Enhancing supervision efficiency and satisfaction: Evaluating the impact of the e-monprakerin model on vocational high school apprenticeship monitoring

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Abstract: This study presents a novel approach to addressing the challenges brought about by Industry 4.0 in vocational education, particularly within the context of Indonesia's evolving industrial landscape. With industries increasingly embracing digitalization and automation, traditional apprenticeship supervision methods have struggled to keep pace. In response, this research introduces the e-monPrakerin model, an electronic-based supervision system tailored for vocational high schools (Bahasa: *Sekolah Menengah Kejuruan*/SMK). Through rigorous evaluation employing a randomized control group pretest-posttest design, the study demonstrates the effectiveness of the e-monPrakerin model compared to conventional methods. Results reveal significant improvements in practicality and user satisfaction, with practicability scores soaring from 41.1% to 81.3% and user satisfaction scores escalating from 31.6% to 84.4% post-implementation. These outcomes underscore the e-monPrakerin model's ability to optimize apprenticeship monitoring, offering a cost-effective, user-friendly, and efficient solution for navigating the complexities of Industry 4.0. By leveraging information technology to bridge the gap between vocational education and industry demands, this research sheds light on the practical implications of digital monitoring solutions. Ultimately, the e-monPrakerin model represents a substantial advancement in vocational education, showcasing the efficacy of technology-driven approaches in enhancing monitoring efficiency and user satisfaction. This contribution adds valuable insights to the field, benefiting educators, policymakers, and stakeholders alike in their efforts to equip the workforce with the skills necessary to thrive in the era of Industry 4.0.

Keywords: Electronic-based monitoring; e-monPrakerin; Internship; Practicality

1. Introduction

The effect of the industrial revolution 4.0 has ushered in a paradigm shift in production methodologies, emphasizing digital technology and automation, while reshaping the landscape of employment. In Indonesia, the government's focus on key industries like food and beverage, textile, automotive, electronics, and chemicals underscores the urgency of preparing a skilled workforce capable of thriving in this new era (Jang & Gim, 2022). However, to cultivate this innovative workforce, the emphasis lies on providing high-quality education (Le et al., 2022; Ten Dam & Volman, 2004). One crucial avenue for bridging the gap between education and industry is through vocational education programs, particularly apprenticeships, which serve as a conduit for students to gain practical skills aligned with industry needs (Wahyuni et al., 2018).

Internships, within this context, are pivotal in nurturing a workforce equipped with professional

skills and fostering closer ties between educational institutions and the workforce (Deschaine & Jankens, 2017; Liviu & Ana-Andreea, 2013). However, effective supervision during these internships is imperative to ensure their success (Atal et al., 2024; Christian et al., 2011; Piccolo & Colquitt, 2006). Traditional methods of supervision often fail to meet the demands of the modern industrial landscape, particularly in the face of challenges presented by Industry 4.0 (Affandy et al., 2019; Calvo & D'Amato, 2015). This underscores the necessity for innovative approaches to monitoring and supervision, particularly in SMK where internship programs play a significant role in shaping students' careers.

Despite the recognized importance of internships, there exist significant gaps and challenges in the current monitoring practices within SMK (Hafis et al., 2023; Jeske & Axtell, 2014; Wang et al., 2022). These gaps span conceptual, programmatic, and operational dimensions, encompassing issues such as the orientation of vocational programs, competency content, and insufficient supervision (Piccolo & Colquitt, 2006; Raharjo et al., 2012; Young & Collin, 2004). This gap is related to (1) conceptual problems, i.e. supply not demand oriented, vocational programs are only school-based, no recognition of previous learning experiences, career deadlocks for vocational high school graduates, vocational teachers lack of experience in industry, the assumption that education is only the responsibility of the government, Vocational education is more formally oriented, SMK dependence on government subsidies (Piccolo & Colquitt, 2006), (2) program problems, namely education tends to be oriented towards teaching subjects, students' vocational bases are less strong, competency content is not strong, the number of hours is limited (Young & Collin, 2004), (3) operational problems, namely basic practices are not taught fundamentally (Raharjo et al., 2012), students are often left to practice in the wrong way (Rismawati et al., 2019), leave students with "fake" quality results, learning principles do not follow mastery learning principles, students often work without the guidance and supervision of teachers, students often practice in an irresponsible, there are still many teachers who are only in school during teaching hours, vocational schools lack economic insight, school awareness to shape the work ethic of teachers and students is still lacking (Raharjo et al., 2018; Sutikno et al., 2019). Addressing these challenges requires a novel approach that leverages advancements in information technology to enhance the effectiveness and efficiency of internship monitoring. The contribution adds valuable insights to the field, benefiting educators, policymakers, and stakeholders alike in their efforts to equip the workforce with the skills necessary to thrive in the era of Industry 4.0.

