CAPACITY DEVELOPMENT OF PRINCIPLES BASED ON INFORMATION TECHNOLOGY IN IMPROVING THE COMPETITIVE ADVANTAGES OF VOCATIONAL HIGH SCHOOL (SMK) WITH BIG DATA ANALYSIS

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Abstract

The principal capacity is one of the factors that will improve the quality of the school. Information technology is present as a digital service and will provide all the necessary information into big data. The research objective is to improve the ability of school principals in carrying out their duties as implementation by utilizing big data as an effort to increase the competitive advantage of Vocational High Schools (SMK) in the Industrial Revolution 4.0 era. The method used is a development based on existing data in Vocational High Schools (SMK). The results achieved are the formulation of the model for developing the capacity of school principals in carrying out big-data analytics to increase the competitive advantage of Vocational High Schools (SMK) in the era of the Industrial Revolution 4.0. The implication is that the principal will have the competence to lead schools and produce alumni of Vocational High Schools (SMK) who are ready to compete in the era of industrial revolution 4.0.

Keywords: Principal, Big Data, Industrial Revolution 4.0

INTRODUCTION

Vocational High School (SMK) is an employment-oriented secondary education unit. The graduates of Vocational High School (SMK) who work are the main indicators of their success. In fact, the graduates of Vocational High School (SMK) still dominate the number of unemployed in Indonesia.

The current problem is the high graduate unemployment of Vocational High School being a serious problem that must be addressed by school principals. Unemployment can be caused by over-supply, namely the excess of graduates compared to the needs of the workforce and the level of competence that is not in accordance with the labor recruitment standards in the company. Another factor is the Industrial Revolution 4.0 which changed the needs of the labor market. The basis of Industry 4.0 is the concept of the Internet of things. It assumes that each physical object ("thing") has an integrated technology that allows it to interact with other objects. A key driver of the Fourth Industrial Revolution is the integration of "cyber-physical systems", CPS, in production processes.[1]

Big data is one of the resources that can be utilized by educational institutions to rearrange their institutions to suit the needs of the work world. Mastery of big-data analytics by principals as leaders is needed so that schools have a competitive advantage that will impact the ability of

graduates to compete in the labor market. From year to year, the number of unemployed graduates of Vocational High School continues to increase as shown by data from the Central Statistics Agency (BPS) from 2014 to 2018, the number of graduate unemployed of Vocational High School continues to increase with an average increase of 7% per year. Based on BPS data and seen from the level of education, the TPT for Vocational High Schools (SMK) is still the highest among other education levels, which is 8.63 percent. [2] The proportion between graduate unemployed of Vocational High School and the number of unemployed as a whole is known to continue to increase.

This is because almost all existing vocational high school graduates are not ready to compete in the world of work in the era of the industrial revolution 4.0. After all, the industrial revolution is at its peak at this time with the birth of digital technology and the internet, which have a massive impact on human life. [3]

Along with the existing problems, the researchers conducted research in producing a model for developing the capacity of school principals in following the development of information technology and utilizing big data to be analyzed and implemented in Vocational High School (SMK).

This is highly needed to prepare school principals who have competence in leading Vocational High Schools to produce high-quality alumni who are ready to compete in the 4.0 revolution era. In addition to offering convenience and technological updates, the Industrial Revolution 4.0 also raises various challenges. All existing opportunities will certainly end up in vain if they cannot be handled by qualified and broad-minded human resources. [4]

The solution is to utilize all existing information resources of Vocational High Schools by utilizing big data in managing them so that they have the necessary competencies in implementing information technology-based leadership. The teaching and learning process will take place well in schools if it is supported by programs, both at the class, school, and cluster levels. This means that the educational process must be managed properly, which is arranged in a school program. The process of preparing this program is a process consisting of activities to achieve the objectives, including the capacity building of school principals.[5] The reason for the research is a lack of graduates compared to the opportunities or workforce needs needed by the world of work in the era of the industrial revolution 4.0 because the industrial revolution 4.0 is a phase of the technological revolution that changes the way human activities are carried out in scale, scope, complexity, and transformation of life experience the previous one. [6]

A school principal is currently required to have competence in processing large digital data, school leaders in the 21st century demand new knowledge, skills and ethical qualities. They need leadership in IT application in teaching. The leadership competence in IT application of school leaders is one of the focus currently emphasized when talking about the leadership capacity of school leaders in the 21st century. Teaching for principals is one of the important factors to develop human resources ready to meet the requirements of educational innovation.[7]

