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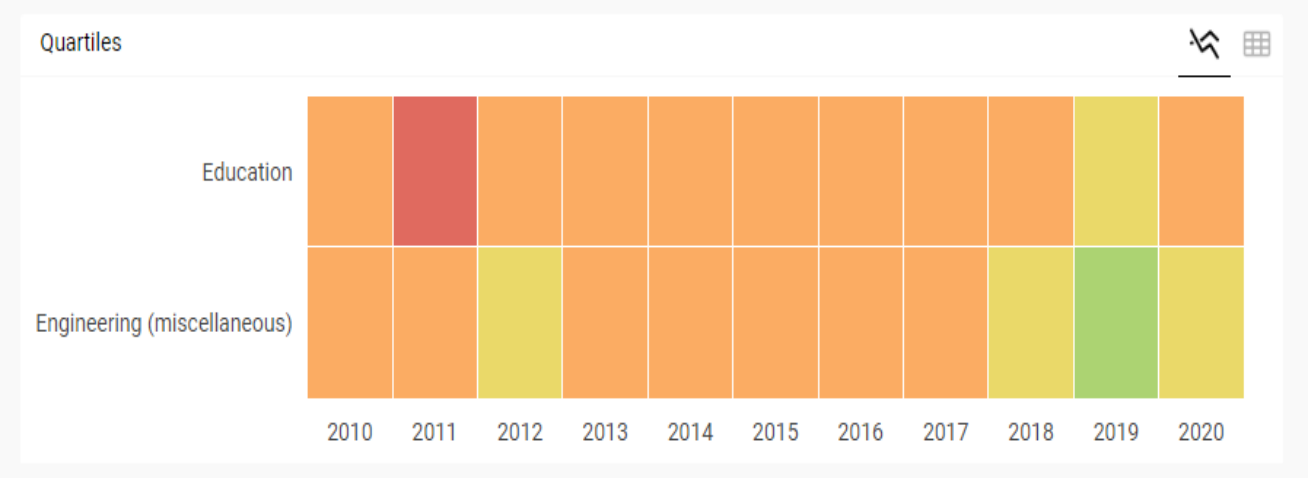

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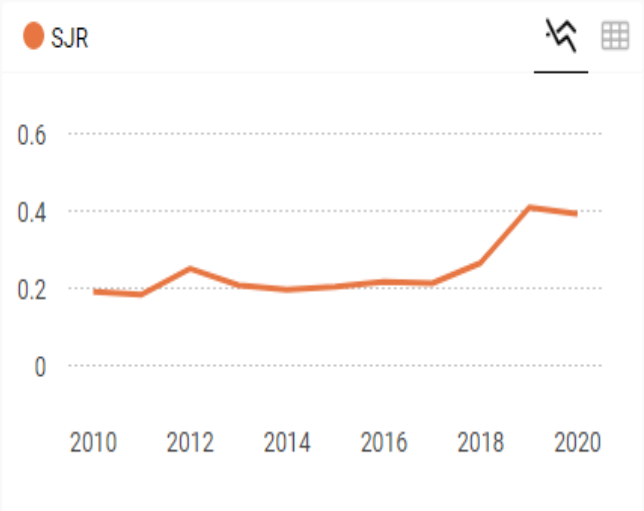

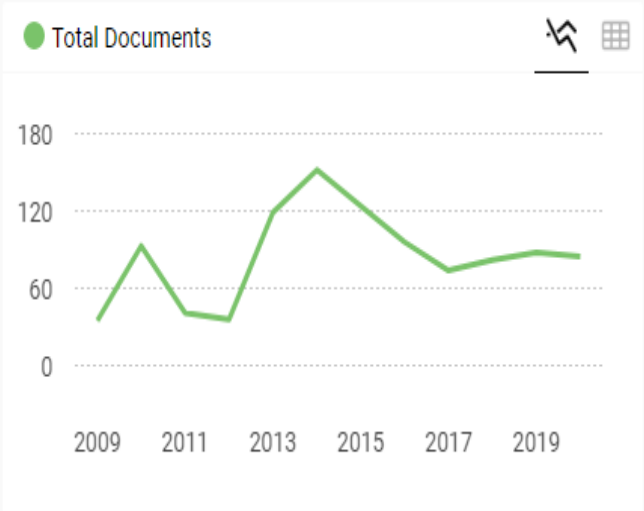

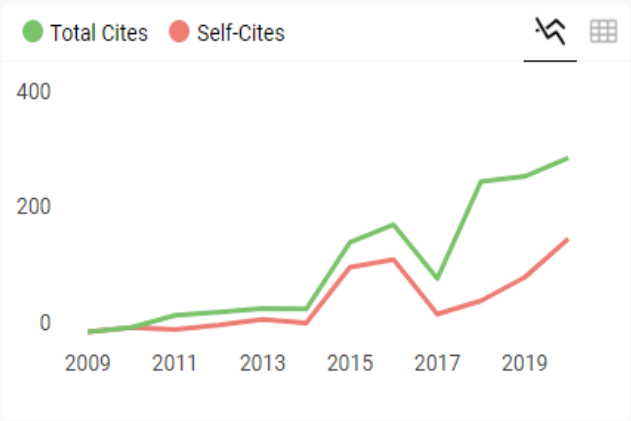

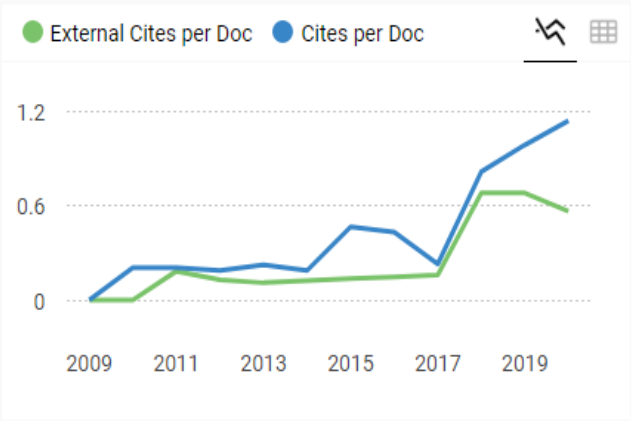

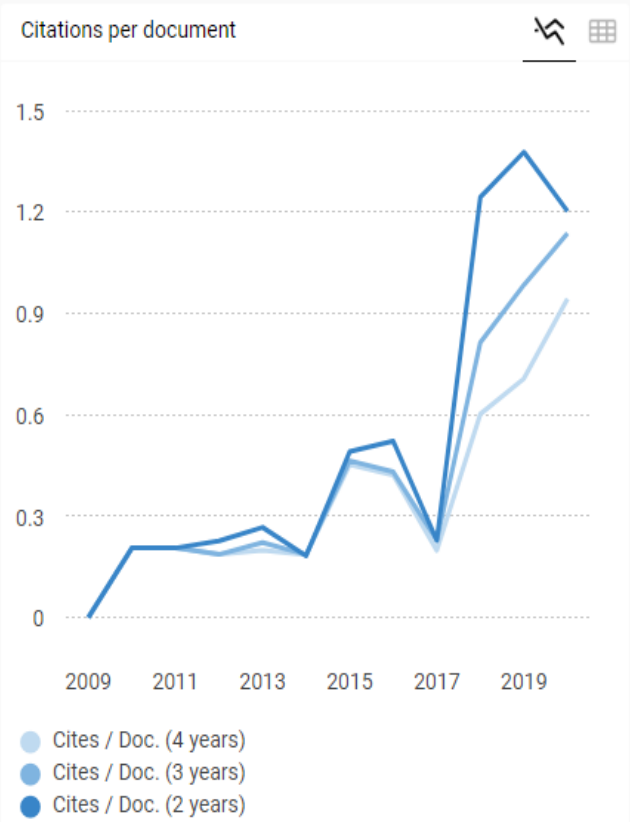

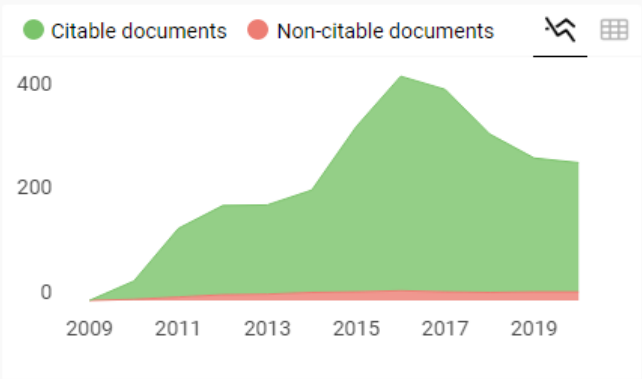

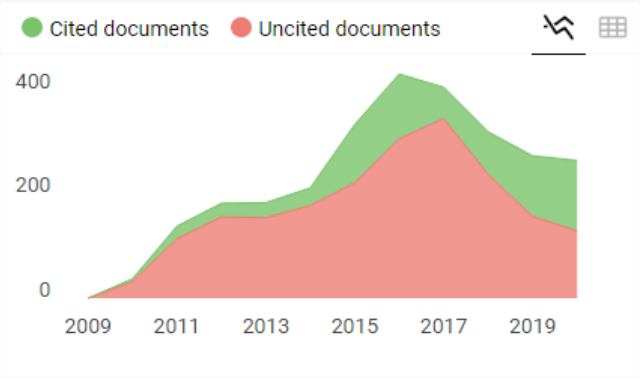

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			AUTHOR	PUBLISHER	
1	31 Januari 2018	8.05 AM	Komunikasi dengan publisher jurnal GJEE	-	1
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3	31 Januari 2018	9.14 AM	Submit artikel ke jurnal GJEE	-	3
4	31 Januari 2018	10.01 AM	-	Artikel tidak sesuai publikasi di jurnal GJEE dan dipertimbangkan di jurnal WTE&TE.	4
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9	8 Februari 2018	12.35 PM	-	Diminta menunggu proses review	9
10	17 Februari 2018	10.44 AM	-	Artikel telah dinilai 3 reviewer internasional dan terbit pada WTE&TE Vol. 16 No. 1	10

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13	1 Maret 2018	9.11 AM	-	Mengirim tanda penerimaan bukti pembayaran	13
14	11 Maret 2018	11.57 AM	-	Bukti artikel sudah direview dan diformat sesuai gaya selingkung WIETE untuk terbit di WTE&TE Vol. 16 No.1	14
15	18 Maret 2018	1.55 PM	-	Artikel terpublikasi di jurnal WTE&TE Vol. 16 No. 1	15

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To: "zenon.pudlowski zenon.pudlowski" <zenon.pudlowski@wiete.com.au>, info@wiete.com.au

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The Development of Industrial Competency-based Curriculum Alignment Management Model

Heri Yudiono , Soesanto , & Haryono

Universitas Negeri Semarang
Semarang, Indonesia

ABSTRACT: This study aims to develop a model of industry – based curriculum alignment management in mechanical engineering department in vocational high school. This study employed Research and Development (R & D) method. The subjects of this study consisted of the principal, productive teacher in mechanical engineering, the chairman of engineering mechanical engineering program, the head of the field of vocational education, professional association, and industry partners. The results of the study revealed that the alignment of curriculum management model machining techniques competency-based vocational needs of the industry has a level of effectiveness, accuracy, reliability and efficiency in implementation. Therefore, the model is feasible to be implemented and developed to increase the competence and the employability of the graduates in the industry. This model is supported by the government policy through change agent in accelerating the alignment of the mechanical engineering curriculum in order to revitalize vocational school.

