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The Use of Teaching Factory-Based Learning Models to Optimize Social Science Learning Outcomes Among Vocational School Students

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Abstract: *This study explores the use of a teaching factory-based learning model to optimize Natural and social sciences learning outcomes in Vocational High Schools. Teaching Factory emerged as an innovative solution that bridges vocational education and the industrial world by integrating real production experiences into learning. This model not only equips students with technical skills but also prepares them to face the complexities of the world of work. This study uses a mixed methods approach with the Exploratory Sequential Design method, starting with a qualitative exploration to understand learning phenomena, followed by a quantitative method to test qualitative findings.*

Data was collected through participatory observation, in-depth interviews, document analysis, and learning experiments. The results of the study show that the Teaching Factory has excellent potential to increase the relevance of science learning, develop students' practical skills, and motivate students. However, its implementation faces challenges such as limited resources and a lack of institutional support. This research emphasizes the importance of the Teaching Factory as an effective learning model in vocational education, with implications for curriculum development, teacher training, and industry collaboration.

Keywords: Mixed Methods; Science Social; Teaching Factory

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1. INTRODUCTION

Vocational education, primarily vocational high schools, has a strategic role in preparing skilled human resources to compete in the world of work (Jing et al., 2023). One of the main challenges in vocational education is how to ensure that learning not only focuses on mastering theory but also develops practical skills that suit the needs of the industry. In this context, the Teaching Factory-based learning model emerged as an innovative solution that combines the learning process with a real production experience in a school environment (Hatmojo & Ikhsannudin, 2024). Teaching factories as innovative learning models have emerged as an essential bridge between vocational education and the industrial world (Putri Irna Amalia & Murniawaty, 2020). This model not only equips students with technical skills but also prepares them to face the real-world complexities of the workforce. In this context, the integration of Social Natural Sciences has become crucial to creating a holistic and relevant learning experience (García-Carmona, 2020).

Social science plays a central role in the teaching factory, especially in the aspects of product development, quality testing, and technological innovation. In a teaching factory environment, students have the opportunity to apply the principles of social science in a real industrial context (De Prada Pérez De Azpeitia, 2016). For example, in the food processing industry, students can learn and use chemical and biological principles to develop new food products, improve the quality of existing products, or optimize production processes. They can also engage in product quality testing to ensure that they meet the safety and quality standards set (Starrett et al., 2021). However, even though the Teaching Factory has been implemented in many vocational schools, there is still a gap in its use to optimize learning outcomes, especially in the subjects of natural and social sciences (Kailani & Rafidiyah, 2020). Some of the obstacles include limited facilities and infrastructure, a lack of teacher training in integrating social science with teaching factory practices, and a lack of collaboration with related industries (Hernández-Leo et al., 2018). In fact, if applied correctly, this model can increase students' motivation to learn, deepen conceptual understanding, and hone the technical skills needed in the workplace.

In addition, optimal science learning outcomes are not only measured by academic scores but also by students' ability to apply this knowledge to solve real problems (Bamrungsin & Khampirat, 2022). For example, students majoring in Chemical Engineering can learn the concept of chemical reactions through the production of soap or disinfectants in the Teaching Factory (Tri Cahyono et al., 2023). In contrast, agribusiness students can apply biological science to the cultivation of hydroponic plants. Thus, social studies learning becomes more contextual and meaningful while supporting the development of 21st-century competencies such as critical thinking, creativity, and collaboration (Fischer & Hänze, 2019). On the other hand, technological developments and the Industrial Revolution 4.0 require vocational school graduates to master science and technology literacy in more depth (Schwab, 2018). Social science-based teaching factories can introduce students to cutting-edge technologies, such as the Internet of Things, in production monitoring or the use of digital simulations for science experiments (Farida et al., 2020). However, not all vocational schools are able to adapt this model optimally due to budget constraints, human resources, or a lack of clear implementation guidelines.

According to Gerritsen-van Leeuwenkamp et al., 2019, the influence of teaching factory learning on the entrepreneurial interest of vocational school students, with an experiential learning approach, students not only receive information passively but also actively engage in the learning process through V actions and reflection. Furthermore, according to Diwangkoro & Soenarto, 2020 vocational education is directed to prepare learners and adults to be job-ready. The design of vocational education emphasizes the mastery of competencies that are in accordance with the characteristics of the needs of the industrial world (Mavrikios et al., 2018). Cooperation between vocational education and relevant stakeholders to create quality education through the teaching factory is essential. Vocational education has a vital role in the social field and economic development of a nation. The development of vocational education in preparing students who are ready to work and competent in the industrial world should be a concern so that students can live prosperously in the community. The operational management in question is the management of the teaching factory (Saputro et al., 2021).

