Deep Learning Through Teaching Factory

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ABSTRACT

In mid-2025, the Ministry of Primary and Secondary Education of Indonesia launched a deep learning initiative to improve the quality of education nationally. Deep learning is an approach that stimulates students to learn mindfully and attentively (mindful), find meaning and relevance of what is learned to their lives (meaningful), and enjoy the learning process with enthusiasm and passion (joyful). As a new initiative, deep learning is certainly not immediately fully understood by schools, although some teachers have actually implemented it. One of mindful, meaningful, and joyful learning implementations in vocational secondary schools is the teaching factory. Teaching factory provides students with experiential learning based on industry in the school environment. This article aims to provide a conceptual analysis of the deep learning framework in the implementation of the teaching factory learning model in vocational secondary schools. This analysis is expected to help vocational secondary schools understand deep learning and its application in a vocational context. The results of the conceptual analysis on the dimensions of graduate profiles, learning principles, learning experiences, and learning frameworks indicate that teaching factory is an operationalization of the deep learning concept in vocational secondary schools.

Keywords: *deep learning, teaching factory, vocational secondary school.*

1. INTRODUCTION

In mid-2025, the Ministry of Primary and Secondary Education of Indonesia launched an educational transformation through deep learning. This was realized through regulations, curriculum revision, and guidelines. As a new initiative, it will certainly take time for the public to fully understand this, although some teachers have already implemented it.

Deep learning in education initially emerged from a study conducted by Marton and Saljö (1976) regarding two levels of processing: deep-level processing and surface-level processing. Biggs (1987) later defined deep learning strategies as meaningful learning, involving extensive reading and connecting with relevant prior knowledge. Bentz (1992) explained that deep learning stimulates learner maturity, which aligns emotional and intellectual expression. Hattie and Donoghue (2016) define deep learning as seeking meaning, relating and extending ideas, looking for patterns and underlying principles, checking evidence and relating it to conclusions, examining arguments cautiously and critically, and becoming actively interested in course content. In the Indonesian context, deep learning is defined as an approach that honors human dignity by fostering a learning atmosphere and process that are mindful, meaningful, and joyful. It integrates holistic and interconnected processes of intellectual, ethics, aesthetic, and kinesthetics that engage learners in learning. Deep learning framework consists of four components, namely (1) dimensions of graduate profile, (2) learning principles, (3) learning experiences, and (4) learning framework (Suyanto et al., 2025).

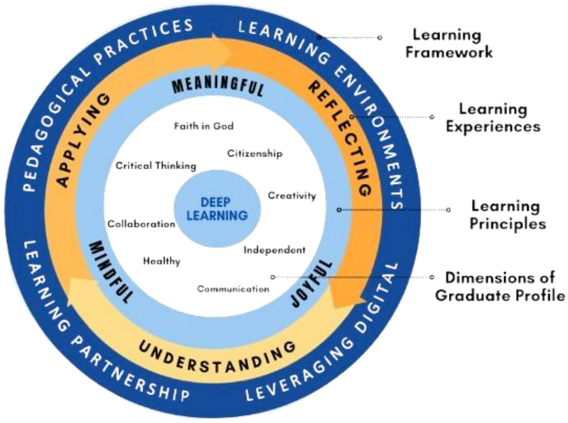

Figure 1. Deep learning framework (Suyanto et al., 2025)

Deep learning encourages students to learn mindfully and attentively, enjoy the learning process with enthusiasm and passion, and discover the meaning and relevance of what they learn to their lives. This allows students to be actively engaged, connect new knowledge with previous experiences, and build understanding that has a long-lasting impact (Ministry of Primary and Secondary Education, 2025). This deep learning approach is applied at all levels of education, including vocational secondary schools.

In 2016, the Indonesian government through Presidential Instruction Number 9, issued instructions to revitalize vocational secondary schools. One of these initiatives is the alignment of vocational secondary school curricula with a link and match approach. Djojonegoro (1998) stated that "link" refers to the connection between vocational learning and the working world and "match" refers to graduates who meet workplace standards. Therefore, "link and match" can be interpreted as an effort to align the learning process and graduates to meet the needs of the working world. One link and match strategy is to develop a teaching factory.