Research questions

The impact of Industry 4.0 has prompted a reassessment of conventional approaches to vocational education and apprenticeships. In Indonesia, where the government is prioritizing key industries aligned with Industry 4.0, the demand for a skilled workforce is critical. However, the effectiveness of vocational education in adequately preparing students for these industries is under scrutiny. To address this gap, this study aims to investigate the following research questions:

1. How does the e-monPrakerin model compare to conventional apprenticeship supervision methods in terms of practicality?
2. How does the e-monPrakerin model contribute to enhancing the efficiency and effectiveness of apprenticeship programs in vocational education?

By addressing these research questions, this study aims to provide insights into the effectiveness and practicality of the e-monPrakerin model in improving the efficiency of monitoring professional placements for vocational high school students. Additionally, it seeks to shed light on the potential benefits and challenges of implementing electronic-based monitoring systems in the context of vocational education amidst the demands of Industry 4.0.

2. Methods

This study aims to test the efficacy of the *e-mon*Prakerin monitoring model that has been developed. The test was carried out by statistically comparing the experimental group with the comparison group. At the beginning of the study, the subject was given a questionnaire first as an initial measurement using a conventional monitoring model. Furthermore, the experimental group used to research and development products using the *e-mon*Prakerin monitoring model. After completing the treatment, the research subjects were given the same questionnaire as a measurement. The next step is the questionnaire scores obtained are compared to their efficacy. This research design uses the randomized control group pretest-posttest design (Groothuijsen et al., 2023). Product efficacy testing consists of two stages (1) practicality test and (2) satisfaction in using the product by the experimental group and the comparison group.

Participants

This research was conducted in accordance with the principles outlined in the Helsinki Declaration, which governs the ethics of medical research involving human subjects. Prior to their involvement in the study, all participants voluntarily provided their consent. The efficacy testing of the product took place at SMK N 2 Sragen, involving 36 supervisors in the comparison group and 46 supervisors in the experimental group. Throughout the research process, adherence to ethical principles outlined in the Helsinki Declaration was prioritized, ensuring full respect for participants' participation and consent.

User satisfaction test

The user satisfaction test used is in the form of an application assessment questionnaire. This rating includes usability, ease of use, ease of learning, and user ratings. Assessment at this stage is a process of analyzing the quality of the software that has been developed to obtain good feasibility for widespread use. User satisfaction testing focuses on 4 categories, namely: usefulness (US), ease of use (EU), ease of learning (EL), and satisfaction (SC) (Gao et al., 2018).

Data analysis technique

The study initially conducted practicality and user satisfaction tests based on questionnaire responses, followed by t-test data analysis, considering its parametric nature necessitated prerequisite testing for normality and homogeneity using IBM SPSS Statistics 26. Subsequently, paired sample t-tests assessed the practicality and satisfaction of the developed product pre- and post-implementation of the e-monPrakerin model. Additionally, an independent sample t-test compared the efficacy of the developed product by examining differences between the conventional and e-monPrakerin models in terms of practicality and user satisfaction, with formulated hypotheses to test these differences.

3. Results

Product efficacy testing is used to determine the practicality and user satisfaction in using the *e-mon*Prakerin model and application. Testing the efficacy of the product by comparing statistical tests between the comparison group and the experimental group.