The application of the teaching factory learning concept can be one of the learning innovations in schools for the development of teacher and student competencies. Teaching factories involve partner industries by utilizing production units as a form of business development in schools (Ferns et al., 2016). Optimizing the implementation of teaching factories in schools is expected to develop student competencies in accordance with the characteristics of the needs of the industrial world. In addition, the school benefits both in terms of teacher competency development and the implementation of a profit-based business development system (Syauqi et al., 2022).

Despite growing evidence that teaching factory models enhance experiential learning and entrepreneurial interest, and their recognized role in aligning vocational education with industry demands

(Mavrikios et al., 2018), existing studies largely focus on technical or vocational competencies, with limited attention to their application in non-technical domains such as social studies. This gap is critical, given the strategic role of vocational education in preparing adaptive, work-ready graduates within complex socio-economic contexts. Moreover, while collaboration with industry and production-based learning environments has been widely advocated, there remains insufficient empirical exploration of how teaching factory models can be pedagogically integrated into social science learning to enhance both cognitive outcomes and real-world relevance. Addressing this gap, the present study offers a novel contribution by examining the implementation of a teaching factory approach in social studies learning within vocational schools, focusing on instructional design, curriculum integration, and learning outcomes. This research not only extends the application of teaching factory beyond its conventional technical scope but also provides a more holistic model for competency-based vocational education aligned with contemporary workforce needs.

Therefore, this study focuses on exploring the use of factory-based learning models to optimize social studies learning outcomes in vocational schools. This study is essential to provide an overview of best practices in integrating social science with the Teaching Factory, including teaching strategies, curriculum design, and evaluation of learning outcomes. The research findings are expected to serve as a reference for educators, policymakers, and industry in developing more relevant and competency-based vocational education.

2. METHOD

This study uses a mixed methods approach with the Exploratory Sequential Design method (Toyon, 2021), which explores learning phenomena and then uses quantitative methods to test or generalize qualitative findings. So that the impact of the Teaching Factory on the learning outcomes of social science can be measured. Data was collected through Participatory Observation, namely by observing learning activities in the Teaching Factory that integrated social science materials. Conducting In-Depth Interviews with teachers, students, and industry representatives to explore the challenges and successes of Implementation, Document Analysis examined the curriculum Learning Implementation Plan, student learning evaluation results, and Learning Experiments, comparing learning outcomes between classes using the Teaching Factory and conventional courses (Luederitz et al., 2017). Respondents were taken from 4 teachers and 80 students of SMK Warga Surakarta class X for the even semester 2024/2025, with a total of 2 classes of study groups. The Research Model can be depicted in image one below. The research sample needs to be clearly explained in this section. It is also necessary to write down techniques for obtaining subjects (qualitative research) and/or sampling techniques (quantitative research).

The procedure should be described according to the type of research. How research is carried out and how data is obtained needs to be described in this section. For experimental research, the kind of design (experimental design) used should be written in this section. Types of data, how data is collected, the instruments where data is collected, and how technical the collection is should be explained clearly in this section. Then, the interpretation of the data obtained in relation to problems and research objectives needs to be explained clearly.

Figure 1 shows the exploratory sequential design model of the mixed-methods approach.

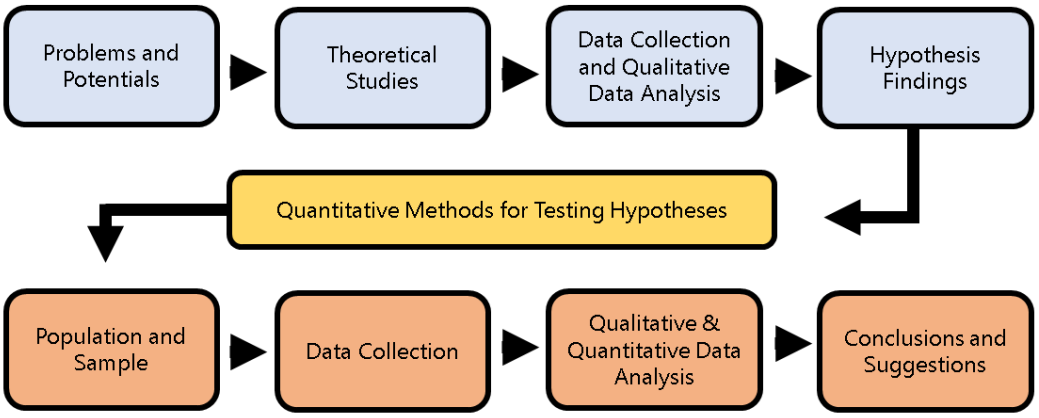


Figure 1. Exploratory Sequential Design Model Combination Method

The research was carried out at SMK Warga Surakarta using a population of 4 teachers and 80 class X students with a total of 2 class study groups. By using two classes, it is hoped that there will be a significant comparison of the ability to implement science subjects using the exploratory sequential design method.