The teaching factory concept has evolved over time. According to Chryssolouris et al. (2006, 2016), the teaching factory paradigm aims to align teaching and training with industry needs through the effective integration of education, research, and innovation, as well as the involvement of industry and academia. According to Sutopo et al. (2017), a teaching factory is an activity in vocational education that produces goods or services managed by teachers and students. From a learning perspective, Sudiyanto et al. (2011) defines a teaching factory as a learning activity in which students directly carry out production activities, either in the form of goods or services, within a school environment. Kuswantoro (2014) and Khurniawan et al. (2016, 2021) state that a teaching factory is a learning concept in real conditions to bridge the competency gap between the knowledge provided by schools and the needs of industry. The Indonesia Directorate of Vocational Secondary Schools or Direktorat SMK (2023) defines a teaching factory as a learning model that integrates the achievement of school curriculum competencies and production processes in accordance with workplace procedures and standards, to produce competent and character-based graduates through the completion of products as learning media in the form of goods and/or services. Although using the term factory, the physical form does not have to be a manufacturing production line because a teaching factory can produce goods or services. It can be a farm, a barn, a greenhouse, a workshop, a studio, a hotel, a restaurant, a kitchen, a service office, or a retail sales unit. The concept of a teaching factory is in line with the Prosser & Quigley (1950) theorem, where vocational education will be effective in proportion as it trains the individual directly and specifically in the thinking habits and the manipulative habits required in the occupation itself.

Since a teaching factory is a learning model, it has stages or a learning syntax (Sani, 2013). The sequence of activities in a teaching factory, according to various sources, can be outlined as follows:

1. Problem analyzing, where students analyze the needs of potential product users (the community or partners in the workplace). For teaching factories with established markets, students at this stage must learn about the product market.
2. Product designing, where students, along with teachers or industry partners, design and develop a prototype of the product, including packaging, if necessary. For teaching factories with established products, students at this stage must study the product.
3. Organizing the production process, where students, along with teachers or partners in the workplace, organize resources, organize workflows, and schedule schedules. For teaching factories with established business processes, students at this stage must learn work procedures.
4. Implementing the production process, where students work according to the organization, both individually and collaboratively, conducting quality control, and making follow-up improvements (if necessary) to the resulting product.
5. Marketing the product, where students market or participate in marketing teaching factory products to the public or partners in the workplace.
6. Evaluating the production process, product, and documents, where students, along with teachers or partners in the workplace, conduct evaluations as part of quality assurance and continuous improvement efforts (Direktorat SMK, 2023; Damarjati, 2025).

Based on this syntax, the teaching factory that encourages student engagement is quite relevant to deep learning. This study aims to analyze the implementation of deep learning through the teaching factory in vocational secondary schools.

2. METHODOLOGY

This research employed a deep conceptual analysis method based on existing literature resources. The data used in the conceptual analysis came from a literature search using a berrypicking technique in several journals, books, and academic manuscripts on the topic discussed through web browsers and examining citations of several concepts within the literature. The search query evolved based on the depth of information needed and the results of previous searches (Bates, 1989). The researchers searched literature including books, journals, regulations, and official presentations published without a specific timeframe because some old concepts and theories related to deep learning, teaching factory, and vocational education are still relevant today. However, publications published in the last 10 years are prioritized.

The collected literature was then analyzed using conceptual analysis techniques, which treats concepts as classes of objects, events, properties, or relationships. The technique involves precisely defining the meaning of a given concept by identifying and specifying the conditions under which any entity or phenomenon could be classified under the concept in question. (Furner, 2004) This technique was used to analyze the relationship between the concepts of deep learning and the teaching factory, obtained from various literature sources.

3. RESULT AND DISCUSSION

Teaching factory builds dimensions of graduate profile

Billett (2011) states that vocational education has objectives that focus on: (1) preparation for entering work including selecting the type of work, (2) initial preparation of individuals for working life, including developing the capacity to practice skills in the chosen job, (3) development of ongoing competencies, and (4) education and experience that supports the transition of work positions from one position to another. The World Economic Forum (2025) outlines several skills that are most needed by the world of work in 2025 which are grouped into cognitive skills, engagement skills, ethics, management skills, physical abilities, self-efficacy, technology skills, and working with others.

One of the benefits of the teaching factory is to improve the soft skills and hard skills of vocational school graduates according to the demands of the working world (Direktorat SMK, 2023). These skills are obtained by students from managing work activities, teamwork, and interacting with customers. This occurs because the teaching factory learning process is designed and implemented based on actual work procedures and standards to produce goods or services that are in accordance with market or customer demands. The skills that students will gain through teaching factory learning include (1) entrepreneurial character, in the form of the ability to overcome obstacles/barriers that usually make people stop; (2) competitive skills, in the form of innovation, efficiency, and creativity; (3) problem-solving skills, and decision-making; (4) basic entrepreneurial skills, in the form of the ability to design business plans, production plans, financial plans, and relationships with customers; (5) the ability to communicate with customers; (6) customer-oriented production skills; and (7) natural interaction with the industry. The teaching factory also builds honesty, discipline, the ability to work in teams, independence, and student self-confidence (Khurniawan et al., 2016). The skills obtained through the teaching factory are closely related to the deep learning graduate profile dimensions.