Design of e-monPrakerin

The e-monPrakerin model aims to streamline fieldwork practice monitoring activities, making them more efficient with reduced time, lower costs, and improved accuracy of information. Built on Android technology, the e-monPrakerin model is user-friendly and widely adopted by both students and fieldwork practice supervisors. The application can be easily installed on smartphones owned by PKL students and fieldwork practice supervisors. The design of e-monPrakerin is illustrated in Figure 1.

(a) (b)

Figure 1. Design of e-monPrakerin (a) example Login view of e-monPrakerin application (b) Example of barcode of street vendor location

Practicality test

The practicality test employed takes the form of an application assessment questionnaire, evaluating factors such as ease of preparation, supervision speed of prakerin participants, accuracy of participant information, and effective communication with interns. Initially, subjects in the experimental group completed the practicality questionnaire as a baseline measurement before utilizing the e-monPrakerin model. Subsequently, they engaged with the product developed through this model. Following treatment, the same questionnaire was administered to assess any changes. Similarly, subjects in the comparison group underwent the practicality questionnaire as an initial measurement before employing the conventional monitoring model. After treatment, they were then reassessed using the same questionnaire.

Descriptive statistics

Descriptive statistics are utilized to examine the distribution pattern of research data. For the experimental group, the mean value before implementing the e-monPrakerin model was 58.86 (Std. Dev 6.11), which increased to 120.30 (Std. Dev 11.51) post-implementation. Conversely, in the comparison group, the mean value before adopting the conventional monitoring model stood at 56.80 (Std. Dev 6.66), rising to 101.83 (Std. Dev 7.87) afterward. The disparity between the means before and after implementation was 61.43 for the e-monPrakerin model and 45.03 for the conventional model, highlighting notable shifts in both scenarios.

Normality test

The normality test assesses whether research questionnaire data follows a normal distribution, employing Kolmogorov-Smirnov and Shapiro-Wilk theories. Utilizing the Shapiro-Wilk test,

which is more sensitive for sample sizes of 50, normality tests were conducted for both experimental and comparison groups, indicating that both sets of data exhibited normal distribution. The results of the normality test are presented in Table 1.

Table 1. Data normality test results

Group		Shapiro-Wilk		
		Statistic	*df*	*Sig.*
Before	Experimental group	.953	46	.062
	Comparison group	.968	36	.364
After	Experimental group	.978	46	.520
	Comparison group	.975	36	.591

Data homogeneity test

The homogeneity test was used to determine the similarity of the data variants. The results of the homogeneity test, using Levene's Test for Equality of Variances, obtained a significant value of practicality before implementation (0.82) and after implementation (0.10), meaning that it was greater than 0.05, so it can be concluded that the two groups of practicality before implementation were homogeneous. While the practicality after the implementation of monitoring in both experimental and comparison groups was not homogeneous. However, the homogeneity test is not an absolute requirement for the next test, namely the independent sample t-test.

Independent Samples t-Test

The Independent sample t-test compares the means of two unpaired samples, the comparison group, and the experimental group. For practicality before implementation, with equal variances assumed, the test yielded a non-significant Sig value (> 0.05), indicating no significant difference between the groups. However, after implementation, the test showed a significant difference (Sig. < 0.05), indicating a disparity between the groups in practicality.

User satisfaction test

The user satisfaction test used is in the form of an application assessment questionnaire. The assessment at this stage is a process of analyzing the quality of the software that has been developed, to obtain good feasibility for widespread use. At the beginning of the study, subjects in the experimental group were given a USE questionnaire first as a measurement before using the *e-mon*Prakerin model. Furthermore, the research subject uses the product developed by using the e-mon Prakerin model. After being treated, the research subjects were given the same questionnaire. Subjects in the comparison group were given a satisfaction questionnaire first as a measurement before using the conventional monitoring model. Furthermore, the research subjects used the conventional monitoring model, after being given treatment, the research subjects were then given the same questionnaire.

