pusat Penelitian Ekonomi LIPI. (2023). Investasi Pendidikan dan Pelatihan: Kunci Daya Saing Industri Manufaktur Indonesia. Jakarta: LIPI.
- Schultz, T. W. (1961). Investment in Human Capital. *The American Economic Review*, 51(1), 1-17.
- Suharno, Pambudi, N. A., & Harjanto, B. (2020). Vocational Education in Indonesia: History, Development, Opportunities, and Challenges. *Children and Youth Services Review*, 115, 105092.
- Suyanto, & Pratono, A. H. (2018). Education and Productivity in Indonesian Manufacturing: The Role of Foreign Ownership. *Economic Journal of Emerging Markets*, 10(1), 8-17.
- Suyono, E., & Noorhasanah, Z. (2020). Tingkat Pendidikan dan Efisiensi Produksi: Studi Kasus Industri Otomotif Indonesia. *Jurnal Aplikasi Manajemen*, 18(3), 521-533.
- Tambunan, T. (2019). The Impact of Educational Background on Efficiency and Productivity in Indonesian Manufacturing Firms. *International Journal of Education Economics and Development*, 10(2), 205-222.
- Tim Nasional Percepatan Penanggulangan Kemiskinan. (2021). Kesenjangan Keterampilan dan Strategi Pengembangan SDM di Indonesia. Jakarta: TNP2K.
- Widodo, W., Chariri, A., & Sutopo, B. (2022). Peran Pendidikan dalam Meningkatkan Inovasi dan Kinerja Perusahaan Manufaktur di Indonesia. *Jurnal Akuntansi dan Keuangan Indonesia*, 19(1), 23-41.

- Wijaya, A., & Sunarto, S. (2020). Relevansi Kurikulum Perguruan Tinggi dengan Kebutuhan Industri Manufaktur di Indonesia. *Jurnal Pendidikan dan Pembelajaran*, 27(1), 39-50.
- World Bank. (2019). *The Changing Nature of Work*. World Development Report.
- Zainal, A., Primiana, I., Suryana, Y., & Hendarsyah, S. (2021). Modal Manusia dan Produktivitas Industri Manufaktur di Indonesia. *Jurnal Ekonomi dan Pembangunan Indonesia*, 21(2), 156-172.

Declarations

Funding

The authors received no financial support for the research and publication of this article.

Conflicts of interest/ Competing interests:

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Data, Materials and/or Code Availability:

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