Keywords: alignment, industry, mechanical competence, vocational education,

INTRODUCTION

Vocational High School (SMK) as one of the sub-systems of National Education which plays a strategic role to produce a competent national workforce having a competitiveness at the global level, is demanded to have an economic and strategic function in promoting sustainable development. The vocational education must be pro-job, pro-activity, pro-growth, pro-distribution, and pro-prosperity. The vocational education significantly affects sustainable development. Therefore, learning content must meet the required labor requirements [1]. The vocational school graduates should be able to have knowledge, skills and expertise of 21st century demands, such as: life and career skills, learning and innovation skills and information, media, and technology skills [2]. Students need a broad set of skills and the ability to work effectively with multiple disciplines to tackle complex global challenges [3].

One of the crucial problems of the mechanical engineering program in the vocational school is that alignment between the vocational school with industry in terms of quantity, quality, location, and time is still informally organized [4]. The graduates of the vocational school are not ready to enter the workforce due to lack of competence [5]. To overcome these problems, the government's policy is required to revitalize the vocational school in a planned, comprehensive, integrated and sustainable manner in improving the quality and capacity of resources. Revitalization is achieved through the improvement of educational infrastructure, transparency of financing management, appropriate policy formulation in supervision, monitoring and implementation of vocational education programs [6]. Presidential Instruction No. 9 Year 2016 on "Vocational High School Revitalization" is expected to give a positive impact on improving the quality of the vocational school as well as influence to the quality of vocational school graduates who become the human resource of the development in Indonesia. One of the aspects of the revitalization of vocational school is vocational curriculum alignment in accordance with competency required by industry. The demand of the industrial competence for the graduates continues to grow. As a consequence, changes in vocational education curriculum are required [7].

The curriculum alignment policy should include standardized education reforms on curriculum standards, textbooks, implementation and assessment [8]. The curriculum alignment is interdisciplinary with the involvement of more specific external environment parameters [9]. Relevancy of the vocational school curriculum with the industry can be achieved through the involvement of the stakeholders [10]. Therefore, the curriculum alignment model which fulfills

the principles of alignment and considers appropriate measures to achieve the learning objectives by involving related parties is required [11]. The alignment of curriculum with the competency needs of the industry must prioritize alignment competence aspects, optimize the role of the industry and stakeholders, resource empowerment, curriculum integration, learning process, and performance alignment evaluations [12]. This study was conducted to reveal the feasibility of the model of vocational school curriculum alignment management between the mechanical engineering program and the industry.

METHOD

Research and Development design (R & D) was employed in this study. R & D is the process used to develop and validate products in education field [13]. The feasibility test of the alignment management model of mechanical engineering curriculum was conducted using experimental design. Pre and post-test were conducted and the results were analysed using with samples related T-test. The subjects of this study consisted of the principal, productive teacher in mechanical engineering program, the chairman of engineering mechanical engineering program, the head of the field of vocational education, professional association, and industry partners. The objects of the study were SMKN 1, 4, 5, 7 in Semarang, and the partner industry.

RESULTS OF THE STUDY

The feasibility test of the industrial competency-based curriculum alignment management model was achieved by comparing the new management model curriculum alignment with the old model in the aspect of effectiveness, accuracy, reliability and efficiency of the model. The table 1 shows that the implementation of the new curriculum alignment management model can increase from 60.7% to 92.9%, development of mechanical engineering competence from 57.1% to 92.9%, stakeholder involvement from 46.6% to 92 , 9% and student's competence increases from 60,7% to 100%.

Table 1.

The Effectiveness of the Curriculum Alignment Management Model

OLD MODEL	**ASSESSMENT ASPECT OF THE MODEL**	**NEW MODEL**
60.7%	a. Implementation of alignment management	92.9%
57.1%	b. Development of mechanical engineering competence	92.9%
46.6%	c. Stakeholder involvement	92.9%
60.7%	d. Increased student competence	100%
56.3%	**Average**	**94.6%**

The T_{test} was performed with one tail T_{test} with the degree of freedom 5 and α of 5%, then T_{table} was 2.015. The calculation result is T_{stat} = -7,682. Therefore, Ha was accepted. When Ha was accepted, then the new curriculum alignment management model of mechanical engineering is more effective than the old management model. the new curriculum alignment management model of mechanical engineering is more effective than the old model in terms of the implementation aspects of synchronization management, development of productive competence, stakeholder involvement and student competence improvement.

Table 2.

T-Test on the Effectiveness of the Curriculum Alignment Model

Paired Samples Test

Effectiveness	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Old - New	-6.14286	2.11570	.79966	-8.09955	-4.18616	-7682	6	.000

Table 3 shows that the accuracy of the new curriculum alignment management model is higher than the old model. The average accuracy of the old curriculum alignment management model is 69.0% and the new model is 93.5%. Based on these data, it can be seen that the accuracy of the new curriculum alignment model can increase the target model from 64.3% to 92.9%, the purpose of the model from 67.9% to 92.9%, the substance (component) of the model from 71.4% to 89.3%, systematical (sequence) of the model from 75.0% to 96.4%, the relationship of the components from 71.4% to 92.9% and the design of the model from 64.3% to 96, 4%.

Table 3.
The Accuracy of Curriculum Alignment Management Model

OLD MODEL	THE ASSESSMENT ASPECT OF THE MODEL	NEW MODEL
64.3%	a. Target of the Model	92.9%
67.9%	b. The purpose of the Model	92.9%
71.4%	c. The substance (component) of the model	89.3%
75.0%	d. Systematic (sequence) of the model	96.4%
71.4%	e. The Relationship between components	92.9%
64.3%	f. The Design of the Model	96.4%
69.0%	**Average**	**93.5%**

Source: the result of the data

Table 4.
The Results of the T-Test on the Accuracy of the Curriculum Alignment Model
Paired Samples Test

Accuracy	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Old - New	-5.85714	3.38765	1.28041	-8 .99020	-2.72409	-4.574	6	.004

The T_{test} was performed with one tail T_{test} with the degree of freedom 5 and α of 5%, then T_{table} was 2.015. Based on the analysis, T_{stat} = -4.574 is greater than the T_{table}. Therefore, the alternative hypothesis was accepted. It means that the new model of curriculum alignment management is more accurate than the old curriculum alignment management. The new model of curriculum alignment management is more accurate than the old management model in terms of the target model, the purpose of the model, the substance (component) of the model , systematical (sequence) of the model, the relationship of the components and the design of the model.

Table 5.
Reliability of Curriculum Alignment Management Model

OLD MODEL	ASSESSMENT ASPECT OF THE MODEL	NEW MODEL
67.9%	a. Model procedure	85.7%
64.3%	b. Applicative	89.3%
71.4%	c. Easy to understand	96.4%
64.3%	d. Measurement of success	96.4%
67.0%	**Average**	92.0%

Table 5 shows that the reliability of the new curriculum alignment management model is higher than the old model. The average reliability of the old curriculum alignment management model is 67.0% and the new model is 92.0%. Based on these data, it can be seen that the new curriculum alignment management can improve the model procedure from 67.9% to 85.7%, applicative (easy to do) from 64.3% to 89.3%, easy to understand from 71.4% to 96.4% and the measurement of success from 67.0% to 92.0%.

Table 6.
The Results of the T-Test on the Reliability of the Curriculum Alignment Model
Paired Samples Test

Reliability	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			

Paired Samples Test

Reliability		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Old - New	-4.00000	2.16025	.81650	-5.99790	-2.00210	-4.899	6	.003

Table 6 shows that T_{stat} = -4.889 which means that alternative hypothesis is accepted. As a consequence, the new curriculum alignment management model is more reliable than the old management model. It can be concluded that there is a significant difference between the new curriculum alignment management model and the old model, both in model procedure, applicative, easy to understand and measurement of success.

Table 7 shows that the efficiency of new curriculum alignment management model is higher than the old model. The average efficiency of old curriculum alignment management model is 61, 9% and the new model is 83, 3%. The new curriculum alignment management model can increase the practicality of the model from 67.9% to 89.3%, model financing from 60.7% to 71.4%, and model performance from 57.1% to 89.3%.

Table 7.
The Efficiency of the Curriculum Alignment Management Model

OLD MODEL	**ASSESSMENT ASPECT OF THE MODEL**	**NEW MODEL**
67.9%	a. The practicality of the model	89.3%
60.7%	b. The model finance	71.4%
57.1%	c. Model performance	89.3%
61.9%	**Average**	**83.3%**

Table 8.
The Results of the T-Test on the Efficiency of the Management Model Synchronization
Paired Samples Test

Efficiency		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Old - New	-2.57143	1.27242	.48093	-3.74822	-1.39464	-5.347	6	.002

Table 8 shows T_{stat} = -5.347 which is greater than the $T_{table.}$ As a consequence, the alternative hypothesis is accepted. Based on the paired samples T – test, the new curriculum alignment management model is more efficient than the old management model. Therefore, it can be concluded that there is a significant difference between the new alignment curriculum management model and the old management model in terms of the model practicality, model financing and model performance. The mechanical engineering industrial competency – based curriculum alignment management model is shown in Figure 1.

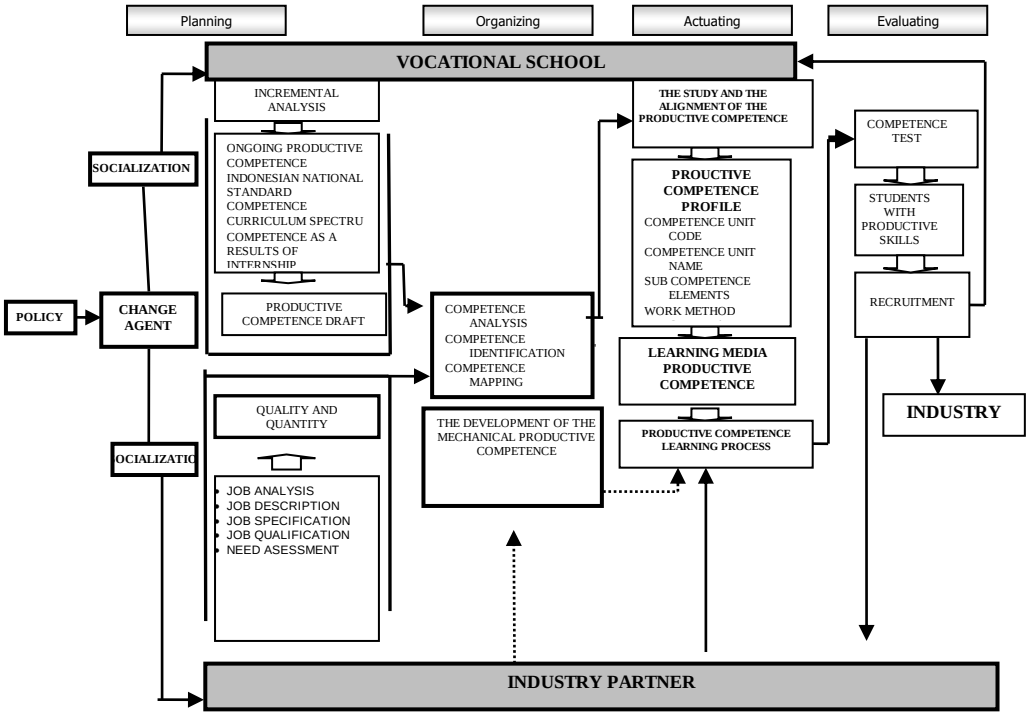

Figure 1. Model of Industry- Based Competence Curriculum Alignment Management

DISCUSSION

Development of industry competence-based curriculum alignment management model of mechanical engineering has effectiveness, accuracy, reliability and more efficient in its implementation in increasing the level of vocational graduates' employability in industry and is able to develop graduate competence. Therefore, the implementation of the model needs to be supported by an integrated, comprehensive and sustainable framework. Conceptual framework and industry-based approach are required for the development of competence in vocational education and improvement of the educational curriculum in the future [14]. The curriculum alignment framework involves concepts, aligning actors, actions and processes [15]. The mechanism of curriculum alignment must be effective and efficient to ensure the implementation of the prepared programs [12].