Descriptive statistics

Descriptive statistics serve to ascertain the distribution pattern of research data. In the experimental group, before the e-monPrakerin model implementation, the mean value stood at 64.80 (Std. Dev 5.80), while post-implementation it rose to 176.41 (Std. Dev 6.67). A notable

increase of 111.61 in the mean indicates significant change. Conversely, in the comparison group, mean values were 63.08 (Std. Dev 5.20) and 86.19 (Std. Dev 9.44) before and after conventional monitoring model implementation, respectively, reflecting a more modest increase of 23.11 in the mean.

Normality test

The normality test aims to assess the distribution of research data from the questionnaire, whether the distribution of the data is normally distributed or not. The results of the normality test are presented in Table 2. The results of the normality test of data using SPSS obtained normality test outputs based on the theory of Kolmogorov-Smirnov and Shapiro-Wilk. The test results are used to test the normality of the data using Shapiro-Wilk, this is because the sample used is 50. The sensitivity of data analysis with Shapiro-Wilk is better for data 50. The results of the normality test of data before and after implementation in both the experimental group and the comparison group, indicate the value of Sig. >.

Table 2. Data normality test results

Group		Group		
		Statistic	df	Sig.
Before	Experimental group	.983	46	.748
	Comparison group	.989	36	.976
After	Experimental group	.964	46	.160
	Comparison group	.979	36	.723

Data homogeneity test

The homogeneity test was conducted to assess the similarity of data variances. Using Levene's Test for Equality of Variances, significant values were obtained for practicality before implementation (0.44) and after implementation (0.14). Since the significance threshold is 0.05, it can be concluded that the two groups of satisfaction tests before and after implementation exhibit homogeneity.

Independent samples t-test

The Independent Sample t-test was utilized to compare the difference between two means of two unpaired samples, specifically before and after the implementation of the e-monPrakerin model. Based on Equal variances assumed, the Sig. (2-tailed) value of 0.167 > 0.05 indicates that there is no significant difference between the average satisfaction before implementation in the experimental group and the comparison group. The mean difference value is 1.721, signifying the variance between the average satisfaction before implementation in the experimental group and the comparison group is within the range of -0.7366 to 4.178 (95% Confidence Interval of the Difference Lower Upper).

Regarding user satisfaction after implementation in both the experimental group and the comparison group, as presented in Table 4.31 under the Equal variances assumed section, the Sig value (2-tailed) is recorded as 0.000 <0.05. Consequently, it can be deduced from the independent sample t-test that there exists a significant difference between the average satisfaction after implementation in the experimental group and the comparison group. Additionally, the Mean Difference value noted in Table 4.31 is 90.21, indicating the variance between the average

satisfaction before implementation in the experimental group and the comparison group lies within the range of 86.67 to 93.93 (95% Confidence Interval of the Difference Lower Upper).

4. Discussion

Comparative analysis of practicality between the e-monprakerin model and conventional methods in apprenticeship supervision

The efficacy can be assumed to be better than the previous model (Nieveen, 1999). In this study, the results of the efficacy test of the *e-mon*Prakerin monitoring model were compared with the conventional monitoring model. Measuring the efficacy of the product is seen from the results of the independent sample t-test of the conventional monitoring model with the *e-mon*Prakerin model. Practicality in the use of the model is also presented in Table 3.

The findings of the research demonstrate a significant improvement in the practicality of monitoring apprenticeships with the implementation of the e-monPrakerin model. Specifically, the experimental group exhibited a substantial increase in practicality, with the average value rising from 58.87 to 120.30 post-implementation, representing a notable difference of 61.43. Moreover, statistical analysis confirms the significance of this improvement. Conversely, the comparison group showed a lesser increase in practicality, indicating the efficacy of the e-monPrakerin model in enhancing monitoring efficiency (Deschaine & Jankens, 2017; Liviu & Ana-Andreea, 2013). These results align with indicators such as cost-effectiveness, ease of preparation, speed of supervision, accuracy of participant information, and communication smoothness. Notably, the findings also suggest potential cost-saving benefits for Prakerin supervisors and address logistical challenges, such as distance barriers. These outcomes underscore the importance of the e-monPrakerin model in optimizing apprenticeship monitoring processes, offering practical implications for vocational education. Comparisons with previous research (Atal et al., 2024; Calvo & D'Amato, 2015) could provide further insights into the efficacy and applicability of the e-monPrakerin model within the broader context of vocational training and educational practices.

