



## Innovation of Vocational Technology Education

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### Vocational Education: The New Development and Change in the Adaptive Curriculum of Learning Model

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#### ABSTRACT

The challenges with vocational education are that graduates are not prepared to work because they do not have the competencies required by the business industry. The graduates from vocational high school have a high unemployment rate because the curriculum is not in line with the needs of the business industry and also graduates standards are quite low. The research aimed to find a solution to these problems. One of the solutions that could be explored was by implementing an integrated learning curriculum model in vocational education. Adaptive curriculum policy is a curriculum that is modified and adapted when necessary, and each educational unit is allowed to innovate. The research method used was a systematic literature review on journals from the last ten years relating to adaptive curriculum and vocational education. The result showed that learning with an integrated curriculum model explored the greatest potential of teachers and students to innovate and improve the quality of learning independently. This promotes the development of working opportunities in the business and industrial sectors, creating high-quality of vocational school graduates with a high degree of skills and characters to become professional workers that are ready to compete in the global era and also creating confident graduates who have the entrepreneurial capacity.

#### 1. Introduction

Changes during the Fourth Industrial Revolution (Industry 4.0) era happen rapidly and massively (Chou et al., 2018; Qin, Liu, & Grosvenor, 2016). The transition in the Industry 4.0 has become more complicated with unforeseen conditions that have taken place in more than 200 countries around the world due to the Corona Virus Disease (COVID-19) pandemic (WHO, 2020). These conditions would have a significant impact on various established or existing industries such as the economy, health, and education. In Indonesia, the education sector has had a major impact on the learning process during the COVID-19 outbreak. Previous research has shown that 53.8% of people in 194 cities in China have experienced a psychological impact on the COVID-19

phenomenon. In the education sector, females and students have encountered the most psychological impact (Chan et al., 2019). The Industry 4.0 requires better preparation on education for the development of high-quality human resources. Therefore, vocational high school plays a vital role in producing graduates that are part of the Industry 4.0.

In the midst of the Industry 4.0 phenomena, Indonesia needs to prepare for the various changes that will occur in different sectors including education. Previous research has shown that unemployment is increasingly rampant and vocational education graduates are part of the disruption since attempts to advance technology, industrialization, and economic growth are found to be sluggish (Olajide, 2015). In line with research conducted in Ghana in 2016 and several other countries, Indonesia shows that the open unemployment rate for vocational education graduates is still the highest with a percentage of 8.49% as in Figure 1 below.

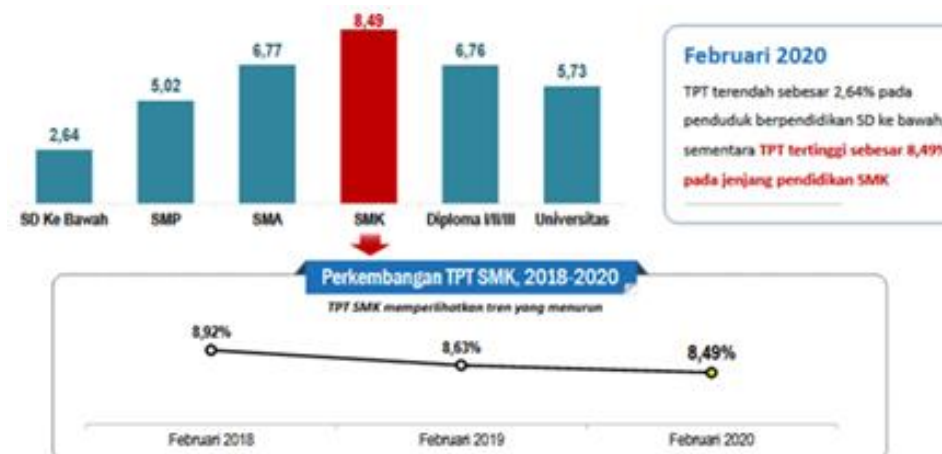


Figure 1. The open unemployment rate based on education level (Source: BPS, 2020)

The data in Figure 1 shows the results that are incompatible with the purpose of vocational education. Furthermore, many aspects make vocational school graduates contribute to the highest open unemployment data in Indonesia within the last 3 years. Therefore, the assessment that needs to be carried out is to look at the needs of the industry, given that these vocational school graduates are prepared to be able to work in the industry. Thus, it is important to determine the degree to which the performance of each expert program meets the needs of the industry.