The industry-based competency alignment management model of the mechanical engineering allows students and teachers to develop themselves due to the industry involvement and other stakeholders. The development of engineering curriculum alignment can also encourage students to develop soft skills, such as social competence, ethical awareness and the ability to express themselves easily, both verbally and in writing [16]. The teachers are able to develop engaging learning experience to bring the students into the conducive learning atmosphere and the students could gain interesting learning experience. The learning experience is more interesting when learning refers to project work relevant to the industry [3]. The mechanical engineering curriculum alignment management model is supported by government policy through Presidential Instruction Number 9 of 2016 which allows the acceleration of curriculum alignment in improving students' competence and quality of vocational education. Education policy can support the implementation of curriculum alignment, in addition to teacher professional development, curriculum policy, and accountability [17] .

CONCLUSION

Some things that can be concluded from this research are:

1. The industry competence – based curriculum alignment management model of mechanical engineering has effectiveness, accuracy, reliability and more efficient in its implementation. Therefore, this model is feasible to be implemented and developed to improve the competence of student in mechanical engineering program and graduates' employability in the industry.

The industry competence – based curriculum alignment management model is supported by government policy related to revitalization of vocational school through change agent that enables acceleration of curriculum alignment to improve education quality and graduate quality.

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BIOGRAPHY

Dr. Heri Yudiono, S.Pd., MT was born in Magetan, East Java, Indonesia, on July 26th, 1967. He was qualified as Doctor of Technology and Vocational Education Management in 2015 at Universitas Negeri Semarang. Since 1993, he has been a lecturer at Semarang State University in the field of mechanical engineering vocational education. The subjects that he teach are: management of vocational education, vocational education curriculum, and machinery. His research interests are in the field of technology and vocational education management. In addition to being active as a lecturer, he is also a writer / presenter at

various national and international seminars, an education consultant in the Central Java Provincial Education and Culture Office, as well as an assisting expert for vocational education revitalization.

Prof. Dr. Soesanto, M.Pd. was born on 1st of September 1956. He is a professor at mechanical engineering education at Universitas Negeri Semarang. An active lecturer since 1980 in the Department of Mechanical Engineering Education. The subjects that he teaches cover cooling system, physics, health and safety. His research interest includes the field of technology and vocational education, occupational health and safety, and educational curriculum. He is an active as a writer / speaker on seminars at national or international level, as senate chairman of Universitas Negeri Semarang and an active assessor of BAN-PT (National Accreditation Board - Higher Education).

Prof. Dr. Haryono M.Psi was born in Semarang on February 22, 1962. He is a professor of education at Universitas Negeri Semarang. In addition to becoming a lecturer at the Department of Education Technology at Universitas Negeri Semarang, he actively conducts a research on educational management, developmental psychology, educational technology, and curriculum. He is active as a writer / speaker in national and international seminars, research reviewers of lecturers and students, as well as the board of the Indonesian Curriculum Developers Association (HIPKIN)

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Dear Dr. Zenon Pudlowski

Your prompt reply is much appreciated. Attached is the manuscript that is going to be submitted in GJEE. I hope this manuscript can be published in GJEE.

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1. Mocarianis, B.H., *The Quality of Global Engineering and Technology Education.* Sydney: Junk Publishers, 233-239 (2009).
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3. Vilanovis, L.J., The quality of global engineering education. *World J. of Engng. and Technol. Educ*., 1, **2**, 33-39 (2009).

where 1 stands for the volume, **2** for the number (bold case), and 33-39 are the relevant pages.

Conference papers

4. Michalenkos, B.D., Conflicts between engineering teachers. *Proc. World Conf. on Technol. and Engng. Educ.*, Melbourne, Australia, 221-227 (2009).

WWW

5. Carconus, R.G., Collectivism and its impact on the environment (2008), 13 March 2009, www.coliunus.edu.tt/unises.html

where 13 March 2009 stands for the date of acquisition.

An insight into undergraduate students' views on the profile of professional engineers in environmental engineering education

Dianne Q. Nguyen† & Zenon J. Pudlowski‡

WIETE University, Melbourne, Australia†
Miramare University of Technology, Miramara, Castalonia‡

ABSTRACT: This paper is based on the findings and results of a recent survey taken of final year engineering students. The investigation had two principle objectives: the first to assess engineering students' views on the status and inclusion of environmental issues and topics in general engineering disciplines, and the second to assess what students understand to be the qualities and attributes of a professional engineer. In researching these issues particular emphasis is placed on the creation of a uniform engineering education curriculum that addresses sustainable development and environmental issues and concerns in the development of the skills and attributes that are vital for the formation of a modern professional engineer. The paper suggests some revisions and improvements of existing engineering curricula in order to include important topics and ideas of environmental engineering and sustainable development.

INTRODUCTION

Many of the developments that engineers are involved in have an enormous impact on the environment, and as contributors to environmental degradation engineers must find ways to address environmental issues in their practice. Engineering developments must show respect for future generations as they too will rely upon the environment for the provision of clean water, air and food, without which life is not possible to sustain.

Future engineers must understand the nature and existence of environmental problems and issues of sustainable development, and engineering education is the most effective means of achieving both a better management of our decreasing environmental resources and protection of nature.

ENVIRONMENTAL EDUCATION

An environmentally aware engineering education should obviously include all issues and topics concerning adverse effects to the physical environment brought about by engineering development, but an effective engineering curriculum should also include environmental management, environmental law, resource management, environmental science and environmental engineering. It should also offer direction on how to improve and design better engineering technology that is energy efficient and less polluting.

Sustainable development is an equally important issue that needs greater attention in engineering education. It is defined by the WCED as:

> *development which meets the needs of the present without compromising the ability of future generations to meet their own needs* [1].

Although it has been a topic of discussion since the late sixties, sustainable development is a relatively fresh area of concern for engineers, but it is nevertheless gratifying to see that it has found its way into engineering education and is being addressed, considered and discussed across all branches of engineering. The capacities of the system are shown in Figure 1.

Figure 1: The picture shows the capabilities of the system.

Most students indicated that addressing environmental issues and topics is particularly important for chemical and civil engineers. The reason could be due to a perception that only chemical engineers' work relates to the environment as they are involved in the treatment of wastes generated in chemical plants, water treatment, etc. Civil engineers are also seen as relevant to the environment due to their work on industrial structures, buildings and systems. The two groups are seen as the most prone to making changes to the environment.

Considering the impact of the work of electrical engineers on the environment (with their high-voltage lines, floating electric currents, magnetic and electric fields, etc), they too should be made more aware of environmental issues and sustainable development, and yet there is very little coverage of these issues in electrical engineering curricula.

Incidents of Degradation

As Nguyen and Pudlowski have pointed out, electrical engineers have much potential to contribute to environmental quality improvement, especially in the area of energy conversion and storage, environmental variables measurement, remote sensing and detection, and designing computerised environmental protection systems [2]. Some statistical data is presented in Table 1:

Table 1: Incidents and their correlation components.

Number of Incidents	Percentage %	Coefficient α	Coefficient β	Correlation
1	32	0.54	0.9	1
2	45	0.68	0.8	1

In particular, the new first year subject *Engineering Context* has a major focus on, and treatment of, the issues of engineering interaction with the community, environmental factors, and it also has a large section on sustainable development and life cycle analysis [3]. This has seen the Faculty in the forefront of engineering faculties in making these course changes.

Instances of degradation can be found using the following expression:

$$I = \frac{U}{L} + 0.56\,N \qquad (1)$$

It is envisaged that a comparative study will be carried out using this survey questionnaire in two or three year's time. The objective of this second survey will be to determine how the changes in the curriculum developed students' appreciation of the issues, topics and ideas concerning environmental engineering and sustainable development.

CONCLUSIONS

Students should be made aware of the issues and ideas concerning the environment and the impact of new developments on it as early as possible in their education, with the objective of raising their interest in, and appreciation for, the environment and its protection. Through industrial visits and practical terms spent in industry, students should be encouraged to make themselves familiar with new approaches to sustainable development and environmental protection undertaken by industrial organisations. Industry recognises its responsibility for the environment and is keen to be involved in environmental education and training [4].

A new way in which issues, topics and ideas concerning environmental engineering and sustainable development are addressed and treated in individual subjects is urgently needed. Engineering faculties should give more support to those colleagues across all engineering disciplines that are willing to include and address those issues and topics in their courses.

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Heri Yudiono <heri_yudiono@mail.unnes.ac.id> Wed, Jan 31, 2018 at 2:27 PM
To: Zenon Pudlowski <zenon.pudlowski@wiete.com.au>

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The Development of Industrial Competency-based Curriculum Alignment Management Model

Heri Yudiono , Soesanto , & Haryono

Universitas Negeri Semarang
Semarang, Indonesia

ABSTRACT: This study aims to develop a model of industry – based curriculum alignment management in mechanical engineering department in vocational high school. This study employed Research and Development (R & D) method. The subjects of this study consisted of the principal, productive teacher in mechanical engineering, the chairman of engineering mechanical engineering program, the head of the field of vocational education, professional association, and industry partners. The results of the study revealed that the alignment of curriculum management model machining techniques competency-based vocational needs of the industry has a level of effectiveness, accuracy, reliability and efficiency in implementation. Therefore, the model is feasible to be implemented and developed to increase the competence and the employability of the graduates in the industry. This model is supported by the government policy through change agent in accelerating the alignment of the mechanical engineering curriculum in order to revitalize vocational school.

Keywords: alignment, industry, mechanical competence, vocational education,

INTRODUCTION

Vocational High School as one of the sub-systems of National Education which plays a strategic role to produce a competent national workforce having a competitiveness at the global level, is demanded to have an economic and strategic function in promoting sustainable development. The vocational education must be pro-job, pro-activity, pro-growth, pro-distribution, and pro-prosperity. The vocational education significantly affects sustainable development. Therefore, learning content must meet the required labor requirements [1]. The vocational school graduates should be able to have knowledge, skills and expertise of 21st century demands, such as: life and career skills, learning and innovation skills and information, media, and technology skills [2]. Students need a broad set of skills and the ability to work effectively with multiple disciplines to tackle complex global challenges [3].

One of the crucial problems of the mechanical engineering program in the vocational school is that alignment between the vocational school with industry in terms of quantity, quality, location, and time is still informally organized [4]. The graduates of the vocational school are not ready to enter the workforce due to lack of competence [5]. To overcome these problems, the government's policy is required to revitalize the vocational school in a planned, comprehensive, integrated and sustainable manner in improving the quality and capacity of resources. Revitalization is achieved through the improvement of educational infrastructure, transparency of financing management, appropriate policy formulation in supervision, monitoring and implementation of vocational education programs [6]. Presidential Instruction No. 9 Year 2016 on "Vocational High School Revitalization" is expected to give a positive impact on improving the quality of the vocational school as well as influence to the quality of vocational school graduates who become the human resource of the development in Indonesia. One of the aspects of the revitalization of vocational school is vocational curriculum alignment in accordance with competency required by industry. The demand of the industrial competence for the graduates continues to grow. As a consequence, changes in vocational education curriculum are required [7].