3. RESULT AND DISCUSSION

The purpose of teaching factory learning in social studies subjects is to realize that teaching students should be more than just what is contained in books. Students not only practice soft skills in education, learn to work in teams, and practice interpersonal communication skills, but also gain hands-on experience and work practice to enter the world of work. The teaching factory creates a holistic and relevant learning experience (Priniski et al., 2018). By combining these two fields of science, students can understand the relationship between the technical and social aspects of the industry. They learned that product development and technological innovation must not only meet market needs but must also consider social and environmental impacts. The results of the initial qualitative research show that teachers have a favorable view of the potential of teaching factories in increasing the relevance of science learning to the industrial world. They see the teaching factory as an effective platform for developing students' practical skills, such as problem-solving, teamwork, and communication. However, teachers also identified several challenges in their implementation, including limited resources, difficulties in integrating the curriculum with industry needs, and the need for additional training for teachers. Students' perceptions of the teaching factory are generally positive, with students feeling more motivated and engaged in learning when they can apply social science concepts in practical projects. They also appreciate the opportunity to learn firsthand about production processes and management in an environment that resembles the world of work.

The findings of this qualitative research underscore the importance of the teaching factory as a promising learning model for vocational education, especially in the context of social science. The integration between academic theory and industry practice not only enhances students' understanding of key concepts but also equips them with skills relevant to the needs of the job market. The challenges identified by teachers highlight the need for strong institutional support, including the provision of adequate resources, collaborative curriculum development, and ongoing teacher professional development programs. Students' positive responses emphasize the potential of teaching factories to increase motivation and learning engagement, which can ultimately contribute to better learning

outcomes and higher job readiness. These findings provide a solid basis for future quantitative research, which will measure the impact of teaching factories more systematically and identify the factors influencing their success.

In an Exploratory Sequential Design, qualitative research is carried out first to explore the phenomenon, and the results are used to develop instruments or quantitative research focuses, as seen in Table 1.

Table 1. Teachers' Experience and Students' Perceptions of the Teaching Factory

No	Qualitative Focus Items	Qualitative Data Collection Methods	Qualitative Participants	Number of Qualitative Participants
1	The teacher's experience in implementing *a teaching factory*	In-depth interviews	Science / Social Studies Teacher	4
2	Students' perceptions of teaching *factory learning*	Focus Group Discussion (FGD)	Student	2 Groups (8-10 students/group)
3	Challenges and solutions in the implementation of *teaching factories*	Participant observation	Teachers and Students	During the implementation period
4	The impact *of teaching factories* on students' motivation to learn	Document analysis (journals, portfolios)	Student	Sample of 20 students

Exploration of Experience and Perception in the Implementation of Teaching Factory presents a framework for the early stages of qualitative research. This stage aims to explore in depth the teacher's experience and student perception regarding the application of the teaching factory learning model in the context of Natural and Social Sciences subjects. Data collection was conducted through a variety of qualitative methods, including in-depth interviews with teachers to understand their perspectives, Focus Group Discussions (FGDs) with students to capture group views, participant observation to record direct interactions in the classroom, and analysis of documents such as student journals and portfolios to obtain additional evidence of learning impact. Participants in this stage included four science/social studies teachers and two groups of students (with 8-10 students per group) for the FGDs, as well as a sample of 20 students for document analysis. Thus, this table details the initial exploration strategy to understand the teaching factory phenomenon holistically before proceeding with quantitative data collection.

Some teachers show high applicability in project planning and collaboration with industry, while others focus more on the production aspect. Students' perception of the benefits of teaching factories is overall positive, with high scores on the dimensions of practical skills development and relevance to the world of work. Correlation analysis revealed a significant positive relationship between the level of teaching factory implementation by teachers and students' intrinsic motivation. This means that teachers who are more actively applying this model tend to have students with higher learning motivation. However, no significant relationship was found between the application of the teaching factory and the extrinsic motivation of students. This indicates that the influence of the teaching factory is more substantial in encouraging students' interest and satisfaction in learning than simply increasing external rewards such as grades.