Vocational education in Indonesia continues to increase in number from year to year. At the same time, a range of skills programs are established in line with the growing number of vocational schools. There are nine areas of expertise, 49 expertise programs, and 146 competencies listed on the regulation of Vocational School Expertise Spectrum (Subdit Kurikulum, 2018). Therefore, graduates of vocational school must be able to cope with the rapid changes. One of which is in the process of planning for shift changes in the interactions such as changes in human-computer interactions (Sanders, Elangeswaran, & Wulfsberg, 2016).

In line with the changes that have occurred in the era of Industry 4.0, there is a need for a more creative learning framework in schools, such as an adaptation of the learning curriculum that can

improve student skills. Learning that addresses existing needs are learning through an adaptive curriculum model. Adaptive learning is ordinary learning that is adapted and designed in such a way that it can be studied, implemented, and meet educational needs (Jonsdottir, Jakobsdottir, & Stefansson, 2015; Shelle et al., 2018). Adaptive learning is thus essentially a modification of practices, strategies, resources, or the learning environment that seeks to provide opportunities for students to pursue acceptable learning programs (Darling-Hammond et al., 2020) in an efficient and fulfilling manner. The core concept of activity adjustment is to change the learning tasks according to the ability of students in implementing the activities. Ideally, vocational school graduates are well accepted in the industry. In 2018, there were five programs with the most unemployed graduates, as shown in Figure 2 below.

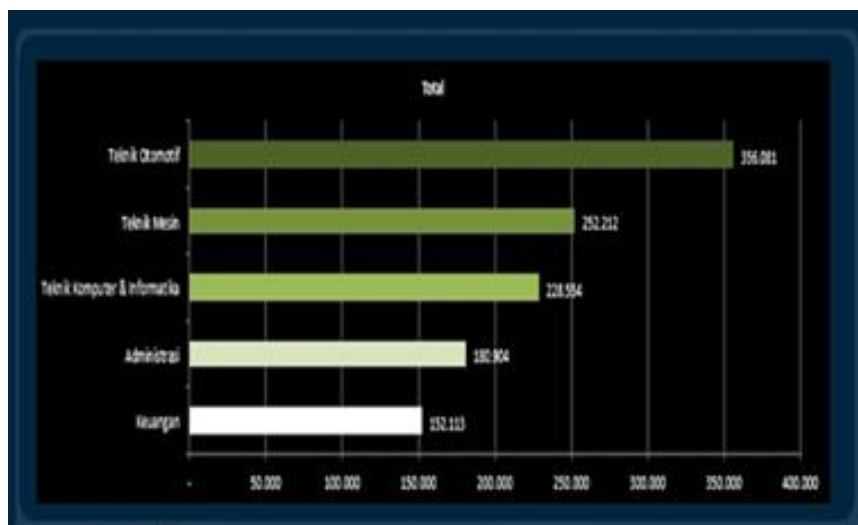


Figure 2. The largest unemployed vocational expertise program in 2018 (Source: BPS, 2018)

Based on the data shown in Figure 2, the largest unemployed vocational skills program was the automotive engineering expertise program of 356,081, while the second-largest was the mechanical engineering expertise program of 252,212, followed by the information and network engineering expertise program of 228,554, the administrative expertise program of 180,904, and the financial expertise program of 152,113 respectively. The problems that arise at the vocational high school emerge because of several factors including the curriculum which is not in line with the needs of graduate users (link and match). Therefore, it has not been able to meet the demands of workforce, industry, and business field. The number of vocational school graduates is not incorporated with the industrial field due to their low competencies. Needless to say, the high number of unemployed graduates emerges due to their low abilities, the mismatch of vocational school skills with the needs of industry, and their hesitation to work.

Furthermore, the growth of the vocational school spectrum in Indonesia needs to be highlighted because of the need for its relevance towards industrial needs in the era of Industry 4.0 and the current curriculum. The authors were interested in creating a theme-based vocational school framework and the Industry 4.0 in its implementation of an individual learning model curriculum

because vocational schools and industries are very closely related. The vocational school aims to create graduates who are able to work and who are integrated with the market demands.

The Adaptive Curriculum Model gives each educational unit the autonomy to make innovation happens (Kemendikbud, 2020).