Deep learning is focused on achieving eight dimensions of graduate profiles which are complete competencies that must be possessed by every student after completing the learning process (Suyanto et al., 2025; BSKAP, 2025). The dimensions are derived from the Indonesian national education goal as stated in Law Number 20 of 2003 that is the development of students' potential to become human beings who believe in and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. In addition, the graduate profile dimensions are also inspired by 6 global competencies, namely: character, citizenship, collaboration, communication, creativity, and critical thinking. These competencies include compassion, empathy, socio-emotional learning, entrepreneurship, and related skills to function in a complex world (Fullan et al., 2018; Quinn et al., 2020). The following is a comparison of the dimensions of deep learning graduate profile and teaching factory.

Table 1. Comparison of the dimensions of graduates profile of deep learning and teaching factory

Dimensions and sub-dimensions of graduates profile (Suyanto et al., 2025; BSKAP, 2025)	**Teaching factory (Khurniawan et al., 2016; Subdit Kurikulum, 2020)**
Faith and devotion to God Almighty, with sub-dimensions of relationships with God Almighty, relationships with fellow human beings, and relationships with the environment	Honest, disciplined, and efficient in utilizing resources
Citizenship, with sub-dimensions of local, national, and global citizenship	Behave according to the rules and norms at work
Critical thinking, with sub-dimensions of delivering arguments, decision-making, and problem solving	Problem solving and decision making
Creativity, with sub-dimensions of developing new ideas, flexibility of thinking, and developing work	Innovation and creativity in developing products
Collaboration, with sub-dimensions of caring, sharing, and cooperation	Working in a team
Independence, with sub-dimensions of responsibility, leadership, and self-development	Independence

Dimensions and sub-dimensions of graduates profile (Suyanto et al., 2025; BSKAP, 2025)	Teaching factory (Khurniawan et al., 2016; Subdit Kurikulum, 2020)
Health, with sub-dimensions of clean and healthy living, fitness, physical health, and mental health, and environmental health	Creating a safe, clean and healthy work environment
Communication, with subdimensions of listening, speaking, reading, and writing	Ability to communicate with customers and interact with industry

Teaching factory applies the deep learning principles

Learning principles are a crucial foundation for ensuring effective learning. Three key principles of deep learning are mindful, meaningful, and joyful. These three principles complement each other in building deep learning for students (Suyanto et al., 2025). The relationship between these three principles and the teaching factory can be analyzed as follows.

1) Mindful

Mindfulness is a flexible state of mind in which we are actively engaged in the present, noticing new things and sensitive to context. Mindfulness results in an increase in competence; an increase in memory, creativity, and positive affect; a decrease in stress; and an increase in health and longevity. Mindful learning engages people in what they are learning, and the experience tends to be positive (Langer, 2000). In deep learning, students engage in issues and tasks of value to students and the world (Fullan et al., 2018). Mindful learning involves students' total involvement in the learning process, increasing awareness of their thoughts, feelings, and surroundings (Suyanto et al., 2025).

In a teaching factory, students must thoroughly understand the customer, product, and work procedures before engaging in the production stage. Students then produce and/or market the product under the supervision of teachers or industry partners. These production activities are carried out continuously so that students receive maximum benefits (Widjajanti et al., 2017). The full involvement of students in this learning process illustrates that the teaching factory applies the mindful principle.

2) Meaningful

Biggs (1987) defined meaningful learning as reading widely and interrelating with previous relevant knowledge. Deep learning transforms learning by focusing on material that has personal and collective meaning (Fullan et al., 2018). Ausubel (1962) stated that meaningful learning occurs when something students learn is linked to previously learned concepts. Deep learning adheres to the principle of meaningful learning because it prioritizes comprehensive understanding of the material, not just memorization (Suyanto et al., 2025). Acquiring knowledge through deep learning is a good way to understand meaning. This increases learning efficiency and long-term retention (Kovač et al., 2025).

In a teaching factory, students plan, implement, and evaluate production based on what they've learned in the classroom or in the workshop. This is a meaningful characteristic of a teaching factory. Furthermore, dynamic interactions with customers and the team also provide students with new knowledge that builds on what they've learned previously.