The use of big data in education units in Indonesia is still not widely practiced. Even in international research, there is very limited research that examines the use of big data in secondary education units. Research on big data in the education field is mostly carried out at the higher education level. There is a gap in knowledge, when training education (training) for prospective school principals is carried out, from the ministry that uses the Learning Management System (LMS) as training for strengthening principals with the address, https://sim.tendik.kemendiknud.go.id/penguatanks, This information system uses a single authentication system, the material consists of 7, namely introduction to training on strengthening principals, introduction, activities on the job training I, activities in-service training, activities on the job training 2, reading materials, and collection of assignments and exercises, material that all submitted online, then what about prospective school principals whose regions do not have good signal data due to various technical matters.

The research objective is to develop the capacity of school principals in increasing competitive advantage based on big-data analysis in the industrial revolution 4.0. The research will use all existing information / big data on national vocational high schools, and further development will be carried out according to the conditions and needs that exist Vocational High Schools in East Jakarta and DKI Jakarta.

The method used, the development standard, begins with an analysis of the model that will be developed by utilizing big data of Vocational High Schools in improving the competence of principals and the needs of the work world for further use in Vocational High Schools (SMK).

The innovations proposed throughout the development process will use information technology facilities in utilizing big data for Vocational High Schools, which will sequentially list the steps taken to produce quality principals and have competence in producing quality alumni of Vocational High School following the needs of the work world in the revolutionary era industry 4.0.

One of the phenomena that emerged in Industrial Revolution 4.0 is big data. In the employment context, big data is one of the resources that can be used to map labor market trends and make human resource development decisions. The principal as a central figure of leadership in Vocational High School [8] needs to empower big data for the benefit of the school's competitive advantage, which will have a direct impact on the competitiveness of its graduates in the job market. To be able to use big data optimally, big-data analysis skills or big-data analytics are needed. But in reality, this ability has not been introduced and developed in school principals in Indonesia. One of the things that is developing in the use of technology in the teaching and learning process is how to use data, when obtaining data that supports the educational process, ranging from the use of various supporting applications to e-learning-based learning and data acquisition processes. Utilization of technology, one of which is through Big Data related to educational psychology, that the use of Big Data can be used as a data center that can record student learning achievements, through a programming system that provides a recap of information on the development of student learning outcomes. [9]

Tabel 1: Gap in Supply and Demand for Vocational High School Graduates with Labor Needs

No	Expertise Areas	Vocational High School Graduates in 2006	Opportunities for Labor Needs	Advantages (+) / Weaknesses (-)
1.	Technology and Engineering	441.561	611.644	170.083
2.	Energy and Growth	3.486	27.008	23.522
3.	Information Technology and Communication	277.545	327.813	50.268
4.	Health and Social Work	60.944	68.245	7.301
5.	Agribusiness and Agrotechnology	52.319	445.792	393.473
6.	Maritime	17.249	3.364.297	3.347.048
7.	Business and management	348.954	119.255	-229.699
8.	Tourims	82.171	707.600	625.429
9.	Arts and Creative Industries	12.017	88.133	76.116
	Total	**1.296.246**	**5.759.787**	**4.463.541**

Table 1 above generally provides information related to graduates of Vocational High School and the needs of the work world.

The principal is one of the determinants in producing quality alumni in the era of competitive information technology by utilizing existing big-data analysis of Vocational High School.