The philosophy of learning using the Adaptive Curriculum Model adapts to the circumstances under which the teaching and learning process operates, both in terms of culture, local knowledge, socio-economic and infrastructure. Moreover, it is a curriculum that can encourage teachers to choose high-quality resources or learning methods, but based on the level of abilities, interests, and potential of each student (Kemendikbud, 2020).

## **2. Literature Review**

### **2.1 Vocational secondary education and industry 4.0**

Vocational education is part of an education system that prepares a person to work better in a working or professional community than in other areas of work. According to the explanation of Law Number 20 of 2003 Article 15, vocational education is secondary education that prepares students to specifically work in certain fields. In the era of Industry 4.0, the vocational secondary education learning model needs to be adapted to the needs of different facilities and learning models, focusing on the demand of the industry (Chou et al., 2018). The demands of the Industry 4.0 are closely connected to the Internet of Things (IoT) which continues to grow and is widely used in various learning activities (Jones & Pimdee, 2017; Prinz et al., 2016; Xu, Xu, & Li, 2018).

Thus, learning must be able to shape the abilities of students in accordance with industrial demands that are growing massively and rapidly (Liu & Ning, 2017; Serdyukov, 2017; Xu, 2014). Changes in the time of the Industry 4.0 take place not only in the use of technology in various fields of employment but also in the adjustment of the industrial conditions for the competence of vocational education graduates (Azmi et al., 2018; Bauer et al., 2015).

The synergy between vocational education and industry would create qualified graduates and in line with industry demand, so the production would increase by up to 30% and productivity by more than 25% (Rüßmann et al., 2015). This rapid shift in the industrial world really demands a swift response from vocational education, which can bridge the ongoing challenges of the phenomena of the Industry 4.0 era (Stock & Seliger, 2016). In view of these conditions, there are great opportunities for vocational education to develop an IoT and Cyber-Physical System (CPS) oriented learning system with the numerous challenges and opportunities to meet industrial demand and rapid technological advances (Oztemel & Gursev, 2020; Sanders, Elangeswaran, & Wulfsberg, 2016).

## 2.2 Development of vocational education curriculum

Vocational education around the world has different curriculum characteristics (Berger et al., 2012; Pule', 2019). The development and changes of the vocational education curriculum needs to focus on the demands and need of the industry, so it allows the graduates to meet the industrial needs. Previous research has shown that poor academic performance of vocational education students is due to a lack of government services, funding, and support (Okolie, Igwe, & Elom, 2019). In addition, other studies point out that vocational education needs to pay close attention to the curriculum and establish the curriculum input by upholding and enhancing the quality and relevance of vocational education programs (Albashiry, Voogt, & Pieters, 2015).

The International Instructional Systems Study (IISS) analysis conducted by the UCL Institute of Education and sponsored by the United States Center for International Education Benchmarking (CIEB) demonstrates that what needs to be resolved in vocational education involves particular aspects of the system including the goals of the education system; the centralized or decentralized of the teaching system management; the accountability principles and methods; the compulsory and optional subjects included in the curriculum; the degree to which the curriculum is regulated by disciplines or incorporated through disciplines; the generalization or differentiation in curriculum; the 21<sup>st</sup>-century skills that are incorporated into the curriculum; the consistency and quality of the curriculum for secondary vocational pathways; and the assessments made to ensure the progress of each student can be seen (Creese, Gonzalez, & Isaacs, 2016).

In addition, the vocational education curriculum reflects the idea of contemporary curriculum integration (Owoh, 2016). Various factors need to be considered, particularly the bridging of vocational education students into the industrial world, the role of vocational education institutions in providing facilities and as facilitators for students to provide accredited skills in accordance with their respective areas of expertise (Sheldon, Fesenmaier, & Tribe, 2011). Moreover, the skills and characteristics of students are one of the priorities to be included in the concept of a vocational education curriculum (Winch, 2015).

Vocational education has succeeded in preparing learners who are willing to absorb a range of subjects according to industry requirements and needs. However, there are some aspects that need to consider including knowledge, education, and additional training for vocational education. In addition, the ability that must be prepared to meet the demands of the 21<sup>st</sup> century and the Industry 4.0 which has brought a variety of rapid shifts and transitions. (Ahmad, 2015; Alcácer, & Cruz-Machado, 2019; Reeve, 2016).