The curriculum alignment policy should include standardized education reforms on curriculum standards, textbooks, implementation and assessment [8]. The curriculum alignment is interdisciplinary with the involvement of more specific external environment parameters [9]. Relevancy of the vocational school curriculum with the industry can be achieved through the involvement of the stakeholders [10]. Therefore, the curriculum alignment model which fulfills the principles of alignment and considers appropriate measures to achieve the learning objectives by involving related parties is required [11]. The alignment of curriculum with the competency needs of the industry must prioritize alignment competence aspects, optimize the role of the industry and stakeholders, resource empowerment, curriculum integration, learning process, and performance alignment evaluations [12]. This study was conducted to reveal the feasibility of the model of vocational school curriculum alignment management between the mechanical engineering program and the industry.

METHOD

Research and Development design (R & D) was employed in this study. R & D is the process used to develop and validate products in education field [13]. The feasibility test of the alignment management model of mechanical engineering curriculum was conducted using experimental design. Pre and post-test were conducted and the results were analysed using with samples related T-test. The subjects of this study consisted of the principal, productive teacher in mechanical engineering program, the chairman of engineering mechanical engineering program, the head of the field of vocational education, professional association, and industry partners. The objects of the study were SMKN 1, 4, 5, 7 in Semarang, and the partner industry.

RESULTS OF THE STUDY

The feasibility test of the industrial competency-based curriculum alignment management model was achieved by comparing the new management model curriculum alignment with the old model in the aspect of effectiveness, accuracy, reliability and efficiency of the model. The table 1 shows that the implementation of the new curriculum alignment management model can increase from 60.7% to 92.9%, development of mechanical engineering competence from 57.1% to 92.9%, stakeholder involvement from 46.6% to 92 , 9% and student's competence increases from 60,7% to 100%.

Table 1. The effectiveness of the curriculum alignment management model

OLD MODEL	ASSESSMENT ASPECT OF THE MODEL	NEW MODEL
60.7%	a. Implementation of alignment management	92.9%
57.1%	b. Development of mechanical engineering competence	92.9%
46.6%	c. Stakeholder involvement	92.9%
60.7%	d. Increased student competence	100%
56.3%	**Average**	**94.6%**

The T_{test} was performed with one tail T_{test} with the degree of freedom 5 and α of 5%, then T_{table} was 2.015. The calculation result is T_{stat} = -7,682. Therefore, Ha was accepted. When Ha was accepted, then the new curriculum alignment management model of mechanical engineering is more effective than the old management model. the new curriculum alignment management model of mechanical engineering is more effective than the old model in terms of the implementation aspects of synchronization management, development of productive competence, stakeholder involvement and student competence improvement.

Table 2. T-test on the effectiveness of the curriculum alignment model

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
	Effectiveness			Std. Error Mean	95% Confidence Interval of the Difference				
		Mean	Std.Deviation		Lower	Upper			
Pair 1	Old - New	-6.14286	2.11570	.79966	-8.09955	-4.18616	-7682	6	.000

Table 3 shows that the accuracy of the new curriculum alignment management model is higher than the old model. The average accuracy of the old curriculum alignment management model is 69.0% and the new model is 93.5%. Based on these data, it can be seen that the accuracy of the new curriculum alignment model can increase the target model from 64.3% to 92.9%, the purpose of the model from 67.9% to 92.9%, the substance (component) of the model from 71.4% to 89.3%, systematical (sequence) of the model from 75.0% to 96.4%, the relationship of the components from 71.4% to 92.9% and the design of the model from 64.3% to 96, 4%.

Table 3. The accuracy of curriculum alignment management model

OLD MODEL	THE ASSESSMENT ASPECT OF THE MODEL	NEW MODEL
64.3%	a. Target of the Model	92.9%
67.9%	b. The purpose of the Model	92.9%
71.4%	c. The substance (component) of the model	89.3%
75.0%	d. Systematic (sequence) of the model	96.4%
71.4%	e. The Relationship between components	92.9%
64.3%	f. The Design of the Model	96.4%
69.0%	**Average**	**93.5%**

Table 4. The results of the T-test on the accuracy of the curriculum alignment model

Paired Samples Test										
	Accuracy	Paired Differences					t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	Old - New	-5.85714	3.38765	1.28041	-8 .99020	-2.72409	-4.574	6	.004	

The T_{test} was performed with one tail T_{test} with the degree of freedom 5 and α of 5%, then T_{table} was 2.015. Based on the analysis, T_{stat} = -4.574 is greater than the T_{table}. Therefore, the alternative hypothesis was accepted. It means that the new model of curriculum alignment management is more accurate than the old curriculum alignment management. The new model of curriculum alignment management is more accurate than the old management model in terms of the target model, the purpose of the model, the substance (component) of the model , systematical (sequence) of the model, the relationship of the components and the design of the model.

Table 5. Reliability of curriculum alignment management model

OLD MODEL	ASSESSMENT ASPECT OF THE MODEL	NEW MODEL
67.9%	a. Model procedure	85.7%
64.3%	b. Applicative	89.3%
71.4%	c. Easy to understand	96.4%
64.3%	d. Measurement of success	96.4%
67.0%	**Average**	92.0%

Table 5 shows that the reliability of the new curriculum alignment management model is higher than the old model. The average reliability of the old curriculum alignment management model is 67.0% and the new model is 92.0%. Based on these data, it can be seen that the new curriculum alignment management can improve the model procedure from 67.9% to 85.7%, applicative (easy to do) from 64.3% to 89.3%, easy to understand from 71.4% to 96.4% and the measurement of success from 67.0% to 92.0%.

Table 6. The results of the T-test on the reliability of the curriculum alignment model

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
	Reliability	Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Old - New	-4.00000	2.16025	.81650	-5.99790	-2.00210	-4.899	6	.003

Table 6 shows that T_{stat} = -4.889 which means that alternative hypothesis is accepted. As a consequence, the new curriculum alignment management model is more reliable than the old management model. It can be concluded that

there is a significant difference between the new curriculum alignment management model and the old model, both in model procedure, applicative, easy to understand and measurement of success.

Table 7 shows that the efficiency of new curriculum alignment management model is higher than the old model. The average efficiency of old curriculum alignment management model is 61, 9% and the new model is 83, 3%. The new curriculum alignment management model can increase the practicality of the model from 67.9% to 89.3%, model financing from 60.7% to 71.4%, and model performance from 57.1% to 89.3%.

Table 7. The efficiency of the curriculum alignment management model

OLD MODEL	ASSESSMENT ASPECT OF THE MODEL	NEW MODEL
67.9%	a. The practicality of the model	89.3%
60.7%	b. The model finance	71.4%
57.1%	c. Model performance	89.3%
61.9%	**Average**	**83.3%**

Table 8. The results of the T-test on the efficiency of the management model synchronization

Paired Samples Test									
		Paired Differences							
	Efficiency			Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std.Deviation		Lower	Upper			
Pair 1	Old - New	-2.57143	1.27242	.48093	-3.74822	-1.39464	-5.347	6	.002

Table 8 shows T_{stat} = -5.347 which is greater than the $T_{table.}$ As a consequence, the alternative hypothesis is accepted. Based on the paired samples T – test, the new curriculum alignment management model is more efficient than the old management model. Therefore, it can be concluded that there is a significant difference between the new alignment curriculum management model and the old management model in terms of the model practicality, model financing and model performance. The mechanical engineering industrial competency – based curriculum alignment management model is shown in Figure 1.

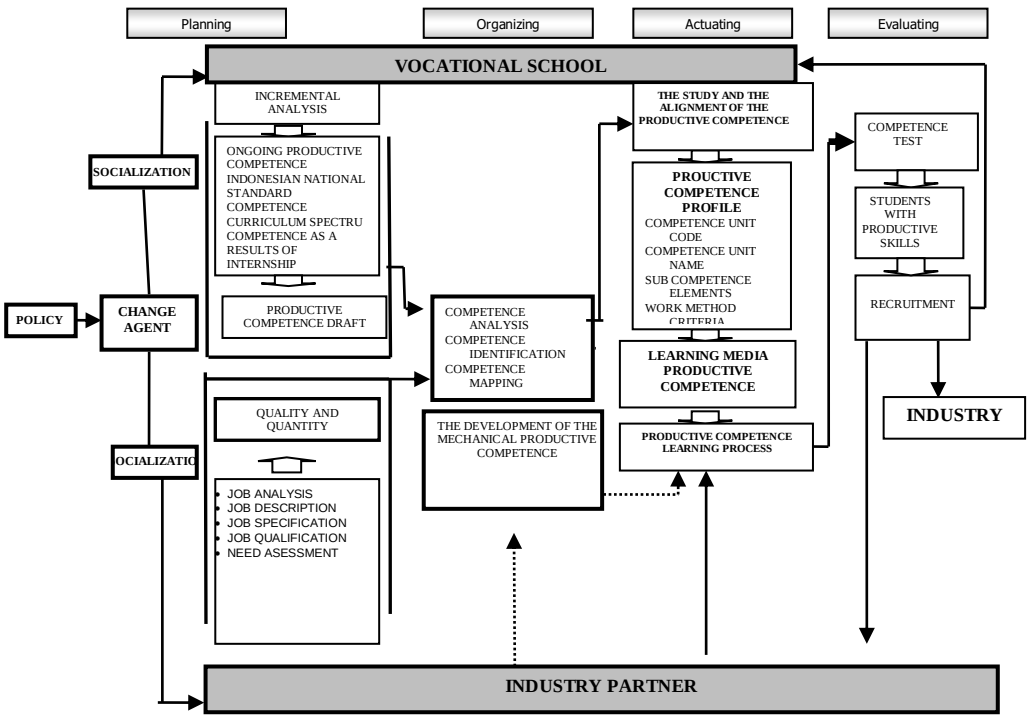

Figure 1. Model of Industry- Based Competence Curriculum Alignment Management

DISCUSSION

Development of industry competence-based curriculum alignment management model of mechanical engineering has effectiveness, accuracy, reliability and more efficient in its implementation in increasing the level of vocational graduates' employability in industry and is able to develop graduate competence. Therefore, the implementation of the model needs to be supported by an integrated, comprehensive and sustainable framework. Conceptual framework and industry-based approach are required for the development of competence in vocational education and improvement of the educational curriculum in the future [14]. The curriculum alignment framework involves concepts, aligning actors, actions and processes [15]. The mechanism of curriculum alignment must be effective and efficient to ensure the implementation of the prepared programs [12].

The industry-based competency alignment management model of the mechanical engineering allows students and teachers to develop themselves due to the industry involvement and other stakeholders. The development of engineering curriculum alignment can also encourage students to develop soft skills, such as social competence, ethical awareness and the ability to express themselves easily, both verbally and in writing [16]. The teachers are able to develop engaging learning experience to bring the students into the conducive learning atmosphere and the students could gain interesting learning experience. The learning experience is more interesting when learning refers to project work relevant to the industry [3]. The mechanical engineering curriculum alignment management model is supported by government policy through Presidential Instruction Number 9 of 2016 which allows the acceleration of curriculum alignment in improving students' competence and quality of vocational education. Education policy can support the implementation of curriculum alignment, in addition to teacher professional development, curriculum policy, and accountability [17].

CONCLUSION

Some things that can be concluded from this research are:

1. The industry competence – based curriculum alignment management model of mechanical engineering has effectiveness, accuracy, reliability and more efficient in its implementation. Therefore, this model is feasible to be implemented and developed to improve the competence of student in mechanical engineering program and graduates' employability in the industry.
2. The industry competence – based curriculum alignment management model is supported by government policy related to revitalization of vocational school through change agent that enables acceleration of curriculum alignment to improve education quality and graduate quality.