3) Joyful

Deep learning occurs when teachers create a learning environment that challenges, provokes, stimulates, and celebrates learning (Fullan et al., 2018). Deep learning is beneficial for learners, increases motivation, and is “fun” (Kovač et al., 2025). Students can find joy in learning by having a deeper understanding of the topic (Tang, 2024). Joyful deep learning focuses on positive emotions related to the learning process, including curiosity, enthusiasm, and motivation. Deep learning accelerates a sense of well-being because it challenges students to explore complex ideas (Suyanto et al., 2025).

In a teaching factory, students are faced with the responsibility of completing production to ensure customer satisfaction. This sense of responsibility motivates them to perform well in completing tasks (Hou et al., 2022). Furthermore, the challenge of achieving customer satisfaction and completing tasks with high quality motivates students to learn new things or revisit previously learned material. This must be supported by a safe, comfortable, and conducive work environment. A better or more conducive work environment will increase work motivation (Prakoso et al., 2014).

Teaching factory provides deep learning experience

Learning experiences are created by the processes individuals undergo in acquiring knowledge, skills, attitudes, or values. These experiences occur in various settings, such as at school, work, home, or in everyday life, and involve interactions with subject matter, teachers, peers, or the environment. Deep learning provides students with learning experiences through the process of understanding, applying, and reflecting (Suyanto et al., 2025).

One taxonomy that is suitable for deep learning is the SOLO (Structured of Observed Learning Outcome) taxonomy (Fullan et al., 2018). The SOLO taxonomy classifies learning outcomes in terms of their structural quality, which makes it useful for defining levels of understanding (Biggs and Tang, 2011). Hook (2018) in a Q&A session with Roberts stated that the SOLO taxonomy makes surface learning and deep learning more visible. The SOLO taxonomy consists of 5 levels. The first level, prestructural, represents irrelevant or failed responses. The next two levels, unistructural and multistructural, relate to shallow learning. The last two levels relate to deep learning (Smith & Colby, 2007). Biggs and Tang (2011) stated that the unistructural and multistructural levels relate to increasing knowledge, while the relational and extended abstract levels relate to deepening understanding. The analysis of learning experiences using the SOLO taxonomy and teaching factory can be described as follows.

1) Understanding

Understanding in deep learning experiences is a phase that aims to build students' awareness of learning objectives, encouraging students to actively construct knowledge so that students can deeply understand concepts or materials from various sources and context (Suyanto et al., 2025). Learning outcomes in the understanding learning experience are relevant to the unistructural level that increases to the multistructural level in the SOLO taxonomy because they are related to knowledge construction. (Biggs and Tang, 2011)

In the teaching factory, the stages of analyzing problems and designing products encourage students to understand the market/consumer (market knowledge) and the product (product knowledge). Therefore, both learning stages are relevant to the learning experience of understanding in deep learning.

2) Applying

Applying is a learning experience that demonstrates students' activities in applying knowledge contextually. This stage provides opportunities for students to apply knowledge both individually and collaboratively (Suyanto et al., 2025). Learning outcomes in the application learning experience are relevant to the relational level in the SOLO taxonomy because they relate to students' efforts to structure and integrate various knowledge that has been learned but is still within the scope of what was taught in the previous phase (Biggs and Tang, 2011).

In a teaching factory, the stages of organizing and implementing the production process are efforts to apply the knowledge of markets and products in the form of production activities for goods or services. This makes the stages of organizing and implementing the production process relevant to the learning experience applied in deep learning.

3) Reflecting

Reflecting is a process where students interpret the process and results of the actual actions or practices they have undertaken. The reflecting stage involves self-regulation as an individual's ability to manage their learning process independently, including planning, implementing, monitoring, and evaluating their learning methods (Suyanto et al., 2025). In the reflective learning experience, students are not only asked to repeat or recall the material they have learned, but are also directed to critically reconstruct their understanding, connect it to a broader context, and identify implications or possible applications in different situations (Puskurjar, 2025). Learning outcomes in the reflective learning experience are relevant to the extended abstract level in the SOLO taxonomy because they relate to students' efforts to go beyond what has been applied in the previous phase to a new context or dimension (Biggs and Tang, 2011).

In the teaching factory, the product marketing stage is a learning step where students who have been able to carry out the production process and understand the product and its market/consumers can market their products through various media and deal with various consumer characteristics, both directly and indirectly. Through marketing, students will communicate the product and obtain consumer feedback for the evaluation stage. In the evaluation stage, students conduct a comprehensive reflection on the analysis, design, process, product, and marketing to improve quality in the next production cycle. Based on this explanation, it can be concluded that the marketing and evaluation stages are relevant to the learning experience of reflecting on deep learning.