## 3. Methods

This research was based on a Systematic Literature Review (SLR). The stages as seen in Figure 3, started from the search for indexed scientific books, journals, or articles in the last 10 years (from 2010-2020). Researchers used unpublished scientific papers such as dissertation, guidelines,

regulations, and policies from educational institutions and government agencies. Also, articles from ERIC, SAGE PUB, ELSEVIER, and national journals. Researchers used several keywords to extract references that relevant to the research. Then, the articles were sorted based on its relevancy to the research and analyzed.

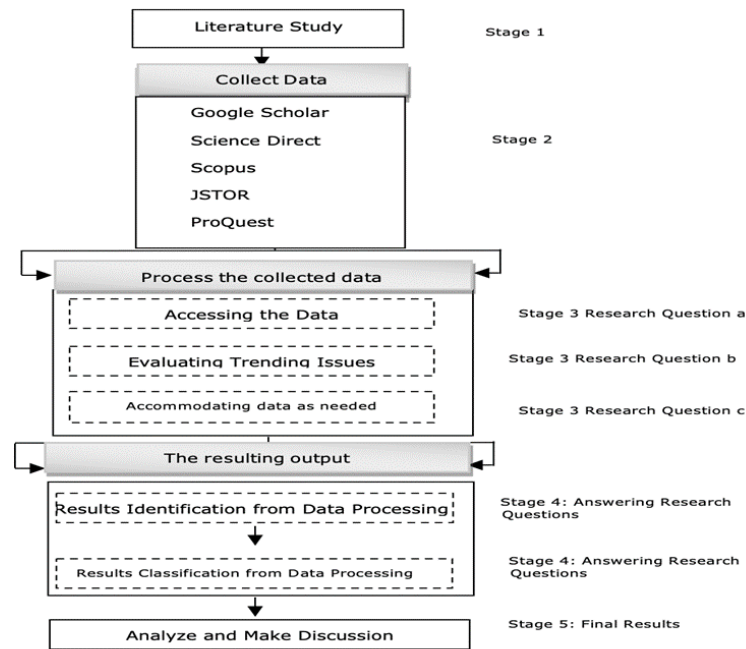


Figure 3. Systematic Literature Review (SLR) research process

After all stages carried out, the findings were displayed in a table to make the analysis process for discussion simpler, as shown in Table 1 below:

Table 1. Systematic literature review scientific article

| No | Keyword   | Description  | Number of searches | Relevant articles |
|----|---|--|--------------------|-------------------|
| 1  | <i>Curriculum TVET</i>                          | A curriculum that applies and is applied to vocational education   | 10                 | 8                 |
| 2  | <i>TVET and Industry</i>                        | The suitability of vocational and industrial education   | 6                  | 4                 |
| 3  | <i>Industrial Revolution 4.0</i>                | Impact of Industry Revolution 4.0 on vocational education  | 5                  | 5                 |
| 4  | <i>Character Skills Worker</i>                  | Job skills that must be acquired by vocational school graduates as a provision for resolving global and Industry Revolution 4.0 challenges | 8                  | 8                 |
| 5  | <i>21<sup>st</sup> Century Character Skills</i> | 21st-century skills required to help the enhancement of the quality of vocational education  | 5                  | 5                 |
| 6  | <i>TVET Outcome</i>                             | Vocational education management that output and outcome are in line with the job competencies demanded by the workforce.                   | 10                 | 10                |
| 7  | <i>Industrial Demand</i>                        | Alignment between supply and demand for vocational education and industry.   | 10                 | 10                |
| 8  | <i>Adaptive Curriculum</i>                      | Adaptive curriculum implementation in the student learning process   | 2                  | 2                 |

#### 4. Results and Discussion

As aforementioned, the goal of vocational education is to prepare qualified graduates to work and able to meet business demands. Several countries such as America, Germany, Nigeria, Jordan, and Malaysia have shown significant results in the competence of their vocational education graduates (Hamisu et al., 2017; Husain et al., 2010). In addition, America and China as the world's largest industrial countries have succeeded in adjusting the graduates to industrial challenges through industrial education (Burmeister, Luettgens, & Piller, 2015; Mukhtar, & Ahmad, 2015). Graduates of vocational education are required to be able to communicate, adapt, and collaborate well in the workplace (Dwiyanti, Ana, & Widianingsih, 2018). Therefore, industrial education impact on vocational students social skills. Furthermore, the learning model applied in vocational education needs to pay close attention to the conditions of change and development that are exist in the industry (Seta, 2018). Industrial needs have become a focus for the definition of the learning model needed by vocational education. Therefore, in the education sector, school evaluation is part of the learning process, which represents the understanding, development and progress of individual learners (Litzinger et al., 2011).