LITERATURE REVIEW

In the education world, data is an important and inseparable part, ranging from simple to complex data, an educator must be able to process, analyze, organize, and organize the data they have. The fourth industrial revolution is changing the way people live, work, and communicate and is reshaping the government system, education system, health care system, and trade system, and almost all aspects of life. Principals must have the capacity to use available data to make decisions about their schools, such as in determining graduate profiles and orientations, developing curricula, and developing school management systems. In developing countries also, the role of IT is very necessary for a leader, why they occur is an important activity that distributes information and ensures a collective understanding. of the conference, capacity building occurred daily as delegates shared their experiences with IT and worked together to forge a community of professionals dedicated to creating a hospitable and practical climate for IT in their own countries, and to continue sharing insights and expertise long after the conference ended.[10]. Leadership is therefore of particular importance in the organization to the extent that without it, goals may be difficult to attain. In fact, reported that in the efforts of various countries for education change and effectiveness, the role of leadership at both the system and site levels is often crucial to their success.[11]
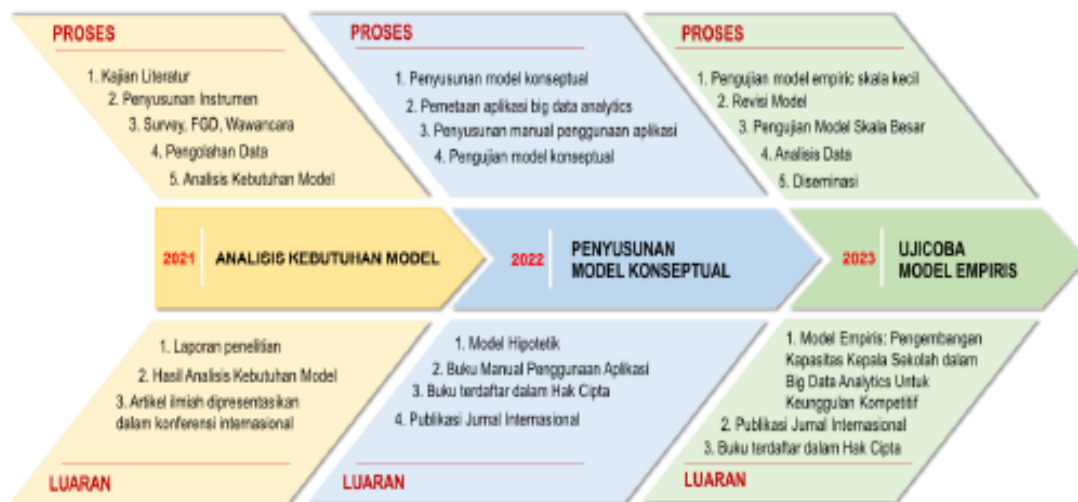
The Industrial Revolution 4.0 has an impact on the workforce. The Industrial Revolution 4.0 drives company efficiency by implementing artificial intelligence, internet of things, and

manufacturing automation causing more jobs to be replaced by machines. One of the negative impacts of the Industrial Revolution 4.0 is causing unemployment. In addition, the Industrial Revolution 4.0 also demands new skills that are relevant as workers in companies that have optimized technological developments in accordance with the characteristics of the Industrial Revolution 4.0.

Big data is a large data set that will be analyzed and processed for certain purposes, such as for making decisions, predictions and other purposes. Big data is any data set in very large, complex and unstructured amounts. Big data is a number of structured, semi-structured, and unstructured data that has the potential to be explored as a source of information [12]. A data set is called big data when the velocity (speed of the flow of data changes), and the variety and volume of data is large [13]. Big data has three characteristics, namely: (1) data volume, meaning that it has a very large amount of data, so that in the data processing process a large storage area is needed and a more specific analysis is needed; (2) data variation, meaning that it has a variety of data formats, both structured and unstructured, and depends on the number of data sources; and (3) data access speed, which means having a fast and real time data flow. Big-data analysis relies on 6c system integration, namely connection, cyber, content/context, community, and customization. Industry 4.0 is a brand new interdisciplinary field combining cyber-physical systems, the Internet of Things and Services, and smart factories. It is promising to provide a new way of value creation in both physical and networked worlds. [14] Big data has a positive impact on decision-makers in the form of better and faster decisions, our data reveal important findings in three areas. First, we find evidence of a shortfall in cognitive capabilities in relation to Big Data (BD), and issues with cognitive biases and cognitive overload. Second, we reveal the challenges to board cohesion presented by BD. Finally, we show how BD impacts on responsibility/control within senior teams.[15] More direct decision making. There are many evolving Big Data opportunities associated with the shift in consumer demand for more atomized, reconfigurable, and transparent accounting data that are discussed in this paper including; strategic capability, auditing, performance measurement and reporting, standardization, and education. [16] open data for innovation, reduced complexity and increased efficiency, and cost savings, We explore how openness in terms of external linkages generates learning effects, which enable firms to generate more innovation outputs from any given breadth of external linkages. Openness to external knowledge sources, whether through search activity or linkages to external partners in new product development, involves a process of interaction and information processing [16]. To be able to take advantage of big data, the principal must have the capacity of big-data analytics, Currently, the integration of technologies such as the Internet of Things and big data seeks to cover the needs of an increasingly demanding society that consumes more resources.[1]

METHOD

Figure 1: Research Flow

Based on the picture above, it is hoped that in three years a model for developing the capacity of school principals in carrying out big data analytics will be obtained to realize the competitive advantage of schools in the era of the Industrial Revolution 4.0.