Teaching factory applies deep learning’s learning framework

In the deep learning framework developed by Fullan et al. (2018), there are four elements of learning design. These four elements encourage better learning design by providing direction and precision in the integration of pedagogical practices, learning partnerships, learning environments, and leveraging digital. In contrast to Fullan's concept, deep learning in Indonesia uses the term learning framework as a systematic guide to creating an educational ecosystem that supports learning. The main focus of this framework is to encourage meaningful, reflective, and contextual learning through planned practices, environments, and partnerships (Suyanto et al., 2025). This learning framework is inspired by four elements of learning design: pedagogical practices, learning environments, learning partnerships, and digital utilization.

1) Pedagogical practices

Pedagogical practices refer to the teaching strategies teachers choose to achieve learning objectives and achieve the dimensions of graduate profile. To achieve deep learning, teachers focus on authentic student learning experiences, prioritize real-world practice, and encourage higher-order thinking skills and collaboration (Suyanto et al., 2025). Deep learning can be achieved by combining currently recognized effective pedagogical practices such as inquiry learning, problem-based learning, cooperative learning, formative assessment, and summative assessment with emerging innovative pedagogical practices such as online learning, blended learning, gamification, game-based learning, e-portfolios, and feedback analysis (Fullan et al., 2018).

Teaching factories, as an extension of production-based learning (Khurniawan et al., 2016), provide authentic, hands-on learning experiences where students apply competencies learned in class or previously practiced in laboratories, workshops, studios, practice fields, or other simulated settings to real-world situations using standard operating procedures. This strategy represents the application of deep learning pedagogical practices.

2) Learning environments

Fullan et al. (2018) stated that researchers and practitioners from various educational disciplines believe that the learning environment is the "third teacher" that can improve the quality of learning that optimizes student potential. The learning environment emphasizes the integration between physical space, virtual space, and learning culture to support deep learning (Suyanto et al., 2025). By integrating these three aspects, the learning process not only supports knowledge development but also shapes students into adaptive and independent learners. For example, the use of virtual laboratories can also train students to conduct virtual lab work before actual lab work (Bunyamin, 2021). This strategy stimulates student capability to learn independently.

Teaching factory learning activities and interaction not only take place in physical spaces but also in virtual spaces. There is interaction in the form of coordination, collaboration, sharing of knowledge, experiences, skills, expertise, feedback, and support, which are characteristics of an organization's learning culture. (Halmaghi and Todăriță, 2023). Therefore, it can be concluded that the teaching factory implements learning environments that support deep learning.

3) Learning partnership

Learning partnerships foster dynamic relationships between teachers, students, parents, communities, and professional partners. This approach shifts control of learning from the teacher to collaborative learning (Suyanto et al., 2025). In deep learning, students can act as co-designers and co-learners. The key to student engagement in deep learning is metacognitive skills, meaningful relationships, a caring environment, and openness to student aspirations (Fullan et al., 2018). In vocational secondary schools, teachers can partner with professionals from the professional world to contextualize learning as guest teachers. Guest teachers collaborate with classroom teachers to improve their own competencies and those of students (Maharani et al., 2024).

The teaching factory is created through, at a minimum, collaboration between teachers and students. Teachers act as supervisors, and students act as the backbone of product production and marketing. In an ideal teaching factory, industry partners are involved, consistently aligning learning activities with production processes in the workplace. Some industry partners are even willing to donate production facilities or build production lines at educational institutions. In the teaching factory, partnerships between teachers, students, and industry practitioners are naturally occurring and integral to the learning process.

4) Leveraging digital

The use of digital technology also plays a crucial role as a catalyst for creating more interactive, collaborative, and contextual learning (Suyanto et al., 2025). The leveraging digital dimension relates to the interaction between teachers, students, and all parties involved in learning using digital technology to improve the quality of learning (Fullan et al., 2018). Digital technology can be utilized in planning, implementation, and assessment.

The teaching factory can be optimized through the use of digital technology. Product analysis and design can be carried out collaboratively through cloud computing or using AI as a tool. Product designs can be communicated through social media or messaging apps. For software products, product development can also be carried out collaboratively through computer networks or the internet. Product marketing can also now be done through digital marketplaces or social media.

4. CONCLUSION

The Ministry of Primary and Secondary Education of Indonesia is transforming education through deep learning. This educational transformation also impacts vocational secondary schools. One learning model in vocational secondary schools is the teaching factory. The teaching factory provides a holistic, industry-based learning experience within the school environment.

This study conceptually analyzes deep learning and the teaching factory. The analysis of deep learning graduate profile dimensions, learning principles, learning experiences, and learning framework shows that teaching factory is an operationalization of the deep learning concept in vocational secondary schools.

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