Industry 4.0 has been a challenge for vocational education. Industry 4.0 has distinctive characteristics (Ana et al., 2018) beginning with the implementation of technology-based information and communication in the production and industry sectors, the advancement of artificial intelligence, robotics, nanotechnology, 3D printing, and biotechnology. The impact of Industry 4.0 involves technological, demographic, and socio-economic changes that continue to shift to business and industrial models with the various challenges to the needs of workers with various abilities or multi-skills. In the midst of the Industry 4.0, there have been several changes called disruptive phenomena which includes changes in the economy, development, employment, and non-linear work. This phenomenon is anticipated by China with the tagline “*2025 All Products in The World Made in China*”. The tagline is implemented with good management of vocational education and takes into account the demands, opportunities, and available industrial space (Qin, Liu, & Grisvenor, 2016).

Furthermore, this study identified a common thread between the implementation of the Adaptive Curriculum Model. The Adaptive Curriculum is a curriculum that is adjusted and adapted as required (Jason, & Westberg, 2018). This is in line with the circumstances of the Industry 4.0 era and the various phenomena that occur. The adaptive curriculum implemented by paying close attention to the development of student competencies based on expertise programs that address the needs and demands of the industry which can be established through the harmonization of education and training provided in collaboration with the government, industry, and schools. The content of the subjects needs to pay attention to the shifts and changes that have occurred massively. In implementing an adaptable curriculum in vocational education in the midst of the COVID-19 pandemic, a strategy needs to be designed according to the existing situation and conditions.



Figure 4. Implementation of adaptive curriculum model in vocational school

Figure 4 shows the implementation of the adaptive curriculum in vocational school during the COVID-19 pandemic. The first is student personal branding, where gaps in how to enhance students' authenticity in the incorporation of online learning explored and followed by the implementation of Project Based Learning. Moreover, subject collaboration that involves the collaboration of several subjects and the application of 21st-century skills namely the application of analytical, creative, communicative, and collaborative thinking. This requires collaboration between schools, teachers, and students so that the learning process can be carried out as planned. The challenges of Industry 4.0 currently are faced by all countries in the world because rapid changes has increasingly begun to replace human skills and abilities with technology. The existence of the Internet of Things, Big Data, and Virtual Reality has accelerated the pace of technology. The issue is that the new technologies will replace many workers and it progressively becomes a threat and a dynamic problem that inevitably demands a significant change. One of the changes is in the shift of education.

Thus, there is one issue that needs to be addressed in the face of the challenges and to seek a solution together which is "*What competencies must learners (both teachers, students, school and education support communities) have in order to compete in the era of Industry 4.0?*" There are four basic competencies required as learners and graduates profiles who are expected to succeed in the 21<sup>st</sup>-century learning and in the era of the Industry 4.0. These four competencies are known as 4Cs which includes Critical Thinking, Creativity, Communication, and Collaboration (Bektaş, Sellüm, & Polat, 2019; Sipayung, Sani, & Bunawan, 2018).

By increasing 4Cs, the Industry 4.0 will not be viewed as a formidable challenge but instead as a new opportunity. The 4Cs should be part of the school learning process and opportunity and also as a practical phase in the preparation for the Industry 4.0. Learning skills must also be accompanied with the ability to innovate. In the meantime, this essential aspect can only be fulfilled if learning takes place in a creative atmosphere. The creative environment will automatically promote the process of innovation, and this will be achieved if the learning atmosphere is autonomous (independent learning). The framework for the implementation of independent learning can therefore be defined in Figure 5.



