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THE UTILIZATION OF DATA ANALYTICS TO DETERMINE THE DEVELOPMENT STRATEGY FOR THE TEACHING FACTORY OF SMK GRAFIKA KOTA TANGERANG

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Abstract

This research aims to formulate a development strategy for the Teaching Factory (TeFa) at SMK Grafika Kota Tangerang, utilizing data analytics and referencing vocational education regulations. The TeFa is crucial for preparing graduates with industry-standard skills, yet its implementation faces constraints in planning, management, and data availability. The study used a descriptive quantitative approach, employing simple statistical analysis of questionnaire data collected from respondents regarding TeFa implementation. The analysis assessed the level of data utilization in the school's planning, operations, evaluation, and decision-making. Results indicate that the use of data analytics is still moderate, specifically in program evaluation, competency mapping, and determining industry-based training needs. These findings necessitate systematically increasing data utilization, particularly for industry-based curriculum development, business collaboration, and production scheduling. The research recommends data-driven strategies, including enhancing data literacy among teachers, integrating school information systems, optimizing program evaluation, and strengthening industrial partnerships. The implications provide a foundation for school policymakers to design TeFa development that is accurate, measurable, and sustainable, thereby increasing graduate competitiveness in the job market.

Keywords: Teaching Factory (TeFa); Data Analytics; Development Strategy; Vocational High School; Data-Driven Decision Making.

INTRODUCTION

Vocational High Schools (SMK) play a strategic role in producing graduates who are competent, possess industry-standard skills, and are ready to enter the workforce or become entrepreneurs. The government has established a strong regulatory basis, including Government Regulation Number 41 of 2015 concerning the Development of Industrial Human Resources, which mandates that the implementation of competency-based industrial vocational education must be equipped with a Teaching Factory as a means of learning based on production and industrial work standards. The TeFa in SMK is expected to provide real learning experiences, foster work ethic, discipline, and technical and non-technical skills, while also producing relevant and competitive products or services. However, its implementation still faces various constraints, particularly in the aspects of planning, learning execution, production activities, and collaboration with the Business and Industrial World (DU/DI), thus its contribution to improving graduate quality has not been optimal.

Furthermore, a mismatch between graduate competencies and labor market needs still persists, reflected in the higher unemployment rate of SMK graduates compared to other education levels. Data from the Central Statistics Agency (BPS) in 2024 showed the Open Unemployment Rate in Tangerang City was 5.92%, with SMK graduates being the largest contributor, although the figure has decreased compared to the previous year. This condition affirms the necessity for a TeFa development strategy that does not only focus on technical learning aspects but is also data-driven. A data-driven approach allows for objective program evaluation, trend identification, training needs mapping, performance measurement, and a more accurate basis for decision-making. The utilization of data analytics in vocational education opens up opportunities for innovation in curriculum development, performance analysis, and development strategies that are adaptive to industrial needs.

Previous studies widely discussed the TeFa from the perspective of graduate quality, learning models, creativity, and industrial partnership (Sudiyono, 2019; Firdaus et al., 2021; Rohmah et al., 2019). However, research integrating data analytics into TeFa development strategy is still limited. Meanwhile, recent studies on big data and data analysis in education show that systematic data management can improve the quality of decisions and the effectiveness of vocational programs (Hergiansa et al., 2020; Widiasanti et al., 2023). Stemming from this condition, this research emphasizes the urgency of an evidence-based strategic model for TeFa development at SMK Grafika Kota Tangerang. This strategy is expected to address fundamental issues such as: (1) the alignment of the TeFa with industrial standards and procedures; (2) the quality of preparation, process, and learning outcomes; (3) students' production capability and work attitude; and (4) the relevance of TeFa products to industry standards.

The theoretical contribution of this study lies in the development of a data-driven decision-making model for the TeFa in SMK, which has not been widely discussed in the literature. The novelty of the research is also evident in the utilization of data analytics to formulate a school development strategy based on the TeFa, differing from previous studies that primarily emphasized learning aspects, curriculum, or student creativity. Furthermore, this research is expected to produce practical and applicable strategic recommendations, not only for SMK Grafika Kota Tangerang but also as a reference for other SMKs in Indonesia to enhance graduate competitiveness. Thus, this research does not merely portray the current condition of TeFa implementation but also offers a systematic, data-driven approach to decision-making. This approach is believed to increase program effectiveness, strengthen industrial partnerships, improve graduate quality, and contribute to reducing the unemployment rate of SMK graduates.