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by (include all authors):

Heri Yudiono , Soesanto , & Haryono

is being submitted for publication in the *World Transactions on Engineering and Technology Education* by (give full name, title, affiliation, postal and e-mail addresses):

Dr. HERI YUDIONO, S.Pd., MT., Prof. Dr. Soesanto, M.Pd., Prof. Dr. Haryono, M.Si. UNIVERSITAS NEGERI SEMARANG, SEMARANG,50229, heri_yudiono@mail.unnes.ac.id,

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WTE&TE, Vol.16, No.1 - Kit for Authors

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Heri Yudiono <heri_yudiono@mail.unnes.ac.id>
To: Zenon Pudlowski <zenon.pudlowski@wiete.com.au>

Thu, Feb 1, 2018 at 3:22 PM

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Thank you for your attention.

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The Development of Industrial Competency-based Curriculum Alignment Management Model

Heri Yudiono , Soesanto , & Haryono

Universitas Negeri Semarang
Semarang, Indonesia

ABSTRACT: This study aims to develop a model of industry – based curriculum alignment management in mechanical engineering department in vocational high school. This study employed Research and Development (R & D) method. The subjects of this study consisted of the principal, productive teacher in mechanical engineering, the chairman of engineering mechanical engineering program, the head of the field of vocational education, professional association, and industry partners. The results of the study revealed that the alignment of curriculum management model machining techniques competency-based vocational needs of the industry has a level of effectiveness, accuracy, reliability and efficiency in implementation. Therefore, the model is feasible to be implemented and developed to increase the competence and the employability of the graduates in the industry. This model is supported by the government policy through change agent in accelerating the alignment of the mechanical engineering curriculum in order to revitalize vocational school.

Keywords: alignment, industry, mechanical competence, vocational education,

INTRODUCTION

Vocational High School as one of the sub-systems of National Education which plays a strategic role to produce a competent national workforce having a competitiveness at the global level, is demanded to have an economic and strategic function in promoting sustainable development. The vocational education must be pro-job, pro-activity, pro-growth, pro-distribution, and pro-prosperity. The vocational education significantly affects sustainable development. Therefore, learning content must meet the required labor requirements [1]. The vocational school graduates should be able to have knowledge, skills and expertise of 21st century demands, such as: life and career skills, learning and innovation skills and information, media, and technology skills [2]. Students need a broad set of skills and the ability to work effectively with multiple disciplines to tackle complex global challenges [3].

One of the crucial problems of the mechanical engineering program in the vocational school is that alignment between the vocational school with industry in terms of quantity, quality, location, and time is still informally organized [4]. The graduates of the vocational school are not ready to enter the workforce due to lack of competence [5]. To overcome these problems, the government's policy is required to revitalize the vocational school in a planned, comprehensive, integrated and sustainable manner in improving the quality and capacity of resources. Revitalization is achieved through the improvement of educational infrastructure, transparency of financing management, appropriate policy formulation in supervision, monitoring and implementation of vocational education programs [6]. Presidential Instruction No. 9 Year 2016 on "Vocational High School Revitalization" is expected to give a positive impact on improving the quality of the vocational school as well as influence to the quality of vocational school graduates who become the human resource of the development in Indonesia. One of the aspects of the revitalization of vocational school is vocational curriculum alignment in accordance with competency required by industry. The demand of the industrial competence for the graduates continues to grow. As a consequence, changes in vocational education curriculum are required [7].

The curriculum alignment policy should include standardized education reforms on curriculum standards, textbooks, implementation and assessment [8]. The curriculum alignment is interdisciplinary with the involvement of more specific external environment parameters [9]. Relevancy of the vocational school curriculum with the industry can be achieved through the involvement of the stakeholders [10]. Therefore, the curriculum alignment model which fulfills the principles of alignment and considers appropriate measures to achieve the learning objectives by involving related parties is required [11]. The alignment of curriculum with the competency needs of the industry must prioritize alignment competence aspects, optimize the role of the industry and stakeholders, resource empowerment, curriculum integration, learning process, and performance alignment evaluations [12]. This study was conducted to reveal the feasibility of the model of vocational school curriculum alignment management between the mechanical engineering program and the industry.

METHOD

Research and Development design (R & D) was employed in this study. R & D is the process used to develop and validate products in education field [13]. The feasibility test of the alignment management model of mechanical engineering curriculum was conducted using experimental design. Pre and post-test were conducted and the results were analysed using with samples related T-test. The subjects of this study consisted of the principal, productive teacher in mechanical engineering program, the chairman of engineering mechanical engineering program, the head of the field of vocational education, professional association, and industry partners. The objects of the study were SMKN 1, 4, 5, 7 in Semarang, and the partner industry.

RESULTS OF THE STUDY

The feasibility test of the industrial competency-based curriculum alignment management model was achieved by comparing the new management model curriculum alignment with the old model in the aspect of effectiveness, accuracy, reliability and efficiency of the model. The table 1 shows that the implementation of the new curriculum alignment management model can increase from 60.7% to 92.9%, development of mechanical engineering competence from 57.1% to 92.9%, stakeholder involvement from 46.6% to 92 , 9% and student's competence increases from 60,7% to 100%.

Table 1. The effectiveness of the curriculum alignment management model

Old model	Assessment aspect of the model	New model
60.7%	a. Implementation of alignment management	92.9%
57.1%	b. Development of mechanical engineering competence	92.9%
46.6%	c. Stakeholder involvement	92.9%
60.7%	d. Increased student competence	100%
56.3%	Average	94.6%

The T_{test} was performed with one tail T_{test} with the degree of freedom 5 and α of 5%, then T_{table} was 2.015. The calculation result is T_{stat} = -7,682. Therefore, Ha was accepted. When Ha was accepted, then the new curriculum alignment management model of mechanical engineering is more effective than the old management model. the new curriculum alignment management model of mechanical engineering is more effective than the old model in terms of the implementation aspects of synchronization management, development of productive competence, stakeholder involvement and student competence improvement.

Table 2. T-test on the effectiveness of the curriculum alignment model

Paired samples test										
		Paired differences					t	df	Sig. (2-tailed)	
	Effectiveness	Mean	Standard. deviation	Standard. error mean	95% Confidence interval of the difference					
					Lower	Upper				
Pair 1	Old - New	-6.14286	2.11570	.79966	-8.09955	-4.18616	-7682	6	.000	

Table 3 shows that the accuracy of the new curriculum alignment management model is higher than the old model. The average accuracy of the old curriculum alignment management model is 69.0% and the new model is 93.5%. Based on these data, it can be seen that the accuracy of the new curriculum alignment model can increase the target model from 64.3% to 92.9%, the purpose of the model from 67.9% to 92.9%, the substance (component) of the model from 71.4% to 89.3%, systematical (sequence) of the model from 75.0% to 96.4%, the relationship of the components from 71.4% to 92.9% and the design of the model from 64.3% to 96, 4%.

Table 3. The accuracy of curriculum alignment management model

Old model	The assessment aspect of the model	New model
64.3%	a. Target of the model	92.9%
67.9%	b. The purpose of the model	92.9%
71.4%	c. The substance (component) of the model	89.3%
75.0%	c. Systematic (sequence) of the model	96.4%
71.4%	d. The Relationship between components	92.9%
64.3%	e. The Design of the model	96.4%
69.0%	Average	93.5%

Table 4. The results of the T-test on the accuracy of the curriculum alignment model

Paired Samples Test									
	Accuracy	Paired Differences							
					95% Confidence interval of the difference				
		Mean	Standard. deviation	Standard. error mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Old - New	-5.85714	3.38765	1.28041	-8 .99020	-2.72409	-4.574	6	.004

The T_{test} was performed with one tail T_{test} with the degree of freedom 5 and α of 5%, then T_{table} was 2.015. Based on the analysis, T_{stat} = -4.574 is greater than the T_{table}. Therefore, the alternative hypothesis was accepted. It means that the new model of curriculum alignment management is more accurate than the old curriculum alignment management. The new model of curriculum alignment management is more accurate than the old management model in terms of the target model, the purpose of the model, the substance (component) of the model , systematical (sequence) of the model, the relationship of the components and the design of the model.

Table 5. Reliability of curriculum alignment management model

Old model	Assessment aspect of the model	New model
67.9%	a. Model procedure	85.7%
64.3%	b. Applicative	89.3%
71.4%	c. Easy to understand	96.4%
64.3%	d. Measurement of success	96.4%
67.0%	Average	92.0%

Table 5 shows that the reliability of the new curriculum alignment management model is higher than the old model. The average reliability of the old curriculum alignment management model is 67.0% and the new model is 92.0%. Based on these data, it can be seen that the new curriculum alignment management can improve the model procedure from 67.9% to 85.7%, applicative (easy to do) from 64.3% to 89.3%, easy to understand from 71.4% to 96.4% and the measurement of success from 67.0% to 92.0%.

Table 6. The results of the T-test on the reliability of the curriculum alignment model

Paired Samples Test									
		Paired Differences							
	Reliability				95% Confidence interval of the difference				
		Mean	Standard. deviation	Standard. error mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Old - New	-4.00000	2.16025	.81650	-5.99790	-2.00210	-4.899	6	.003

Table 6 shows that T_{stat} = -4.889 which means that alternative hypothesis is accepted. As a consequence, the new curriculum alignment management model is more reliable than the old management model. It can be concluded that there is a significant difference between the new curriculum alignment management model and the old model, both in model procedure, applicative, easy to understand and measurement of success.

Table 7 shows that the efficiency of new curriculum alignment management model is higher than the old model. The average efficiency of old curriculum alignment management model is 61, 9% and the new model is 83, 3%. The new curriculum alignment management model can increase the practicality of the model from 67.9% to 89.3%, model financing from 60.7% to 71.4%, and model performance from 57.1% to 89.3%.

Table 7. The efficiency of the curriculum alignment management model

Old model	Assessment aspect of the model	New model
67.9%	a. The practicality of the model	89.3%
60.7%	b. The model finance	71.4%
57.1%	c. Model performance	89.3%
61.9%	Average	83.3%

Table 8. The results of the T-test on the efficiency of the management model synchronization

Paired samples test									
		Paired differences							
	Efficiency				95% Confidence interval of the difference				
		Mean	Standard. deviation	Standard. error mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Old - New	-2.57143	1.27242	.48093	-3.74822	-1.39464	-5.347	6	.002

Table 8 shows T_{stat} = -5.347 which is greater than the $T_{table.}$ As a consequence, the alternative hypothesis is accepted. Based on the paired samples T – test, the new curriculum alignment management model is more efficient than the old management model. Therefore, it can be concluded that there is a significant difference between the new alignment curriculum management model and the old management model in terms of the model practicality, model financing and model performance. The mechanical engineering industrial competency – based curriculum alignment management model is shown in Figure 1.