The research design carried out is to carry out a preliminary study of the principals of Vocational High Schools in DKI Jakarta and East Jakarta, the information obtained will make plans for what is needed in carrying out research, the planning process produces an initial model of the development in vocational high schools, the model obtained is then a trial was held by several experts related to the model to be developed involving four experts, namely learning design experts, linguists, learning design experts and institutional experts, the results obtained based on expert input will be revised for further trials starting from the basic level to large-scale trials. In the test, of course, the researcher will get input and the researcher will revise the input obtained for further dissimulation of the model as a whole. So that the resulting concept is following the needs of the principals of Vocational High Schools in DKI Jakarta and East Jakarta.

The research procedures to be carried out are: analyzing the model to be developed; developing initial models; validation and revision; small-scale field trials and model revisions; and large-scale field trials and revision of the final model.

The research subject is the Principal of the State Vocational High School for Technology and Engineering in East Jakarta and DKI Jakarta. This research was carried out with written permission from the author's institution and the research place and permitted the author to publish the results of this research in international journals. Data Collection Techniques, focus group discussion (FGD).

There are many benefits of big-data analytics, especially for universities. One is to identify existing potential and new opportunities. This new potential and opportunity are utilized by schools by using big data. So, big-data analytics can benefit two parties, the community and the school. Other advantages of big data: reducing production costs, speeding up decision making, easier to provide the latest information following the wishes and expectations of the community regarding the quality of vocational education.

In general, here's how Big-Data Analytics works in developing the capacity of vocational school principals: Theoretically, there is no special application that can make big data collected by itself. This requires a method and a combination of several applications or software to be able to collect all data of vocational high school.

1. Machine learning

To collect data, an AI-based engine is used as a search engine. This machine quickly searches for and learns the data of vocational high school to be retrieved. The machine will automatically generate another model that can analyze larger, more complex, accurate data, and deliver even faster.

2. Data management

Before providing data of vocational high school into the database, the data must be reviewed and confirmed to the relevant parties. This is necessary so that the data used is of high-quality data and is not artificially faked data.

3. Data mining

Data mining technology allows data analysts to examine large-scale data to find patterns in data of vocational high school. The results of this analysis can be used to answer complex school questions.

With data mining technology, school principals can enter various data, mark important things, and make data one of the solutions to influence decision making.

4. Hadoop

Hadoop is the name of one of the technologies used to store very large amounts of data. Hadoop itself is open-source software that can be used to convey data quickly.

5. In-memory analytics

By analyzing data using memory technology in the system, data principals can quickly gain insight into data.

This technology can analyze quickly, create new algorithms, create new models and remove analysis that is considered wrong.

This technology is claimed not only to influence the decision-making of a school but also to create various scenarios as learning materials.

6. Predictive analytics

This prediction technology uses data, statistical algorithms, and machine-learning techniques to identify outcomes based on the history data of vocational high schools that have been used.

Predictive analytics will produce predictions that will occur in the future so that principals through vocational high schools will be more confident in what decisions they will take.

7. Text mining

With this technology, data analysts of vocational high schools can analyze text on the web, comment fields, books, and other text-based parts of the web.

Usually, text mining will be installed in blogs, Twitter, surveys, and even emails to find the hottest topics that can create school relations with the community.

RESULT AND DISCUSSION

The general results of the research in Figure 1 above are a needs analysis of the model whose activities are collecting initial data on the profile of school principals, descriptions of competencies in big-data analysis, understanding of big-data analysis, and learning needs for capacity building for big-data analysis. The initial data collection is done using observation, interviews, questionnaires, and focuses group discussions (FGD). The next stage is the preparation of a model framework which includes: compiling a big-data analysis competency profile for school principals; formulating the objectives of developing the principal's capacity; compiling a model structure (principles, activities, components, behavior, etc.), model technical guidelines (work instructions), preparation of technical guidelines for big-data analytics software (manual books); and data processing guide. The next stage is to develop a model supporting device in the form of compiling a pocketbook. Based on table 1 above, it is known that eight areas of expertise still lack graduates compared to the opportunities or workforce needs. There is only one area of expertise that is over-supply, namely vocational high school in the field of business and management expertise. Based on the table above, it can be analyzed that the cause of unemployment is not only due to over-supply, but it could be because the quality of graduates is not in accordance with the quality of the required workforce. In addition, the graduate competitive ability of vocational high school is still weak so they cannot compete with graduates of other types of secondary education units.

