

Development of Vocational Education Systems in the Industrial Revolution 4.0

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The purpose of this study is to identify the application of an effective vocational education system in the industrial era 4.0 in D4 Government Administration FISIP UNPAD and IPDN Jatinangor, as well as the role of the academic community in the development of an effective vocational education system in the industrial era 4.0 in D4 Government Administration of FISIP UNPAD and IPDN Jatinangor, and developing an effective vocational education system in the industrial era 4.0. The research method used is a comparative descriptive method with a qualitative approach. The selection of this method is based on the type of data used and the purpose of the study: analysing, interpreting, and presenting comparative data and information (Achmadi & Narbuko, 2004). Vocational development is pursued through integration in the curriculum, lecture material, self-development activities, regulations, and various activities outside of study hours organised by the campus.

Key words: *Vocational development, Industrial Revolution 4.0, Education*

Introduction

As a consequence of industry 4.0, a wave of technological disruption is happening in the world, which ranges from the Internet of Things, big data, automation, cloud computing, to artificial intelligence (Artificial Intelligence). This technological disruption is a fundamental change that has shifted technology, established industrial order, and birthed a new industrial order. This change not only requires all lines to adapt, but also encourages it to be ready to transform. Each country must address these changes in an integrated and comprehensive manner by involving all stakeholders so that the 4.0 industrial revolution can be managed into an opportunity.



It was mentioned in the World Economic Forum (WEF) meeting that the 4.0 industrial revolution was a revolution based on the Cyber Physical System, which was a combination of three main domains: digital, physical, and biological. The 4.0 Industrial Revolution had a big impact in influencing various aspects of life and determining the future development of the global economy.

Every industrial revolution will have a big impact on the world of work, including on the existence of labour. The role of humans will be increasingly displaced by technology, shifting jobs cannot be avoided. If compared to agricultural land, a patch of land that is usually done by 10 farmers can now be worked by only two or three farmers with the help of technology, for example by using a tractor or Combine Harvester. The transition of labour over industrial revolution 4.0 must be anticipated as early as possible by providing shifting jobs.

Education and skills are important for the country in creating quality human resources (HR). Vocational education is a necessity so that Indonesia can continue to compete in entering the fourth industrial revolution, therefore it is necessary to develop vocational education oriented to the needs of the labour market (demand driven). This effort is a form of the implementation of a mental revolution, which is a national movement to build the quality of Indonesian human resources, especially in the face of the era of the digital revolution and technological disruption of Industry 4.0.

Currently vocational education is still supply-driven, and curriculum development is still made unilaterally by the education provider so that changes in majors are still rigid. This has caused the curriculum to not be able to keep up with the rapid development of the industry, causing the industry to complain that vocational education graduates do not suit their needs. This inadequacy is called the mismatch between education and work. As a result, the level of job satisfaction will be very low, which in turn causes work productivity to be suboptimal.

The purpose of this study is to identify the application of an effective vocational education system in the industrial era 4.0 in D4 Government Administration FISIP UNPAD and IPDN Jatinangor, as well as the role of the academic community (lecturers, students and management) in the development of an effective vocational education system in the industrial era 4.0 in D4 Government Administration of FISIP UNPAD and IPDN Jatinangor, and developing an effective vocational education system in the industrial era 4.0.

Literature Review

Previous Research

Descriptions of previous research and findings relevant to the topic of the research design are listed in the table below:

Table 1

No.	Author/Title/Journal/Proceedings	Finding
1	Afrina, Eka dkk. (2018). Vocations in the Industrial Revolutionary Era: Employment Studies in the Regions. Association of Initiatives, the first printing.	The government must seriously handle the preparation of the workforce to match market needs. Vocational education has not answered the needs of the informal sectors. Utilisation of technology must be a major requirement. Cross-sectoral vocational needs to be developed.
2	Prof. Dr. H. Muhammad Yahya, M.Kes., M.Eng. (2018). Industrial Era 4.0: Challenges and Opportunities for Vocational Education in Indonesia. <i>Inauguration Speech of Permanent Professor Position in the Field of Vocational Sciences, Faculty of Engineering, Makassar State University.</i>	Revitalisation of the education system (curriculum and character education, information and technology-based learning materials, entrepreneurship, hardening and evaluation); New Literacy Movement (digital literacy, technology literacy and human literacy); Vocational education must be able to equip graduates which include learning systems, education units, participants students, and education staff.