These findings quantitatively confirm and expand on previous qualitative findings, providing empirical evidence on the benefits of teaching factories in increasing students' motivation to learn (Subekti et al., 2019). The positive relationship between the teacher's implementation of the teaching factory and the intrinsic motivation of the students emphasizes the importance of the teacher's role in implementing this model effectively. The variation in the implementation of teaching factories by teachers highlights the need for ongoing training and support to ensure consistent and high-quality implementation. The lack of a significant relationship between the teaching factory and students' extrinsic motivation suggests that this model is more effective in fostering a deep interest in learning than simply pursuing grades. These findings imply that the teaching factory should be promoted as a student-centered learning strategy that emphasizes skill development and real-world relevance, with a focus on increasing students' intrinsic motivation, as seen in Table 2.

Table 2. The Application of Teaching Factory and Its Correlation with Student Learning Outcomes

No	Quantitative Focus Items	Quantitative Instruments	Quantitative Variables	Measurement Scale	Quantitative Participants	Number of Quantitative Participants
1	The level of application of *teaching factory elements* by teachers	Teacher questionnaire	Implementation of Planning, Implementation of Implementation, Application of Evaluation	Likert	Science Teacher	4
2	Students' perceptions of the benefits *of teaching Factory*	Student questionnaire	Skills Development, Relevance of the World of Work	Likert	Student	80
3	The level of student's learning motivation after participating in the *teaching factory*	Correlation Analysis	Application *of Teaching Factory*, Learning Motivation	-	Teachers and Students	4 Teachers, 80 Students

Quantitative analysis of the application of the Teaching Factory and Its Impact on student learning motivation presents a framework for the quantitative stage of research, which aims to systematically measure and analyze the application of the Teaching Factory and its impact on student learning motivation. The main instrument used was a questionnaire, developed based on findings from the previous qualitative stage, to measure variables such as the level of Implementation of the teaching factory element by teachers (e.g., planning, Implementation, and evaluation) and student's perception of the benefits of the teaching factory (e.g., skill development and relevance to the world of work). These variables are measured using the Likert scale to allow statistical analysis. In addition, student questionnaires are also used to measure students' levels of learning motivation (intrinsic and extrinsic motivation). Correlation analysis will be carried out to determine the relationship between the application of teaching factories by teachers and students' learning motivation. Participants in this stage include four science/social studies teachers and 80 students.

Teaching factories have great potential as a transformative learning model in vocational education, especially for science subjects. The initial qualitative findings highlight teachers' positive views of the teaching factory in increasing the relevance of learning and developing students' practical skills (Cahyono, 2022). Students also show enthusiasm for this approach, feeling more motivated and engaged when they can apply academic concepts in a real-world context. However, the study also identified challenges in the implementation of teaching factories, including limited resources and the need for stronger institutional support. Further quantitative analysis confirmed the benefits of teaching factories in increasing students' intrinsic motivation, suggesting that this model is effective in fostering a deep interest in learning (Albrecht & Karabenick, 2018). The positive correlation between the level of teaching factory implementation by teachers and students' intrinsic motivation emphasizes the importance of the teacher's role in practical implementation.

Overall, this study provides strong evidence of the benefits of teaching factories in preparing students for the workforce. This model not only improves students' understanding of social/ science concepts but also equips them with essential skills such as problem-solving, teamwork, and communication. To maximize the potential of the teaching factory, this study recommends the need for comprehensive institutional support, including the provision of adequate resources, collaborative curriculum development, and ongoing teacher professional development programs. Additionally, it is essential to promote the teaching factory as a student-centered approach to learning, with a focus on developing intrinsic motivation and real-world relevance. Future research can explore more effective teaching factory implementation strategies and their long-term impact on students' careers and industry development.

4. CONCLUSION AND SUGGESTIONS

Teaching factory learning in science education effectively demonstrates that learning extends beyond textbooks by integrating theory with real-world practice. This model develops essential skills such as teamwork, communication, problem-solving, and adaptability, while engaging students in activities like prototype development and presenting innovative solutions. By simulating real work environments, teaching factories combine competency-based and production-based approaches, preparing students with industry-relevant skills.

Overall, this study confirms the effectiveness of teaching factories in enhancing both conceptual understanding and workforce readiness. To optimize implementation, institutional support is needed through adequate resources, collaborative curriculum design, and continuous teacher development. Future research should explore more effective implementation strategies and long-term impacts on students’ careers and industry development.

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