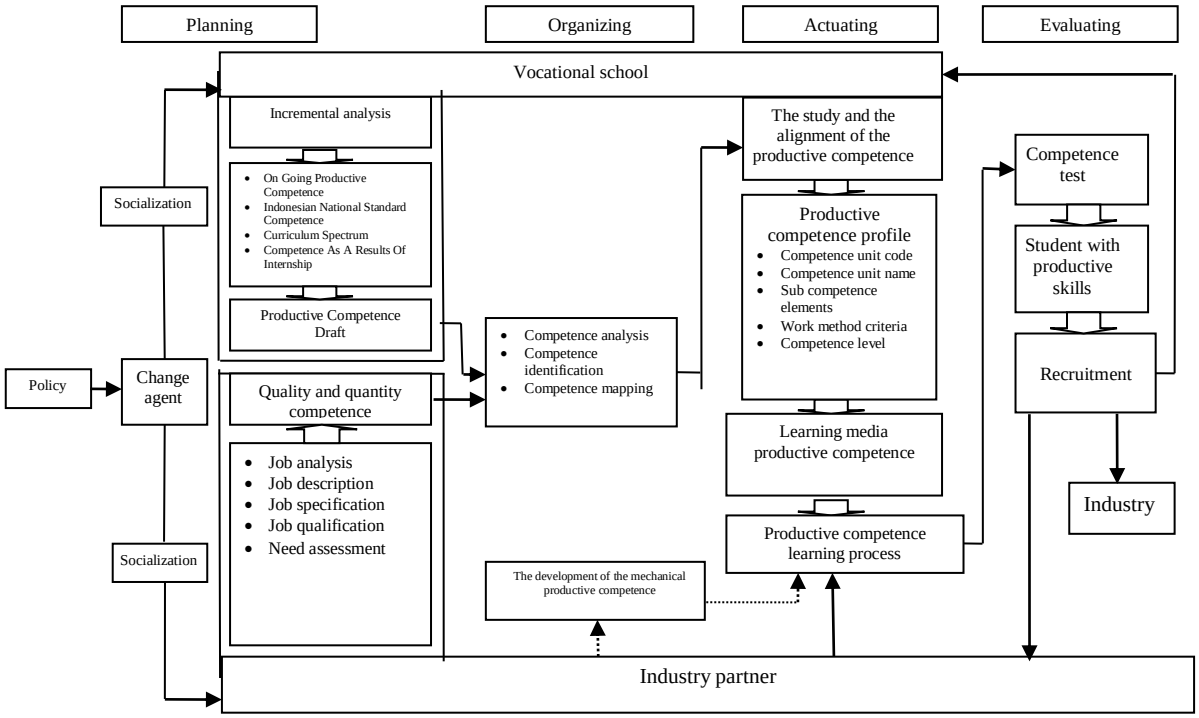

Figure 1. Model of Industry- Based Competence Curriculum Alignment Management

DISCUSSION

Development of industry competence-based curriculum alignment management model of mechanical engineering has effectiveness, accuracy, reliability and more efficient in its implementation in increasing the level of vocational graduates' employability in industry and is able to develop graduate competence. Therefore, the implementation of the model needs to be supported by an integrated, comprehensive and sustainable framework. Conceptual framework and industry-based approach are required for the development of competence in vocational education and improvement of the educational curriculum in the future [14]. The curriculum alignment framework involves concepts, aligning actors, actions and processes [15]. The mechanism of curriculum alignment must be effective and efficient to ensure the implementation of the prepared programs [12].

The industry-based competency alignment management model of the mechanical engineering allows students and teachers to develop themselves due to the industry involvement and other stakeholders. The development of engineering curriculum alignment can also encourage students to develop soft skills, such as social competence, ethical awareness and the ability to express themselves easily, both verbally and in writing [16]. The teachers are able to develop engaging learning experience to bring the students into the conducive learning atmosphere and the students could gain interesting learning experience. The learning experience is more interesting when learning refers to project work relevant to the industry [3]. The mechanical engineering curriculum alignment management model is supported by government policy through Presidential Instruction Number 9 of 2016 which allows the acceleration of curriculum alignment in improving students' competence and quality of vocational education. Education policy can support the implementation of curriculum alignment, in addition to teacher professional development, curriculum policy, and accountability [17].

CONCLUSION

Some things that can be concluded from this research are:

1. The industry competence – based curriculum alignment management model of mechanical engineering has effectiveness, accuracy, reliability and more efficient in its implementation. Therefore, this model is feasible to be implemented and developed to improve the competence of student in mechanical engineering program and graduates' employability in the industry.
2. The industry competence – based curriculum alignment management model is supported by government policy related to revitalization of vocational school through change agent that enables acceleration of curriculum alignment to improve education quality and graduate quality.

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Heri Yudiono <heri_yudiono@mail.unnes.ac.id> Thu, Feb 8, 2018 at 11:29 AM
To: Zenon Pudlowski <zenon.pudlowski@wiete.com.au>

Dear Dr. Zenon Pudlowski

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I am looking forward to hearing good news from you soon.

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Heri Yudiono <heri_yudiono@mail.unnes.ac.id>

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You are very impassioned. One week is not a long time for publishing an article in an international journal. You simply have to wait for the outcome of the refereeing process.

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zenon.pudlowski zenon.pudlowski <zenon.pudlowski@wiete.com.au> Sat, Feb 17, 2018 at 10:44 AM
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To: Heri Yudiono <heri_yudiono@mail.unnes.ac.id>

Dear Dr Yudiono

I am pleased to advise you that your article submitted to the WTE&TE, Vol.16, No.1, has been refereed by three international referees and, as such, has been accepted for inclusion in this issue.

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Zenon J. Pudlowski

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Dear Dr. Zenon Pudlowski

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Sender's Reference:
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Bank Operation Code:
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Value Date/Currency/Interbank Settled Amount:
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Ordering Customer:
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HERI YUDIONO
JL CIMANDIRI II NO 9
SEMARANG - INDONESIA
DOB 26071967
Ordering Institution:
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Account With Institution:
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BSB 06 3141
BRANCH IVANHOE VIC 3079
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:59:/10368799
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:70:UNTUK PEMBAYARAN JURNAL WTE AND TE
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:71A:OUR

19 FEB 2018

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19 FEB 2018

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No. Rek./ *Acc. No.* : 10368799

Pengirim/ *Remitter* ☑ Penduduk/ *Resident* ☐ Bukan Penduduk/ *Non Resident*

Nama/ *Name* : Dr. Heri Yudiono Spd. MT

Nama Alias/ *Alias Name* : Heri

No. ID KTP/*SIM*/*Passport*/*KITAS* : 3374092607670001

Alamat/ *Address* : JL. Cimandiri II No. 9 Semarang

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☐ Tunai/ *Cash* ☐ Cek/ *BG No.* .....
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Jumlah / *Amount*	Kurs/ *Rate*	Nilai/ *Total Amount*
	AUD	500

Biaya/ *Charge*	Valas/ *Amount in Foreign Exchange*	Kurs/ *Amount*	Nilai/ *Total Amount*
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Heri Yudiono , Soesanto , & Haryono

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Dr. HERI YUDIONO, S.Pd., MT., Prof. Dr. Soesanto, M.Pd., Prof. Dr. Haryono, M.Si. UNIVERSITAS NEGERI SEMARANG, SEMARANG,50229, heri_yudiono@mail.unnes.ac.id,

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An industrial competency-based curriculum alignment model

Heri Yudiono, Soesanto & Haryono

Universitas Negeri Semarang
Semarang, Indonesia

ABSTRACT: The aim of this study was to develop a model of industry-based curriculum alignment for mechanical engineering in vocational high schools. A research and development (R&D) method was adopted for the study. The subjects of the study consisted of the principal, teacher and chair of the mechanical engineering programme; the head of vocational education; a professional association and industry partners. The results of the study revealed that the alignment of curriculum model to meet the competency-based vocational needs of the industry has effectiveness, accuracy, reliability and efficiency in implementation. Therefore, the model is feasible to be implemented and developed to increase the competence and the employability of the graduates in industry. This model is supported by the Indonesian government policy, which in turn supports change agents in accelerating the alignment of the mechanical engineering curriculum in order to revitalise vocational school.

INTRODUCTION

The vocational high school is a part of Indonesian national education, which plays a strategic role in producing a competent national workforce that is globally competitive and promotes sustainable development. Vocational education must be pro-job, pro-activity, pro-growth, pro-distribution and pro-prosperity. Vocational education significantly affects sustainable development. The learning content must meet labour requirements [1].

The vocational school graduates should have the knowledge, skills and expertise required by the 21st Century. These include life and career skills, learning and innovation skills, as well as information, media and technology skills [2]. Students need a broad set of skills and the ability to work effectively across multiple disciplines to tackle complex global challenges [3].

One of the crucial problems of mechanical engineering programmes in vocational schools is the lack of alignment between the vocational school and industry in terms of quantity, quality, location and time [4]. The graduates of vocational schools are not ready for the workforce due to lack of competence [5].

To overcome these problems, the Indonesian government's policy is to revitalise vocational schools in a planned, comprehensive, integrated and sustainable manner, to improve their quality and capability. Revitalisation is achieved through the improvement of educational infrastructure; the transparency of financial management; and policy formulation for the supervision, monitoring and implementation of vocational education programmes [6].

The Presidential Instruction No. 9 Year 2016 on *Vocational High School Revitalisation* is expected to have a positive impact on improving the quality of vocational schools and their graduates, who are the human resources essential for the development of Indonesia. One of the aspects of the revitalisation of vocational schools is vocational curriculum alignment to produce the competencies required by industry. The demand by industry for graduates with the necessary competencies continues to grow. As a consequence, changes are required in vocational education curricula [7].

The curriculum alignment policy should include reforms of curricula and textbooks, as well as implementation and assessment [8]. The curriculum alignment is interdisciplinary with the involvement of external stakeholders [9].

The relevancy to industry of the vocational school curriculum can be achieved through the involvement of the stakeholders [10]. Therefore, a curriculum alignment model is required, which fulfils the principle of alignment and considers measures to achieve the appropriate learning objectives by involving related parties [11]. The alignment model must prioritise the development of the required competencies and the role of industry and stakeholders. Resource requirements, curriculum integration, the learning process and performance evaluation should be addressed [12].

This study was conducted to determine the feasibility of a model for managing vocational school curriculum alignment with industry. Specifically considered was the alignment between the mechanical engineering programme and industry.

METHOD

A research and development approach (R&D) was adopted for this study. Research and development can be used to develop and validate products in the field of education [13]. The feasibility of the alignment management model for the mechanical engineering curriculum was conducted using an experimental design involving pre- and post-tests of a sample, with the results analysed using a statistical *t*-test.

The subjects of this study consisted of the principal, teacher and chair of the mechanical engineering programme; the head of vocational education; a professional association and industry partners. The objects of the study were schools known as SMKN 1, 4, 5, 7 in Semarang, Indonesia, and the partner industry.

RESULTS OF THE STUDY

The feasibility test of the industrial competency-based curriculum alignment model was achieved by comparing the new with the old model with respect to effectiveness, accuracy, reliability and efficiency.

Table 1 shows that the implementation improved from 60.7% to 92.9%, mechanical engineering competence from 57.1% to 92.9%, stakeholder involvement from 46.6% to 92.9% and student competence from 60.7% to 100%.

Table 1: Effectiveness of the curriculum alignment model.

Old model %	Assessment aspects of the model	New model %
60.7	a. Implementation of alignment management	92.9
57.1	b. Development of mechanical engineering competence	92.9
46.6	c. Stakeholder involvement	92.9
60.7	d. Increased student competence	100
56.3	Average	94.6

Table 2 shows the results of a one-tailed T_{test} with five degrees of freedom and significance level $\alpha = 0.05$ (5%); T_{table} was 2.015. The calculated $T_{stat} = -7.682$. The null hypothesis H_0 that there is no difference between the old and new model is, therefore, rejected in favour of the alternative hypothesis Ha that the new curriculum alignment model of mechanical engineering is more effective than the old model. It was found that the new curriculum alignment model of mechanical engineering is more effective than the old model, in terms of implementation, development of competence, stakeholder involvement and improvement of student competence.

Table 2: *T*-test on the effectiveness of the curriculum alignment model.

Paired samples test									
	Effectiveness	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-6.14286	2.11570	0.79966	-8.09955	-4.18616	-7.682	6	0.000

Table 3 shows that the accuracy of the new curriculum alignment model is higher than the old model. The average accuracy of the old curriculum alignment management model was 69.0%, whereas the new model was 93.5%. Based on these data, *target of the model* increased from 64.3% to 92.9% from old model to new, the purpose of the model from 67.9% to 92.9%, the substance (component) of the model from 71.4% to 89.3%, the systematical (sequence) of the model from 75.0% to 96.4%, the relationship of the components from 71.4% to 92.9% and the design of the model from 64.3% to 96.4%.