Based on the analysis, there are several innovations in this study, namely:

1. Previous research only focused on discussing the workforce and the general educational environment in the industrial era 4.0. There are no studies discussing the development of vocational education systems and also on the educational environment specifically in the industrial era 4.0. Therefore, this research design is expected to present a new analysis of vocational education models that are adaptable to the development of the industrial era 4.0;
2. In previous studies, researchers did not provide a comprehensive review of common models / patterns that can be adapted more specifically while still adjusting the identity of the educational environment. For this reason, in this research design, the researcher will



focus on the location of developing a common model / pattern of vocational education in accordance with the plan to establish STIA LAN Jakarta Polytechnic 2020.

Not only full of studies of industrial era innovation 4.0, this research design also promotes the development of effective vocational education models based on sustainability approaches that were not discussed in previous studies.

Industrial Revolution Era 4.0

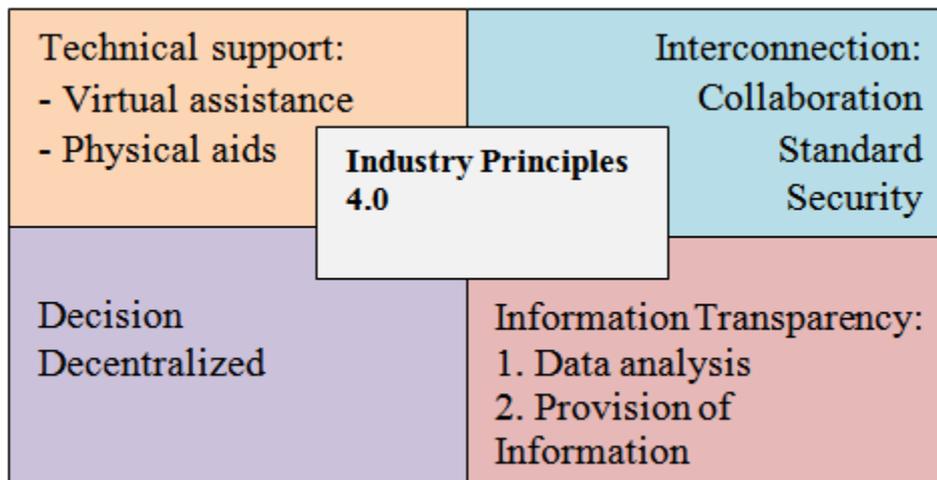
The history of the industrial revolution:

- Industry 1.0 is characterised by the mechanisation of production that supports the effectiveness and efficiency of human activity.
- Industry 2.0 is characterised by mass production and quality standardisation.
- Industry 3.0 is characterised by mass adjustments to the flexibility of automation and robot-based manufacturing.
- Industry 4.0 comes to replace industry 3.0 and is characterised by physical, cyber, and manufacturing collaboration (Hermann et al, 2015; Irianto, 2017). The term industry 4.0 comes from a project initiated by the German government to promote computerised manufacturing.

As Lee et al. (2013) explains, industry 4.0 is characterised by an increase in digitalisation of manufacturing, which is driven by four factors, namely:

1. Increased data volume, computing power and connectivity;
2. The emergence of analysis, ability, and business intelligence;
3. The occurrence of new forms of interaction between humans and machines;
4. Improve digital transfer instructions to the physical world, such as robotics, etc.