Produce a model for Principal Capacity Development in Conducting Big-Data Analytics to Increase the Competitive Advantage of Vocational Schools in the Industrial Revolution 4.0 era includes: (1) identifying the need for big-data analytics capacity development models; (2) a model for developing the capacity of school principals in carrying out big-data analytics is developed; and (3) introduction and assistance on the use of big-data analytics applications or software for school principals.

In the end, a Model for School Principal Capacity Development in Conducting Big-Data Analytics to Increase the Competitive Advantage of Vocational Schools in the Industrial

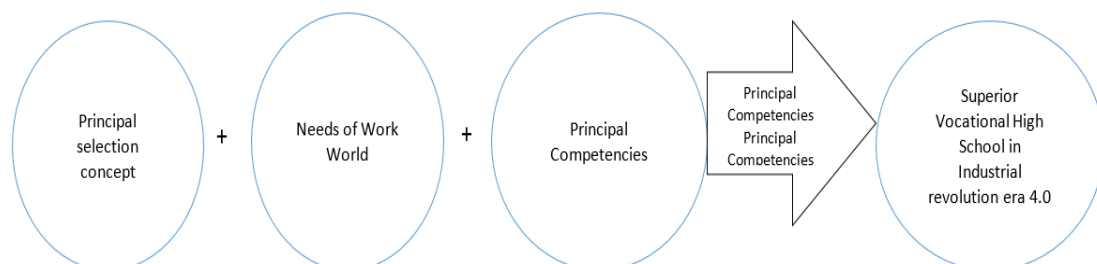Revolution 4.0 era which is empirically tested can be used to increase the capacity of school principals.

The general explanation of the steps for developing the model is as follows:

conducting preliminary research is the initial process that is carried out by utilizing all existing data at the Ministry of Cultural Education in the field of vocational high schools, all existing data is the data of vocational high schools in DKI Jakarta and East Jakarta provinces, all principal character data bases which include education, teaching experience, competence, experience in collaboration with government and private agencies is a big-data analysis that will be used as a reference for the concept of producing quality principals.

Furthermore, in this process, planning will be carried out regarding the needs of the government and the private sector related to the quality of the desired alumni, based on previous research, researchers already have a database of principals. So far, the ministry of cultural education has had a basis or concept used in the selection process for vocational school principals.

In the process of developing the initial model, the researcher will combine the concept of principal selection of vocational high school with the needs of the world of work and competencies that must be possessed by a principal.

Figure 2: The Development Process in producing Superior Vocational Schools in the 4.0 Industrial Revolution era

When conducting an initial field trial (test by experts) after having the development model above, the next step is a trial that will be carried out at the smallest level, namely from individual student groups per group to large groups that will be involved, in this trial process researchers will obtain various inputs from the four experts involved, related to the language used, the learning model used, the instructional learning used and the appearance of the model.

Make revisions based on the results of the initial field trial (expert test), the four experts have produced input on the model that has been made, the input is based on the results obtained from trials on vocational students, then any things that are less pleasing or not following the needs of the researcher will revise the error.

The next step is to conduct a limited field trial. This trial involves a large and broad group involving several practitioners and academic staff who are partners of vocational high school, this is done to fully see the real needs of the work world.

Revise the model of the results of limited field trials, the research results obtained by involving practitioners and the world of work researchers will revise in this way according to the needs of the work world in the era of the industrial revolution 4.0.

To produce superior quality, a large trial is carried out by involving various elements of knowledge related to the graduate quality of vocational high school to be achieved starting from parents, teachers, practitioners, academics, alumni, workers, company leaders, leaders of the workforce, and the general public which is a partner of vocational high school.

At the revision stage of the final model, the researcher guarantees that all the needs of the industrial world and the preparation of vocational schools in producing superior quality alumni can be described in full because they have involved all the components involved.

After that, the researcher will disseminate the concept model of information technology-based principal capacity development in increasing the competitive advantage of Vocational High Schools (SMK) by utilizing the nationally available Big-Data analysis of Vocational High Schools.

CONCLUSION

In achieving a competitive advantage in the era of the industrial revolution 4.0, school principals are required to have the competencies needed by the work world in utilizing big-data analysis of Vocational High Schools.

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