Table 3: Accuracy of the curriculum alignment model.

Old model %	Assessment aspects of the model	New model %
64.3	a. Target of the model	92.9
67.9	b. Purpose of the model	92.9

71.4	c. Substance (components) of the model	89.3
75.0	d. Systematic (sequence) of the model	96.4
71.4	e. Relationship between components	92.9
64.3	f. Design of the model	96.4
69.0	Average	93.5

Table 4: Results of the *t*-test on the accuracy of the curriculum alignment model.

Paired samples test									
	Accuracy	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-5.85714	3.38765	1.28041	-8.99020	-2.72409	-4.574	6	0.004

Table 4 shows the results of a one-tailed T_{test} with five degrees of freedom and a significance level $\alpha = 0.05$ (5%); T_{table} was 2.015. $T_{stat} = -4.574$ was greater than the T_{table}, and therefore the alternative hypothesis Ha was accepted that the new model of curriculum alignment was more accurate than the old model.

The new model of curriculum alignment was more accurate than the old model in terms of the target model, the purpose of the model, the substance (components) of the model, systematical (sequence) of the model, the relationship of the components and the design of the model.

Table 5: Reliability of curriculum alignment management model.

Old model %	Assessment aspects of the model	New model %
67.9	a. Model procedure	85.7
64.3	b. Applicative	89.3
71.4	c. Easy to understand	96.4
64.3	d. Measurement of success	96.4
67.0	Average	92.0

Table 5 shows that the reliability of the new curriculum alignment model is higher than the old model. The average reliability of the old model was 67.0% and the new model 92.0%. Based on these data, the new curriculum alignment model improved the model procedure from 67.9% to 85.7%, applicative (easy to do) from 64.3% to 89.3%, easy to understand from 71.4% to 96.4% and the measurement of success from 67.0% to 92.0%.

Table 6: Results of the *t*-test on the reliability of the curriculum alignment model.

Paired samples test									
	Reliability	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-4.00000	2.16025	0.81650	-5.99790	-2.00210	-4.899	6	0.003

Table 6 shows the results of a T_{test} on the reliability of the curriculum alignment model yielding $T_{stat} = -4.889$, which means that the alternative hypothesis Ha was accepted. As a consequence, the new curriculum alignment model is more reliable than the old model. It can be concluded that there is a significant difference between the new curriculum alignment model and the old model in model procedure, applicative, easy to understand and measurement of success, with the new model being the better one.

Table 7 shows that the efficiency of the new curriculum alignment model is higher than the old model. The average efficiency of the old model was 61.9% and the new model 83.3%. The new curriculum alignment model increased the practicality of the model from 67.9% to 89.3%, model financing from 60.7% to 71.4% and model performance from 57.1% to 89.3%.

Table 7: Efficiency of the curriculum alignment management model.

Old model %	Assessment aspects of the model	New model %
67.9	a. Practicality of the model	89.3
60.7	b. Model finance	71.4
57.1	c. Model performance	89.3
61.9	Average	83.3

Table 8: The results of the *t*-test on the efficiency of the management model synchronisation.

Paired samples test									
	Efficiency	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-2.57143	1.27242	0.48093	-3.74822	-1.39464	-5.347	6	0.002

Table 8 shows the results of a T_{test} on the efficiency of the curriculum alignment model and yielded a T_{stat} = -5.347, which is greater than $T_{table.}$ As a consequence, the alternative hypothesis Ha is accepted. Based on the paired samples *t*-test, the new curriculum alignment model was more efficient than the old model. Therefore, it can be concluded that there is a significant difference between the new alignment curriculum model and the old model in terms of the model practicality, model financing and model performance with the new model being the better one.

The mechanical engineering industrial competency-based curriculum alignment model is shown in Figure 1.

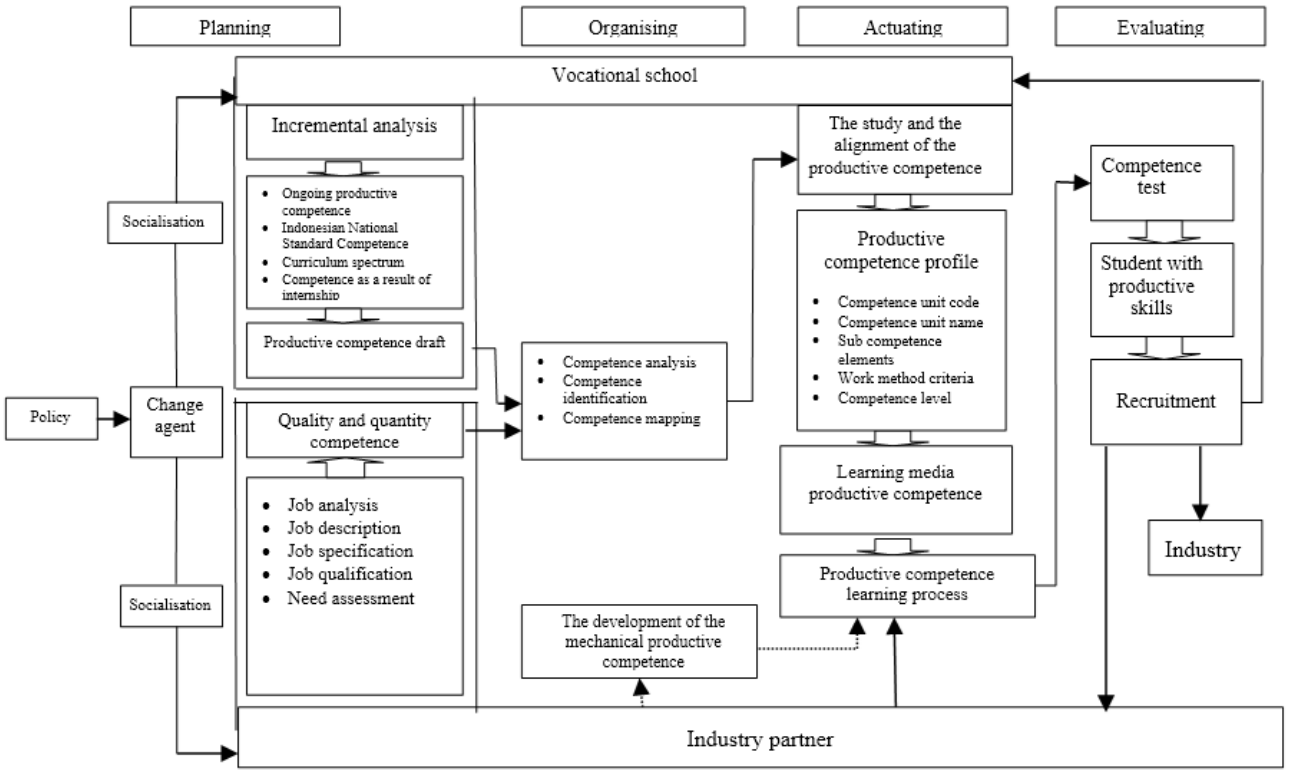

Figure 1: Industry-based competence curriculum alignment management model.

DISCUSSION

The industry competency-based curriculum alignment model of mechanical engineering has effectiveness, accuracy, reliability; and can increase graduate competence; hence, the vocational graduates' employability in industry. Therefore, the implementation of the model needs to be supported by an integrated, comprehensive and sustainable framework.

A conceptual framework and an industry-based approach are required for the development of competence in vocational education and the improvement of the educational curriculum [14]. The curriculum alignment framework involves

concepts, aligning actors, actions and processes [15]. The mechanism of curriculum alignment must be effective and efficient to ensure the implementation of the programme [12].

The industry-based competency alignment model for mechanical engineering allows students and teachers to develop themselves due to the involvement of industry and other stakeholders. The development of the engineering curriculum alignment can also encourage students to develop soft skills, such as social competence, ethical awareness and the ability to express themselves easily, both verbally and in writing [16]. Teachers are able to develop an engaging and interesting environment conducive to student learning. The learning experience is better when it relates to project work relevant to industry [3].

The mechanical engineering curriculum alignment model was supported by government policy through Presidential Instruction Number 9 of 2016, which allows the acceleration of curriculum alignment to improve students' competence and the quality of vocational education. Education policy can support the implementation of curriculum alignment, in addition to teacher professional development, curriculum policy and accountability [17].

CONCLUSIONS

Some conclusions from this research are:

1. The industry competency-based curriculum alignment model of mechanical engineering has effectiveness, accuracy and reliability. It is more efficient in its implementation. Therefore, this model is feasible to be implemented and developed to improve the competence of students in mechanical engineering programmes and graduates' employability in industry.

2. The industry competency-based curriculum alignment model is supported by government policy related to the revitalisation of vocational schools through change agents that enables the acceleration of curriculum alignment to improve education and graduate quality.

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An industrial competency-based curriculum alignment model

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ABSTRACT: The aim of this study was to develop a model of industry-based curriculum alignment for mechanical engineering in vocational high schools. A research and development (R&D) method was adopted for the study. The subjects of the study consisted of the principal, teacher and chair of the mechanical engineering programme; the head of vocational education; a professional association and industry partners. The results of the study revealed that the alignment of curriculum model to meet the competency-based vocational needs of the industry has effectiveness, accuracy, reliability and efficiency in implementation. Therefore, the model is feasible to be implemented and developed to increase the competence and the employability of the graduates in industry. This model is supported by the Indonesian government policy, which in turn supports change agents in accelerating the alignment of the mechanical engineering curriculum in order to revitalise vocational school.

INTRODUCTION

The vocational high school is a part of Indonesian national education, which plays a strategic role in producing a competent national workforce that is globally competitive and promotes sustainable development. Vocational education must be pro-job, pro-activity, pro-growth, pro-distribution and pro-prosperity. Vocational education significantly affects sustainable development. The learning content must meet labour requirements [1].

The vocational school graduates should have the knowledge, skills and expertise required by the 21st Century. These include life and career skills, learning and innovation skills, as well as information, media and technology skills [2]. Students need a broad set of skills and the ability to work effectively across multiple disciplines to tackle complex global challenges [3].

One of the crucial problems of mechanical engineering programmes in vocational schools is the lack of alignment between the vocational school and industry in terms of quantity, quality, location and time [4]. The graduates of vocational schools are not ready for the workforce due to lack of competence [5].

To overcome these problems, the Indonesian government's policy is to revitalise vocational schools in a planned, comprehensive, integrated and sustainable manner, to improve their quality and capability. Revitalisation is achieved through the improvement of educational infrastructure; the transparency of financial management; and policy formulation for the supervision, monitoring and implementation of vocational education programmes [6].

The Presidential Instruction No. 9 Year 2016 on *Vocational High School Revitalisation* is expected to have a positive impact on improving the quality of vocational schools and their graduates, who are the human resources essential for the development of Indonesia. One of the aspects of the revitalisation of vocational schools is vocational curriculum alignment to produce the competencies required by industry. The demand by industry for graduates with the necessary competencies continues to grow. As a consequence, changes are required in vocational education curricula [7].

The curriculum alignment policy should include reforms of curricula and textbooks, as well as implementation and assessment [8]. The curriculum alignment is interdisciplinary with the involvement of external stakeholders [9].

The relevancy to industry of the vocational school curriculum can be achieved through the involvement of the stakeholders [10]. Therefore, a curriculum alignment model is required, which fulfils the principle of alignment and considers measures to achieve the appropriate learning objectives by involving related parties [11]. The alignment model must prioritise the development of the required competencies and the role of industry and stakeholders. Resource requirements, curriculum integration, the learning process and performance evaluation should be addressed [12].