Figure 1. Industry Principles 4.0 (Hermann et al, 2016)



The digital revolution and the era of technological disruption are other terms of industry 4.0. Called the digital revolution because of the proliferation of computers and the automation of records in all fields. Industry 4.0 is said to be the era of technological disruption because automation and connectivity in a field will make the movement of the industrial world and job competition become non-linear.

Vocational Education

Vocational education is known as work education, as stated in www.oxfordbibliographies.com: “vocational and technical education has historically been known as “education for work.” It has focused on providing learners with the skills and knowledge needed to successfully transition to the workplace”. Furthermore, Vocational education is education that is designed to develop the skills, abilities, understanding, behaviour, work habits and rewards needed in the world of work (Alim 2015).

In the Law of the Republic of Indonesia Number 20, Year 2003, Concerning the National Education System, CHAPTER VI concerning Pathways, Levels and Types of Education, Article 13, point 1 states: Educational pathways consist of: a) formal education, b) non-formal, and c) informal. These modes of education can complement and enrich each other.

Vocational Education according to Bukit (2014) is education that is different from other types of education and must be directed to the performance of individuals in the world of work, justified by real needs in the field, possess a curriculum focused on psychomotor, affective and cognitive aspects, have benchmarks of success that are not limited to the educational environment, sensitivity to the development of the world of work, require adequate facilities and infrastructure, and community support.



Method

Research Approach

The research method used is a comparative descriptive method with a qualitative approach. The selection of this method is based on the type of data used. The purpose of the study is to analyse, interpret, and present comparative data and information (Achmadi & Narbuko, 2004). Through this method, researchers can describe and study phenomena and offer solutions to the development of effective vocational education infrastructure facilities in the industrial era 4.0 and the implementation of Indonesia's 2017-2025 vocational development policies.

Data Sources & Data Collection Techniques

- a. Primary data sources: observation and interview data collection techniques;
- b. Secondary data sources: through document analysis data collection techniques.

The flow of data analysis follows the Miles and Huberman (2005) interactive analysis model: data collection, data reduction, data presentation, and conclusion drawing.

Interview Guidelines

Key Informant Name :
Institution / University :
Interview Location :
Interview Time :

1. How is the vocational education that you lead in facing the industry era 4.0?
2. What steps and tips need to be taken in implementing the vocational education system in the industrial era 4.0?
3. What challenges and obstacles are faced in implementing the vocational education system?
4. What is the role of the academic community (lecturers, students and management) in an effective vocational education system in the industrial era 4.0?
 - Doctor
 - College student
 - Management
5. How is the learning system in the industrial era 4.0?
6. What is the composition of learning theory and practice in vocational education in the industrial era 4.0?
7. How should practicum / practice in vocational education be formulated?

8. How is the implementation of the final project on vocational education, whether through an internship / practical field work / college work?
9. How is the research model in facing the industrial era 4.0?
10. What is the model of community service in dealing with industrial era 4.0?
11. What competencies are needed for vocational education lecturers in the industrial era 4.0?
12. How is the development of lecturers to meet the required competence?
13. What facilities and infrastructure are there to support the program vocational education in the industrial era 4.0?
14. Has there been an evaluation of the vocational education curriculum? What are the results regarding whether graduates can be utilised for on-site work?
15. What is the structure of the vocational education budget in the industrial era 4.0? (related with visiting activities / street vendors)
16. How is management's support for the existing study program activities?

Results and Discussion

Comparison and Results of Effective Vocational Education System Interviews in the Industrial Era 4.0

No	Vocational Education Development System	D4 FISIP UNPAD	IPDN Jatinangor
1.	Organisation of Vocational Education in the industrial era 4.0	Learning: Practicum covers a minimum of 55% of the total credits taken.	Smart Campus with IT-based systems ranging from recruitment, to education, training, and care.
2.	Application of Vocational Education in the industrial era 4.0	Taught and accompanied directly by practitioners who are competent and have expertise in accordance with existing programs / majors.	Supporting facilities and infrastructure and upgraded teacher competencies in meeting industry 4.0 era.
3.	Challenges and obstacles	Uneven lecturer competence	Infrastructure: Unstable internet and electricity and inadequate lecturers.