LITERATURE REVIEW

Teaching Factory (TeFa)

Teaching Factory (TeFa) is a production-based learning model that connects school activities with industrial work processes. Its primary goals are to provide students with real work experience, equip them with technical skills aligned with industry standards, and instill non-technical competencies such as discipline, teamwork, and work ethic. Previous research (Sudiyono, 2019; Firdaus et al., 2021) indicates that TeFa is effective in enhancing graduate quality; however, its success heavily depends on planning, implementation, evaluation, and industrial support.

Challenges in Teaching Factory Implementation

Various studies highlight that TeFa implementation in many Vocational High Schools (SMK) is not yet optimal. Major constraints include planning that is not based on industrial needs, limited facilities, weak program management, and inadequate support from the Business and Industrial World (DU/DI). Specific barriers that frequently arise include:

1. Curriculum and production are not yet data-driven, resulting in incomplete alignment with industrial needs.
2. Implementation processes insufficiently resemble industrial work procedures due to minimal guidance from the DU/DI and limited facilities.
3. Program evaluation is not conducted systematically, making the effectiveness of TeFa difficult to measure.
4. Documentation and utilization of production output data are still minimal, leading to subjective decision-making.

Previous research predominantly focused on learning aspects, curriculum, and student creativity, while data-based analysis is still rarely utilized in TeFa development.

Data Analytics in Education and Decision Making

Data analytics is now an essential component in modern education. Studies by Hergiansa et al. (2020) and Widiasanti et al. (2023) affirm that data analysis can improve the quality of program evaluation, map student competencies, identify learning trends, and strengthen objective decision-making.

In vocational education, data analytics can be utilized for:

1. Evaluating TeFa performance (production, student competence, product quality).
2. Adjusting the curriculum to industrial needs.
3. Formulating evidence-based development strategies.
4. Continuously measuring the effectiveness of collaboration with the DU/DI.

Thus, data analytics is a crucial instrument for designing TeFa development strategies that are more structured, accurate, and relevant to industrial needs.

Research Gap

The literature review indicates three main research gaps:

1. Scarcity of TeFa research that integrates data analytics into evaluation and development strategies.
2. The lack of an available evidence-based strategic model that correlates program quality with data analysis results.
3. Previous research has not comprehensively discussed TeFa from the aspects of preparation, process, outcomes, industrial collaboration, and data utilization.

This research addresses these gaps through a descriptive quantitative approach based on questionnaire data and operational TeFa data at SMK Grafika Kota Tangerang.

Theoretical Focus of the Research

The theoretical framework of this research emphasizes that an effective TeFa development strategy must be based on:

1. Analysis of preparatory data (facilities, curriculum, teacher and student readiness).
2. Analysis of implementation process data reflecting industrial standards.
3. Evaluation of program outcomes and impacts (student competence, product quality, work readiness).
4. Analysis of the strength of DU/DI collaboration on learning quality.
5. Consistent utilization of data analytics in decision-making.

This framework serves as the foundation for formulating a data-driven TeFa development strategy at SMK Grafika Kota Tangerang.

METHOD

Research Design

This research employs a quantitative descriptive approach through simple statistical analysis of questionnaire data describing the condition of TeFa implementation and the utilization of data analytics at SMK Grafika Kota Tangerang.

Population and Sample

The study population consists of parties directly involved in the TeFa, namely the school principal, vice principal, productive teachers, TeFa managers, and students. The sample was determined using purposive sampling, with a total of 52 respondents.

Research Instruments

The instrument used was a 1–4 Likert scale questionnaire containing 33 statements grouped into six aspects, namely: (1) TeFa Preparation Aspect; (2) TeFa Implementation Process Aspect; (3) TeFa Outcomes and Impact Aspect; (4) Collaboration with the Business and Industrial World (DU/DI) Aspect; (5) Data Analytics Utilization in TeFa Aspect; and (6) TeFa Development Strategy Aspect.

Data Collection Technique

Data collection was carried out by directly distributing questionnaires to respondents, based on their experience and observation of the TeFa. The collected questionnaire data was then recorded and processed into score tables for each indicator and each aspect.