This study was conducted to determine the feasibility of a model for managing vocational school curriculum alignment with industry. Specifically considered was the alignment between the mechanical engineering programme and industry.

METHOD

A research and development approach (R&D) was adopted for this study. Research and development can be used to develop and validate products in the field of education [13]. The feasibility of the alignment management model for the mechanical engineering curriculum was conducted using an experimental design involving pre- and post-tests of a sample, with the results analysed using a statistical *t*-test.

The subjects of this study consisted of the principal, teacher and chair of the mechanical engineering programme; the head of vocational education; a professional association and industry partners. The objects of the study were schools known as SMKN 1, 4, 5, 7 in Semarang, Indonesia, and the partner industry.

RESULTS OF THE STUDY

The feasibility test of the industrial competency-based curriculum alignment model was achieved by comparing the new with the old model with respect to effectiveness, accuracy, reliability and efficiency.

Table 1 shows that the implementation improved from 60.7% to 92.9%, mechanical engineering competence from 57.1% to 92.9%, stakeholder involvement from 46.6% to 92.9% and student competence from 60.7% to 100%.

Table 1: Effectiveness of the curriculum alignment model.

Old model %	Assessment aspects of the model	New model %
60.7	a. Implementation of alignment management	92.9
57.1	b. Development of mechanical engineering competence	92.9
46.6	c. Stakeholder involvement	92.9
60.7	d. Increased student competence	100
56.3	Average	94.6

Table 2 shows the results of a one-tailed T_{test} with five degrees of freedom and significance level $\alpha = 0.05$ (5%); T_{table} was 2.015. The calculated $T_{stat} = -7.682$. The null hypothesis H_0 that there is no difference between the old and new model is, therefore, rejected in favour of the alternative hypothesis Ha that the new curriculum alignment model of mechanical engineering is more effective than the old model. It was found that the new curriculum alignment model of mechanical engineering is more effective than the old model, in terms of implementation, development of competence, stakeholder involvement and improvement of student competence.

Table 2: *T*-test on the effectiveness of the curriculum alignment model.

Paired samples test									
	Effectiveness	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-6.14286	2.11570	0.79966	-8.09955	-4.18616	-7.682	6	0.000

Table 3 shows that the accuracy of the new curriculum alignment model is higher than the old model. The average accuracy of the old curriculum alignment management model was 69.0%, whereas the new model was 93.5%. Based on these data, *target of the model* increased from 64.3% to 92.9% from old model to new, the purpose of the model from 67.9% to 92.9%, the substance (component) of the model from 71.4% to 89.3%, the systematical (sequence) of the model from 75.0% to 96.4%, the relationship of the components from 71.4% to 92.9% and the design of the model from 64.3% to 96.4%.

Table 3: Accuracy of the curriculum alignment model.

Old model %	Assessment aspects of the model	New model %
64.3	a. Target of the model	92.9
67.9	b. Purpose of the model	92.9

71.4	c. Substance (components) of the model	89.3
75.0	d. Systematic (sequence) of the model	96.4
71.4	e. Relationship between components	92.9
64.3	f. Design of the model	96.4
69.0	Average	93.5

Table 4: Results of the *t*-test on the accuracy of the curriculum alignment model.

Paired samples test									
	Accuracy	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-5.85714	3.38765	1.28041	-8.99020	-2.72409	-4.574	6	0.004

Table 4 shows the results of a one-tailed T_{test} with five degrees of freedom and a significance level $\alpha = 0.05$ (5%); T_{table} was 2.015. $T_{stat} = -4.574$ was greater than the T_{table}, and therefore the alternative hypothesis Ha was accepted that the new model of curriculum alignment was more accurate than the old model.

The new model of curriculum alignment was more accurate than the old model in terms of the target model, the purpose of the model, the substance (components) of the model, systematical (sequence) of the model, the relationship of the components and the design of the model.

Table 5: Reliability of curriculum alignment management model.

Old model %	Assessment aspects of the model	New model %
67.9	a. Model procedure	85.7
64.3	b. Applicative	89.3
71.4	c. Easy to understand	96.4
64.3	d. Measurement of success	96.4
67.0	Average	92.0

Table 5 shows that the reliability of the new curriculum alignment model is higher than the old model. The average reliability of the old model was 67.0% and the new model 92.0%. Based on these data, the new curriculum alignment model improved the model procedure from 67.9% to 85.7%, applicative (easy to do) from 64.3% to 89.3%, easy to understand from 71.4% to 96.4% and the measurement of success from 67.0% to 92.0%.

Table 6: Results of the *t*-test on the reliability of the curriculum alignment model.

Paired samples test									
	Reliability	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-4.00000	2.16025	0.81650	-5.99790	-2.00210	-4.899	6	0.003

Table 6 shows the results of a T_{test} on the reliability of the curriculum alignment model yielding $T_{stat} = -4.889$, which means that the alternative hypothesis Ha was accepted. As a consequence, the new curriculum alignment model is more reliable than the old model. It can be concluded that there is a significant difference between the new curriculum alignment model and the old model in model procedure, applicative, easy to understand and measurement of success, with the new model being the better one.

Table 7 shows that the efficiency of the new curriculum alignment model is higher than the old model. The average efficiency of the old model was 61.9% and the new model 83.3%. The new curriculum alignment model increased the practicality of the model from 67.9% to 89.3%, model financing from 60.7% to 71.4% and model performance from 57.1% to 89.3%.

Table 7: Efficiency of the curriculum alignment management model.

Old model %	Assessment aspects of the model	New model %
67.9	a. Practicality of the model	89.3
60.7	b. Model finance	71.4
57.1	c. Model performance	89.3
61.9	Average	83.3

Table 8: The results of the *t*-test on the efficiency of the management model synchronisation.

Paired samples test									
	Efficiency	Paired differences							
					95% confidence interval of difference				
		Mean	SD	Std. error mean	Lower	Upper	*t*	df	Sig. (2-tailed)
Pair 1	Old - New	-2.57143	1.27242	0.48093	-3.74822	-1.39464	-5.347	6	0.002

Table 8 shows the results of a T_{test} on the efficiency of the curriculum alignment model and yielded a T_{stat} = -5.347, which is greater than $T_{table.}$ As a consequence, the alternative hypothesis Ha is accepted. Based on the paired samples *t*-test, the new curriculum alignment model was more efficient than the old model. Therefore, it can be concluded that there is a significant difference between the new alignment curriculum model and the old model in terms of the model practicality, model financing and model performance with the new model being the better one.

The mechanical engineering industrial competency-based curriculum alignment model is shown in Figure 1.

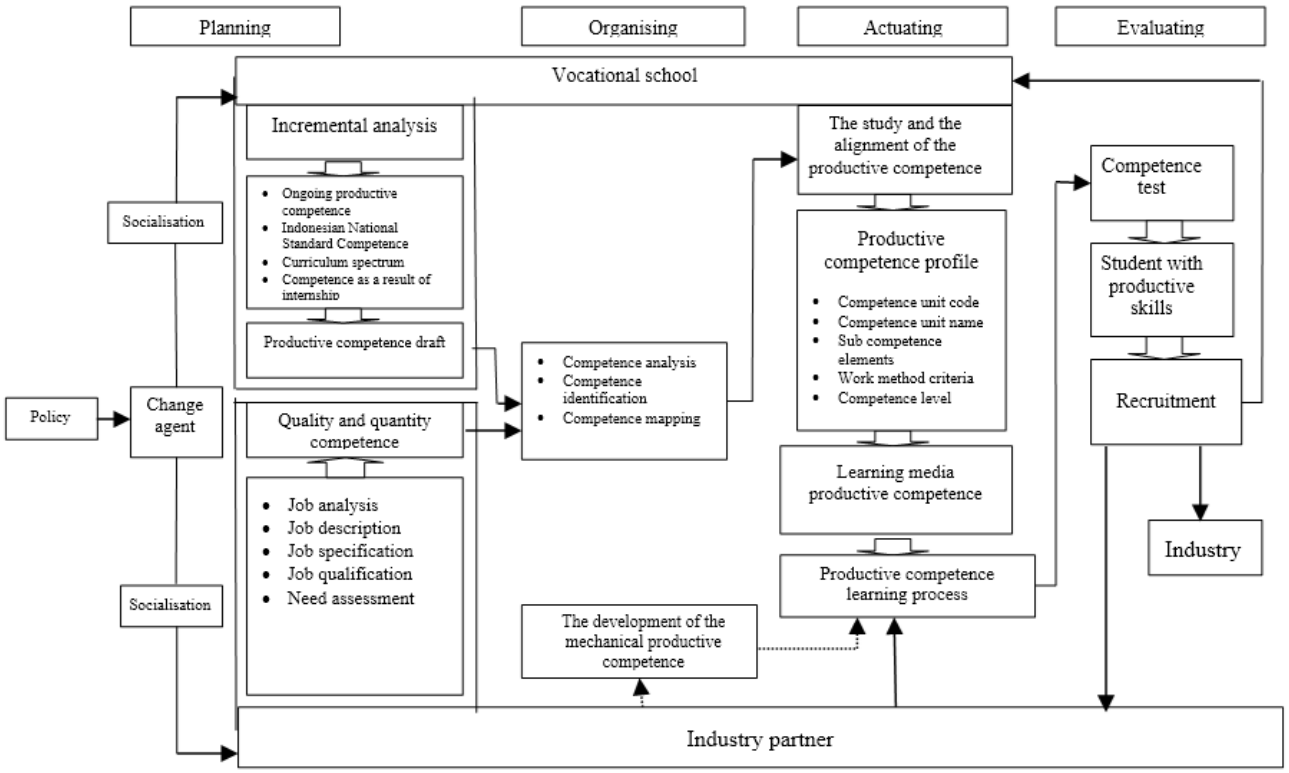

Figure 1: Industry-based competence curriculum alignment management model.

DISCUSSION

The industry competency-based curriculum alignment model of mechanical engineering has effectiveness, accuracy, reliability; and can increase graduate competence; hence, the vocational graduates' employability in industry. Therefore, the implementation of the model needs to be supported by an integrated, comprehensive and sustainable framework.

A conceptual framework and an industry-based approach are required for the development of competence in vocational education and the improvement of the educational curriculum [14]. The curriculum alignment framework involves

concepts, aligning actors, actions and processes [15]. The mechanism of curriculum alignment must be effective and efficient to ensure the implementation of the programme [12].

The industry-based competency alignment model for mechanical engineering allows students and teachers to develop themselves due to the involvement of industry and other stakeholders. The development of the engineering curriculum alignment can also encourage students to develop soft skills, such as social competence, ethical awareness and the ability to express themselves easily, both verbally and in writing [16]. Teachers are able to develop an engaging and interesting environment conducive to student learning. The learning experience is better when it relates to project work relevant to industry [3].

The mechanical engineering curriculum alignment model was supported by government policy through Presidential Instruction Number 9 of 2016, which allows the acceleration of curriculum alignment to improve students' competence and the quality of vocational education. Education policy can support the implementation of curriculum alignment, in addition to teacher professional development, curriculum policy and accountability [17].

CONCLUSIONS

Some conclusions from this research are:

1. The industry competency-based curriculum alignment model of mechanical engineering has effectiveness, accuracy and reliability. It is more efficient in its implementation. Therefore, this model is feasible to be implemented and developed to improve the competence of students in mechanical engineering programmes and graduates' employability in industry.

2. The industry competency-based curriculum alignment model is supported by government policy related to the revitalisation of vocational schools through change agents that enables the acceleration of curriculum alignment to improve education and graduate quality.

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