4.	The role of the academic community	<ul style="list-style-type: none"> - Doctor: Lecturer readiness in the teaching process - Students: Play an active role in developing soft skills and hard skills - Management: Developing facilities and infrastructure 	<ul style="list-style-type: none"> - Lecturer: Qualified and qualified lecturer readiness by providing knowledge about data literacy, digital and soft skills. Students: Active role in developing soft skills and hard skills - Management: Developing facilities and infrastructure that supports education in the campus environment.
5.	Learning system	Practicum 55% of total SKS	Centralised Trinity System: Teaching, Training and Parenting. The section / field that carries out the teaching function is tasked with providing knowledge to students.
6.	Vocational Education Development System	100% teaching weight, 45% theory and 55% practice.	The composition of theory and practice 100%: the weight of teaching, training and caregiving is 30%.
7.	Practicum formula / practice in vocational education	Taught and accompanied directly by practitioners who are competent and have expertise in accordance with the study program / department.	In addition to theory and practice, the IPDN curriculum has a nurturing composition. The composition of the IPDN curriculum is 40% Teaching, 35% Training, and 25% Care. Education

			Diploma I, II, III and IV as well as Bachelor's Degrees (S1) are organised through the teaching, training and care approach (JARLATSUH) using the Semester Credit System (SKS).
8.	Implementation of the Final Project in vocational education	Apprenticeship is a compulsory program so that students can directly come in contact with the real situation of the workforce.	Field practice and thesis are done by final year students.
9.	Research model in the industrial era 4.0	Research carried out involves cross-study programs, so that research results can be felt in the industrial era 4.0	Currently the research of lecturers at IPDN is carried out using research data from the Ministry of Research, Technology and Higher Education in collaboration with the Institute.
10.	Model of community service in the industrial era 4.0	Currently the research of lecturers at IPDN is carried out using research data from the Ministry of Research, Technology and Higher Education in collaboration with the Institute.	Community service is carried out by directly addressing problems in the community, such as: Building houses for earthquake victims in Pandeglan, Banten. The budget comes from IPDN. Posyandu rehabilitation is carried out by IPDN cadres in West Sumatra.
11.	Competence of vocational education	Lecturer practitioners who must be competent and have	Qualified and qualified lecturer readiness by

	teaching lecturers in the industrial era 4.0	expertise in accordance with the study program / department.	providing knowledge about data literacy, digital and soft skills.
12.	lecturer development	Lecturer development by participating in seminar activities, discussions, workshops and trainings.	Lecturer development by participating in seminar activities, discussions, workshops and trainings.
13.	Facilities and infrastructure	Campus facilities include lecture rooms equipped with Wifi, libraries, research institutions, seminar room facilities, dormitories, and others.	Campus facilities include lecture rooms equipped with Wifi, libraries, research institutions, seminar room facilities, office space, dormitories, and others.
14.	Evaluation of vocational education curriculum	Evaluation of learning is done through tracer studies, and interviews with alumni superiors at the alumni place of work, and alumni association communities. Evaluations are continuing to get results that are expected to be appropriate for the workplace. Evaluation is carried out from various program activities carried out such as internships, training, laboratories, and other practicum.	Evaluation of learning is done through tracer studies, and through interviews with alumni superiors at the alumni place of work, and alumni association communities. Evaluations are continuing to get results that are expected to be appropriate for the workplace. Evaluation is carried out from various program activities carried out such as internships, training, laboratories, and other practicum.
15.	Vocational education budget structure in the industrial era 4.0	The budget structure of this study program is purely from the APBN for the operational costs of supervisors and students during the	Budget structure for street vendors per class and according to the number of students and is implemented once a year.

		implementation of activities	PKL activities that are carried out annually per generation are distributed to the border areas.
16.	Management support	Management strongly supports the activities of existing study programs both in terms of academics and tri dharma activities of lecturers, namely education, research and community service.	Handling of troubled Praja, especially those that are non-academic, is carried out by the Counsellor Lecturer who is a member of the TPBK (Guidance and Counselling Service Team)