Table 3. Percentage of practical use of the model

No	Indicators	Experiment		Control	
		Before	After	Before	After
1	Save Funding	44,3 %	76,1 %	39,0 %	72,0 %
2	Ease of Preparation	31,8 %	81,3 %	32,4 %	69,9 %
3	Accuracy	42,0 %	85,7 %	42,6 %	60,2 %
4	Information Quality	40,3 %	80,7 %	40,4 %	59,7 %
5	Communication Speed	47,1 %	82,6 %	46,5 %	66,7 %

The average practicality before using the *e-mon*Prakerin model was 41.1% and after using the *e-mon*Prakerin model was 81.3%. This indicates a significant difference of 40.2%, underscoring the model's effectiveness across various indicators such as cost-effectiveness, ease of preparation, supervision speed, information accuracy, and communication efficiency. In contrast, the comparison group exhibited a lesser increase in practicality, with a difference of only 25.5%. Despite this, the e-monPrakerin model holds promise in minimizing monitoring costs for Prakerin supervisors and addressing logistical challenges associated with remote locations. Furthermore, the model enables proactive error identification and corrective action, aligning with previous research emphasizing the importance of proactive monitoring to mitigate risks

(Rachmawati et al., 2023). These findings not only contribute to the body of literature on apprenticeship supervision but also highlight the practical implications of adopting digital monitoring solutions in vocational education (Christian et al., 2011; Sukardjo & Sugiyanta, 2018). Comparisons with previous research by (Raharjo et al., 2012; Young & Collin, 2004) provide additional insights into the efficacy and potential advantages of the e-monPrakerin model in optimizing apprenticeship monitoring practices.

The contribution of the e-monprakerin model to enhancing the efficiency and effectiveness of apprenticeship programs in vocational education

Based on the data from the satisfaction test results in the use of the model, the average value before the implementation of the *e-mon*Prakerin model was 66.30 and after the implementation of the *e-mon*Prakerin model was 176.41. Satisfaction in the use of the model is also presented in Table 4. This signifies a notable difference of 110.11, underscoring the model's efficacy in enhancing user satisfaction. Moreover, statistical analysis confirms the significance of this improvement, highlighting the model's impact on stakeholders' satisfaction levels (Atal et al., 2024). These results align with the growing body of research emphasizing the importance of technology-driven solutions in enhancing user experiences and satisfaction levels across various domains. Comparisons with previous research (Jeske & Axtell, 2014; Wang et al., 2022) could provide further insights into the effectiveness of similar digital monitoring models and contribute to our understanding of best practices in implementing technology-based solutions in vocational education settings.

Table 4. Percentage of satisfaction using the model

No	Indicators	Experiment		Control	
		Before	After	Before	After
1	Utility	31,4 %	83,5 %	31,4 %	40,7 %
2	Ease of use	31,6 %	83,1 %	30,0 %	40,8 %
3	Ease of learning	31,7 %	86,1 %	31,1 %	39,9 %
4	User rating	31,6 %	84,9 %	27,9 %	42,5 %

This research yields significant new findings compared to previous studies, particularly in the realm of user satisfaction with the e-monPrakerin model. The study reveals a substantial increase in satisfaction levels among participants in the experimental group, with the average satisfaction score escalating from 31.6% to 84.4% post-implementation. This notable difference of 52.8% underscores the effectiveness of the e-monPrakerin model in enhancing user satisfaction, as evidenced by indicators such as usability, ease of use, ease of learning, and user ratings. In contrast, the comparison group exhibited a comparatively smaller increase in satisfaction, with a difference of only 10.1%. This discrepancy highlights the model's pronounced impact on satisfaction levels, particularly in contrast to conventional monitoring methods. These findings contribute to our understanding of the effectiveness of digital monitoring solutions in vocational education and underscore the importance of user-centric design principles in enhancing user satisfaction and acceptance. Such insights offer valuable implications for the development and implementation of similar technology-driven solutions in vocational education contexts, representing a significant advancement in the field compared to previous research efforts (Jang & Gim, 2022).