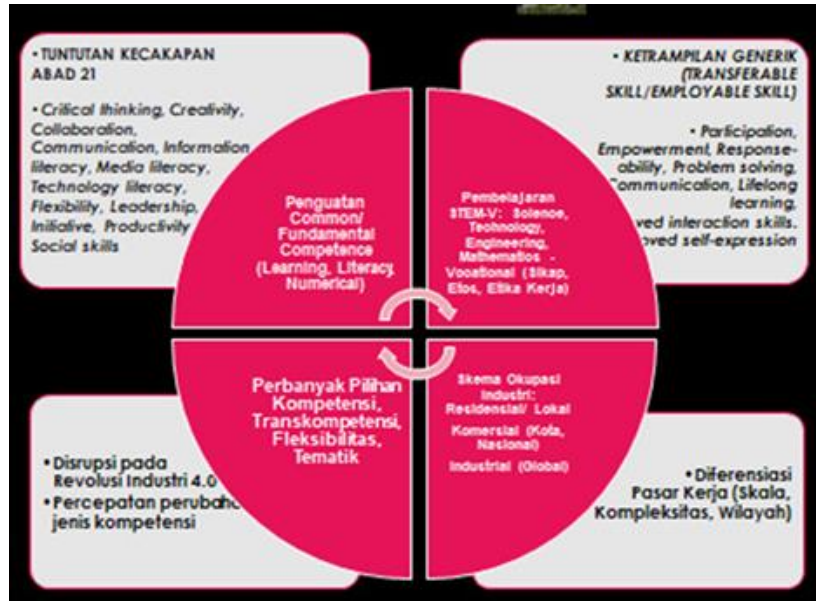


Figure 5. Learning framework for adaptive curriculum implementation

The framework for implementing the adaptive curriculum as seen in Figure 5 is the demand for 21st-century skills which consists of 4Cs as previously described namely Critical Thinking, Creativity, Communication, and Collaboration (Allison, 2018). In addition to 21st-century skills, vocational school students must have generic skills (transferable skills/employability skills) (Mokhtar et al., 2018; Pusriawan & Soenarto, 2019). The period of transformation in the Industry 4.0 has accelerated improvements in competencies in such a way that increased differentiation (a labor market with a complexity of scale) must be strategically designed as a solution to the needs of Industry 4.0 (Espinosa, 2020; Muktiarni et al., 2019).

On the other hand, the implementation of learning at vocational school still focuses on the knowledge aspect at the low order thinking skills (LOTs) level in assessment of students' abilities (Yuliati & Lestari, 2018). It focuses on aspects of knowledge that are glued at the level of remembering (C1), understanding (C2), and mechanistic application (C3). The learning implementation leads to the higher-order level of skill (HOTs) is still limited; therefore, vocational school graduates are relatively still unable to solve daily life problems which are related to their competence. Needless to say, the implementation of independent learning must be supported by the fulfillment of eight education standards. The standards are graduation standards that must be met by students, content standards (what competencies students will learn to achieve the passing standards), process standards (how to process learning is carried out), and assessment standards (what assessment system to measure the competence of students) (Kemendikbud, 2020). The implementation of these four principles must be supported by facilities and equipment standard which includes functional resources and materials, teacher principles mean that qualified teachers must know learning components, institutional standards that regulate the management of educational units, and financing standards which is the implementation of funding to support educational processes (Kemendikbud, 2020).

Therefore, each educational standard is an education subsystem that operates simultaneously and is related to the achievement of educational objectives including competent vocational graduates in accordance with the competencies required by the industry or entrepreneurship. In addition, the slow development of areas should be considered because professional workers prefer working in urban areas to developing their respective regions (Corte, 2015; Vasylyshyna, 2015; Wang, 2015), in order to ensure that regional capacity and industrial availability in each region are recognized. At the identifying and improving stage of regional higher potential through vocational education, an analysis of six dimensions is required (Corte, 2015; Qin, Liu, & Grisvenor, 2016) which include the relationship between the level of development and vocational school, the linkage between sectors, the contribution to the sector or economic structure, the absorption of labour from the vocational school, the human resources of vocational school and technology, and non-economic strategic considerations (Subdit Kurikulum, 2018).

## 5. Conclusion

The issue with vocational education is that graduates are not fully prepared for employment because they do not have the skills that needed in the working industry. In addition, graduates are often unable to compete with foreign workers resulting they become outsiders in their land. It is due to the curriculum which is not in line with the demand of the business world or industry so that the quality of vocational school graduates is poor causing the high unemployment rate. These problems are a challenge that need action and solutions in hope of making vocational school as a competitive institution in terms of employment. The implementation of an Adaptive Curriculum Model in vocational education is expected to pose a challenge to improving the standard of vocational education and training programs in vocational school and to map the work needs. Besides, adaptive curriculum implementation gives every educational unit the ability to innovate. A curriculum that can inspire teachers to choose high-quality materials or learning approaches based on the level of skills, interests, and talents of each student. The key to introducing the adaptive curriculum is to explore the greatest ability of school teachers and students to innovate and improve the standard of learning independently.

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