Analysis of the Development of Effective Vocational Education Systems in the Industrial Era 4.0

In their journal, *Industrial Era 4.0: Challenges and Opportunities for Vocational Education in Indonesia*, Prof. Dr. H. Muhammad Yahya, M. Kes., and M.Eng. (2018) said:

1. Revitalise the education system (curriculum and character education, information and technology-based learning materials, entrepreneurship, hardening and evaluation). Here D4 Fisip Unpad and IPDN Jatinangor have made updates such as: educators and practitioners are competent and have expertise in accordance with existing programs / majors, infrastructure facilities that support the needs of the industrial era 4.0. Development of competency of lecturers in research and service is carried out to directly touch the problem in the community.
2. The new Literacy Movement (digital literacy, technological literacy and human literacy). In this case D4 FISIP Padjadjaran University and IPDN Jatinangor involves: Smart Campus IPDN, readiness of qualified lecturers according to industry needs 4.0, cross-study or department research, development of lecturers by following seminar activities, discussions, workshops and certification training, and campus facilities and learning.
3. Vocational education must be able to equip graduates covering the learning system, education units, students, and education personnel. In this case D4 FISIP Padjadjaran University and IPDN Jatinangor involved: Smart Campus with IT-based systems ranging from recruitment, to education, training, and care. Evaluation of learning is done through tracer study, and apprenticeship is a compulsory program so that students can directly come in contact with the real situation of the world of work.

Conclusion

Based on the results of the research and the discussion, several things related to the findings of the interviews, observations and document search, can be concluded. Both IPDN and UNPAD are campuses that have high standards with a comfortable, clean, neatly arranged campus environment with a large area. The facilities owned by the campus are quite complete, both in terms of quality and quantity to support the implementation of teaching and learning activities and campus administration. The value of discipline and enthusiasm for achievement greatly coloured the activities of all campus residents ranging from leaders, lecturers, education staff and students.

In D4, Government Administration of FISIP UNPAD, there are special subjects on vocations. Vocational development is pursued through integration into the curriculum, lecture material, self-development activities, regulations and various activities outside of study hours organised by the campus, which are both scheduled and incidental. At IPDN there are training courses that help students learn to practice knowledge in the field of government. In preparing campus policies and organising every activity especially related to student development, the campus involves all components, all of them participating according to their respective authorities.

Suggestions

After discussing the various findings from interviews, observations and document searches in IPDN and UNPAD, a number of suggestions can be made:

1. The applied learning method that can be used in the learning process at STIA LAN Jakarta is a teaching system and a training system extension. The learning methods used are TESISASUDIRO, extending from face to face (TA), simulation (SI), field study (SA), case study (SU), discussion (DI), role playing (RO).
2. Steps that need to be taken in applying the applied learning method include Student Cantered Learning (an approach to learning that is believed to be effective in improving the quality of learning of students).
3. Formulating practicum or practice in applied study programs: in one meeting 40% should be theory and 60% practice (simulation, training, discussion, etc.). The modules that must be had in implementing an applied learning system are derived from courses that are in accordance with teaching materials.
4. Research and service should directly relate to problems in the community
5. Implementation of the final task in the implementation of the applied learning system is through an apprenticeship in the relevant agencies.



6. The composition of the value of theory and practice in the implementation of applied learning systems is 40% theory and 60% practice.
7. The competencies needed for teaching lecturers in the implementation of applied learning systems are certified according to the field of science.
8. Development of lecturers to meet the competencies needed in the implementation of applied learning systems is carried out with training, workshops, seminars, conferences, and others.
9. Evaluation of the curriculum of applied study programs is carried out annually by conducting tracer studies, interviews with superiors from alumni work, and through alumni ties.
10. Management support needs to be continuously improved for the existing study program activities.



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