Data Analysis Technique

Data analysis was performed using descriptive statistics, which included:

1. Calculation of Mean Value The mean value of each statement item across the six aspects was calculated to determine the achievement level of each indicator.
2. Score Categorization The mean scores were then categorized into 4 levels:
   a. 1,00 – 1,75 = Low
   b. 1,76 – 2,50 = Sufficient
   c. 2,51 – 3,25 = Good
   d. 3,26 – 4,00 = Very Good

   These categories help illustrate the strengths and weaknesses of each aspect of the TeFa.

RESULTS AND DISCUSSION

This research analyzed 33 statements across six aspects of the TeFa. The questionnaire results indicate that most respondents provided scores of 3 (agree) and 4 (strongly agree) on nearly all indicators, thus the condition of the TeFa can be described as ranging from sufficient to good.

TeFa Preparation Aspect

Most respondents rated the TeFa preparation in the good category, with dominant scores of 3–4. This indicates that the curriculum, planning, facilities, and the readiness of both teachers and students already support the program's implementation. Some scores of 1–2 primarily emerged concerning facilities.
Conclusion: Preparation is progressing very well, but facility improvement is still necessary.

TeFa Implementation Process Aspect

The dominant score of 3 indicates that the TeFa implementation process sufficiently resembles industrial work procedures. However, some respondents gave low scores for schedule consistency and quality of execution.
Conclusion: The implementation process is good, but stronger consistency and standardization are needed.

TeFa Outcomes and Impact Aspect

Scores of 3–4 dominate all indicators, especially concerning the improvement of technical competence, product quality, and student work readiness. However, the utilization of TeFa outcomes as input for curriculum evaluation is not yet widespread.
Conclusion: The program's impact is positive, but the integration of TeFa results into curriculum development is still limited.

Collaboration with the DU/DI Aspect

Collaboration was rated as the best aspect, with a majority score of 4. The DU/DI is quite active in providing internship opportunities, training, and feedback on TeFa products.
Conclusion: Industrial cooperation is already strong, but input in curriculum development needs to be expanded.

Data Analytics Utilization Aspect

The utilization of data analytics is the weakest aspect, still falling into the sufficient category. Data is already documented but not yet structured, and its utilization in decision-making is not consistent.
Conclusion: The school understands the importance of data, but has not been optimal in analyzing and using data for program improvement.

TeFa Development Strategy Aspect

The dominant scores of 3–4 indicate that TeFa development strategies are already available and supported by management, but are not yet entirely based on data analysis.
Conclusion: The development strategy is good, but it is not yet comprehensively based on data analytics.

The following table presents a summary of the questionnaire analysis results, which consists of 33 statements grouped into six main aspects of TeFa implementation at SMK Grafika Kota Tangerang. The mean score for each aspect was calculated using a descriptive statistical approach to provide a general overview of the level of readiness, implementation, outcomes, industrial partnership, utilization of data analytics, and TeFa development strategy. The assessment categories were determined based on a score interval of 1,00 to 4,00 which is divided into four levels: Low, Sufficient, Good, and Very Good. This summary provides a clearer understanding of the aspects that are already operating optimally and the areas that still require improvement, particularly in the utilization of data analytics as a basis for improvement and evidence-based decision-making.

Table 1. Summary of Questionnaire Results by TeFa Aspect

No	Assessment Aspect	Number of Items	Mean Score	Category	Brief Description
1	Preparation of TeFa	5	3,30	Very Good	Planning and curriculum are already TeFa compliant; facilities require slight improvement.
2	TeFa Implementation Process	6	3,20	Good	Production process adheres to industrial standards; schedule consistency needs improvement.
3	TeFa Outcomes and Impact	6	3,25	Good	Improving competence and product quality; impact evaluation is not yet optimal.
4	DU/DI Collaboration	5	3,40	Very Good	Strong industry training, internships, and feedback; curriculum involvement can be increased.
5	Data Analytics Utilization	6	2,05	Sufficient	Data is available but not yet optimally utilized for evaluation and decision-making.
6	TeFa Development Strategy	5	3,20	Good	The strategy is underway and management-supported; not yet entirely data-based.

Summary of Table Findings:
1. TeFa Preparation and DU/DI Collaboration are the strongest aspects (Very Good).
2. Data Analytics Utilization is the weakest aspect (Sufficient).
3. The three other aspects fall into the good category, indicating stable TeFa implementation.