Based on the results of the practicality test in the Equal variances assumed section, it was obtained t = 8,228 and the value of Sig. (2-tailed) = 0.000 and in the Equal variances not assumed section,

t = 8,604 and Sig. (2-tailed) = 0.000. User satisfaction test results in the Equal variances assumed section obtained t = 50,646 and sign (2-tailed) = 0.000 and the Equal variances not assumed section obtained t = 48,599 and sign (2-tailed) = 0.000; < 0.05, meaning that the use of the *e-mon*Prakerin model is more effective than the use of the conventional model. This research unveils novel findings compared to previous studies, particularly regarding the effectiveness of the e-monPrakerin model compared to conventional monitoring methods (Sutikno et al., 2020a, 2020b). The statistical analysis reveals significant differences in practicality and user satisfaction between the two approaches. In both sections, where equal variances are assumed and not assumed, the t-test results indicate a substantial advantage of the e-monPrakerin model over the conventional model, with p-values < 0.05. This suggests that the e-monPrakerin model is more effective in enhancing practicality and user satisfaction in vocational education settings. These results provide empirical evidence supporting the superiority of digital monitoring solutions over traditional methods, offering valuable insights for educators and policymakers (Young & Collin, 2004). Such findings represent a significant advancement in understanding the efficacy of technology-driven approaches in optimizing apprenticeship monitoring processes, highlighting the potential for broader adoption and implementation in vocational education contexts (Dai & Fan, 2012).

The *e-mon*Prakerin model is more effective because it can increase the practicality of monitoring street vendors and users are more satisfied. With the efficacy test results, the development of the *e-mon*Prakerin model product based on Android technology was successful statistically. However, there are still obstacles for a small number of students who do not have an Android smartphone and internet service in less stable PKL locations. To overcome these obstacles, participants can use smartphones together with other people using their respective usernames and passwords. To overcome unstable internet services, you can take advantage of internet access from the company or use internet services from other providers.

5. Conclusion

The results of the research and discussion related to testing the efficacy of the product on the aspects of practicality and user satisfaction show that the *e-mon*Prakerin model is more effective because it can increase practicality in monitoring street vendors and users are more satisfied. The *e-mon*Prakerin model based on android technology was successful statistically. However, there are still obstacles for a small number of students who do not have an Android smartphone and internet service in less stable PKL locations. To overcome these obstacles, participants can use smartphones together with other people using their respective usernames and passwords. To overcome unstable internet services, you can take advantage of internet access from the company or use internet services from other providers.

This study offers significant implications and contributions to the field. Firstly, it introduces a viable solution, the e-monPrakerin model, for enhancing the efficiency and effectiveness of monitoring street vendors during fieldwork practice. Secondly, by demonstrating the feasibility and benefits of utilizing Android-based technology in vocational education settings, the study highlights the potential of technology-driven approaches to address industry demands in the context of Industry 4.0. Furthermore, the strategies proposed for overcoming obstacles related to smartphone and internet access offer practical insights for educators, policymakers, and stakeholders involved in vocational education programs, contributing to the ongoing efforts to bridge the digital divide and ensure equitable access to educational resources. Overall, this research contributes to advancing vocational education practices and addressing the challenges posed by modern industrial developments.

Limitations and further research

In addressing limitations and suggesting avenues for further research, it's crucial to acknowledge accessibility challenges faced by students without access to Android smartphones or stable internet, suggesting the exploration of alternative methods. Expanding sample size and diversity of participants would enhance generalizability, while adopting a longitudinal design could reveal long-term impacts. Comparative analysis with other monitoring models could enrich understanding, and incorporating qualitative feedback would provide deeper insights. Additionally, ensuring consistency in language usage throughout the research method section is essential for clarity.

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Conflict of interest

The author declare that there are no competing interests.

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