The following figure displays a visualization of the mean scores across the six Teaching Factory aspects, as previously presented in the table. This bar chart clarifies the differences in the achievement level of each aspect, where the TeFa preparation aspect and DU/DI collaboration aspect constitute the highest scores, while data analytics utilization shows the lowest score. This visualization helps reinforce the pattern of the questionnaire results: most aspects fall into the good category, but data analytics utilization still requires improvement to optimally support TeFa development.

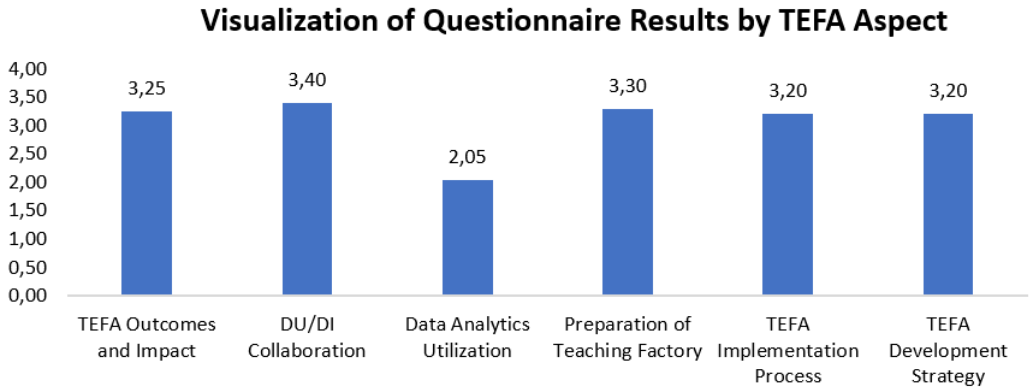

Image 1: Visualization of Questionnaire Results by TeFa Aspect

Based on the questionnaire analysis results presented in the preceding table and visualization, the implementation of the TeFa at SMK Grafika Kota Tangerang is shown to be performing very well in the aspects of DU/DI collaboration and program preparation. However, several aspects still require special attention, such as the utilization of data analytics and increasing the consistency of the implementation process and program impact evaluation. Therefore, a more focused and data-driven development strategy is necessary to ensure the TeFa operates optimally and meets industrial needs. Strategic recommendations are formulated directly based on the findings across

the six main aspects in the table. The recommended TeFa development strategies, among others, focus on curriculum and facility refinement, enforcement of SOPs and quality of the production process, periodic evaluation of outcomes and impacts, strengthening DU/DI collaboration, optimizing data analytics utilization as a basis for decision-making, and formulating a sustainable development plan supported by school management. These TeFa development strategic recommendations for SMK Grafika Kota Tangerang certainly need further review with various entities involved in the TeFa to obtain a development strategy that truly aligns with industrial needs.

CONCLUSION

This research concludes that the implementation of the Teaching Factory (TeFa) at SMK Grafika Kota Tangerang is generally in a sufficient/adequate condition and shows a positive development trend. This is evident particularly in the aspects of program preparation, implementation process, collaboration with the Business and Industrial World (DU/DI), and the outcomes and impact on improving student competence. Program preparation is assessed as being aligned with TeFa standards, reflected in the curriculum alignment and facility readiness, although some facilities still require improvement. The implementation process is also relatively consistent with industrial procedures, thereby providing relevant production experience for the students. Collaboration with industrial partners is the main strength, demonstrated by active involvement in the form of training, internships, providing feedback, and support for production-based learning.

The TeFa outcomes and impact show that the program is capable of improving students' technical skills and work readiness, although the mechanism for impact evaluation needs to be strengthened to be more systematic. TeFa development strategies have also been carried out well, but they are not fully data-driven, making it difficult to ensure long-term effectiveness. A crucial finding of this research is that the utilization of data analytics still falls into the sufficient/adequate category and is the aspect with the lowest score. This condition indicates that operational data, such as production results, student performance, material consumption, and industrial feedback, have not been optimally utilized as a basis for planning, evaluation, or strategic decision-making.

Overall, this research affirms that the success of the TeFa is not only determined by curriculum readiness, facilities, and industrial collaboration, but is also highly dependent on the school's ability to effectively manage and analyze data. Therefore, strengthening data literacy, building digital-based recording and analysis systems, and integrating data into the TeFa management cycle are urgent needs. With the implementation of a focused, collaborative, and data-driven development strategy, the TeFa at SMK Grafika Kota Tangerang has great potential to evolve as a learning model relevant to industrial needs while simultaneously enhancing the competitiveness of graduates in the labor market.

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